

AGR-1 UCO Kernel Phase Analysis Imaging Archive



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Nuclear Energy and Fuel Cycle Division

AGR-1 UCO KERNEL PHASE ANALYSIS IMAGING ARCHIVE

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ABSTRACT

UCO kernels in tri-structural isotropic (TRISO) particles consist of a heterogeneous mixture of uranium oxide and uranium carbide. During the Advanced Gas Reactor Fuel Development and Qualification (AGR) Program, mean kernel composition was specified based on bulk measurements of uranium, oxygen, and carbon content, as well as the resulting O/U, C/U, and O+C/U ratios. Further development of quality control characterization methods has resulted in a method for more direct measurement of phase fractions on a per-kernel basis using optical microscopy of polished kernel cross sections. This report provides benchmark values for this analysis method when applied to kernels from the AGR-1 campaign and to the raw images used.

1. INTRODUCTION

The relative abundance of uranium oxide (UO_2) and uranium carbide ($\text{UC}_{2-x} + \text{UC}$) in UCO kernels for use in tri-structural isotropic (TRISO) particle fuels is commonly specified with the intent of including enough uranium in the form of a carbide to act as a getter for oxygen liberated by fission of uranium from UO_2 , thus preventing pressurization of the particle caused by production of CO gas while also maintaining ease of fabrication and stability within the kernel of oxide-soluble fission products. Historically, the elemental composition of UCO kernels has been measured as a mean value for the batch based on chemical analyses, which provided the relative content of uranium, oxygen, and carbon. The kernel composition was then specified based on the desired range of elemental ratios (O/U, C/U, and C+O/U).

This method has generally been sufficient in irradiations of UCO-based TRISO particles; however, there are several key weaknesses with this bulk chemistry approach. First, bulk chemistry analysis provides no information regarding the statistical distribution of phase compositions within a kernel batch—only a mean value. The primary concern raised by this limitation is that the low-carbide tail of the distribution may not have sufficient uranium in the form of a carbide to suppress carbon monoxide formation for the intended life of the fuel. This concern has historically been addressed by increasing the mean carbide phase fraction to an amount substantially above the minimum required. Second, bulk chemistry analysis cannot differentiate between free carbon trapped within pores because of the incomplete conversion and carbon present in the carbide phase. Third, the specified elemental ratios are generally designed based on an assumed carbide phase stoichiometry to target a given fraction of uranium in the form of a carbide, but based on kernel processing conditions, the ratio of monocarbide to dicarbide and the substoichiometry of the dicarbide phase may vary.

A new method for measuring phase fractions in UCO kernels on a per-kernel basis using automated image analysis of optical microscopy images of kernels polished to near-midplane was developed at Oak Ridge National Laboratory [1]. The method has been applied to historical UCO kernel samples from the AGR program and compared with the results from other measurement methods [2]. Results for LEU03 kernels from the AGR-1 irradiation campaign are reported herein, and the optical microscopy images of the kernels are included.

2. BENCHMARK RESULTS FOR LEU03

A total of 233 UCO kernels from an archived sample of LEU03 were successfully mounted, polished to near-midplane, imaged by optical microscopy, and analyzed for determination of the phase fractions of oxide, carbide, and void present. Based on powder x-ray diffraction of the kernels, the mass fraction of the carbide fraction was assumed to be 64.8% of the total carbide, and the stoichiometry of the dicarbide phase was assumed to be 1.86. Based on these values, the densities of the oxide, monocarbide, and

dicarbide phases were calculated to be 10.93, 13.62, and 12.57 g/cm³, respectively. These densities are used to convert the measured volumetric phase fractions into molar phase fractions, and the carbide stoichiometry is used for calculation of elemental ratios. Previous investigation of the sensitivities of this method found that uncertainty in the carbide phase stoichiometry had a substantial impact on calculated elemental ratios but only a very minor effect on densities and molar phase fractions [1]. In addition, the molar phase fractions present are a more direct measure of the basis for the specification, which is the amount of uranium present in the form of a carbide.

Based on the 233 kernels measured from LEU03, the mean UO₂ volume fraction was 68.9% with a standard deviation of 1.3%, the mean uranium carbide volume fraction was 25.1% with a standard deviation of 1.3%, and the mean void fraction was 6.0% with a standard deviation of 1.3%. Histograms showing the statistical distribution for each of these parameters are shown in Figure 1 through Figure 3. The raw and segmented images for each kernel are given in Appendix A, and the raw data measured for each kernel is given in Appendix B.

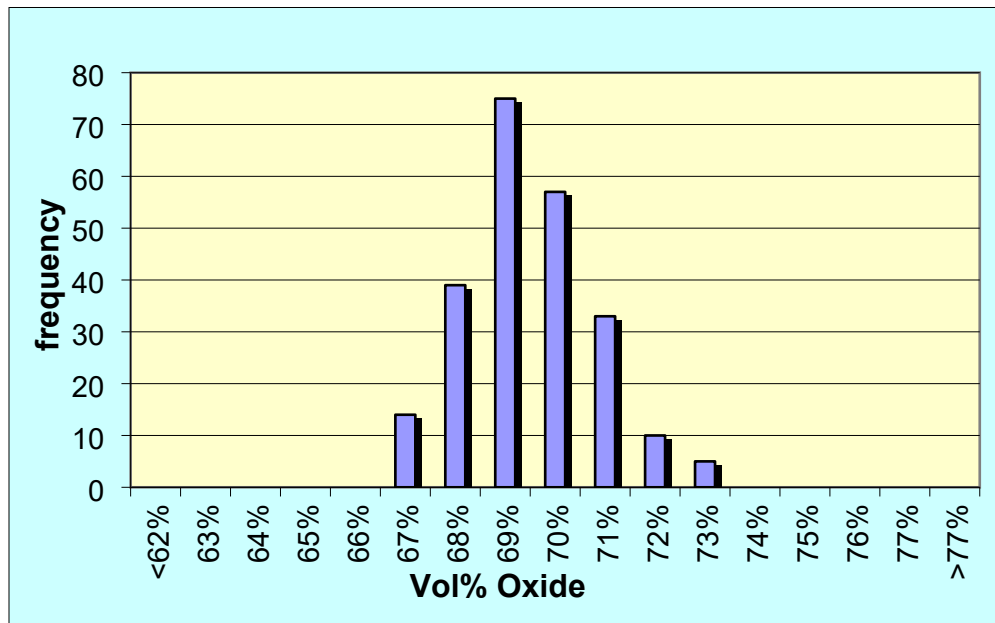


Figure 1. Statistical distribution of oxide phase volume percent in LEU03 kernels as measured by optical microscopy.

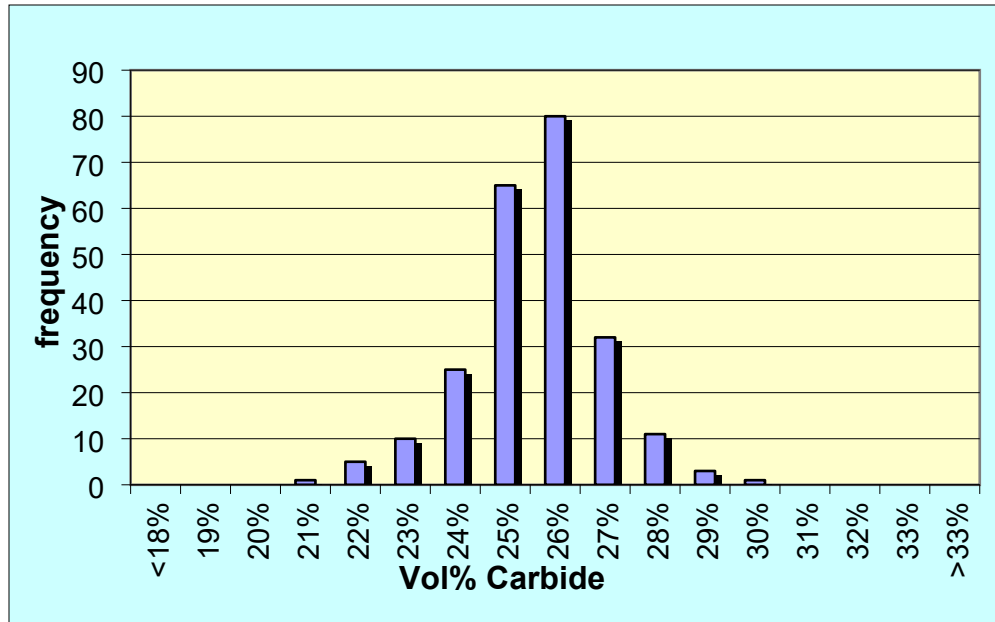


Figure 2. Statistical distribution of carbide phase volume percent in LEU03 kernels as measured by optical microscopy.

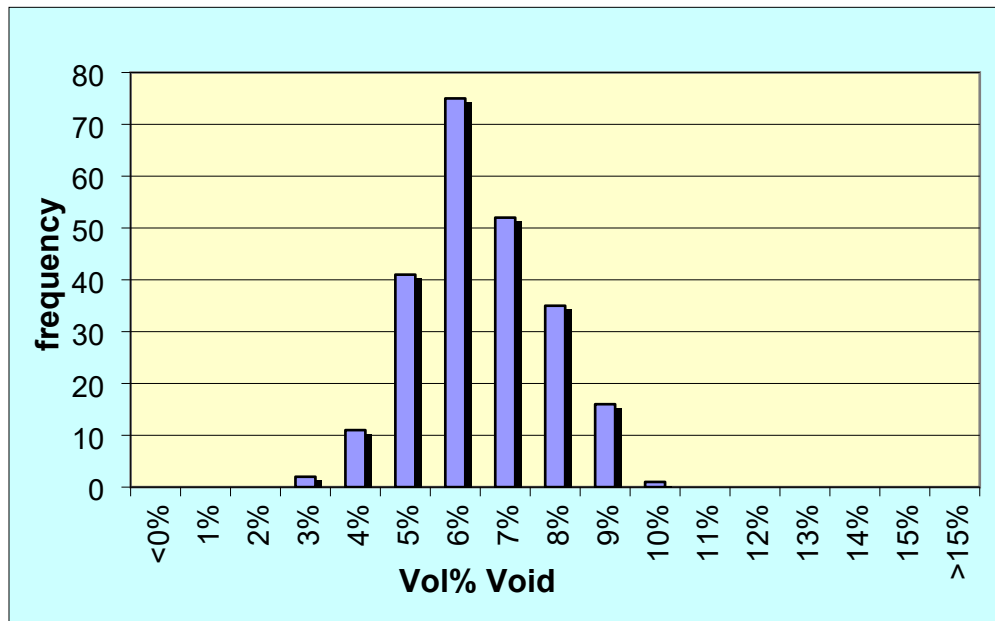
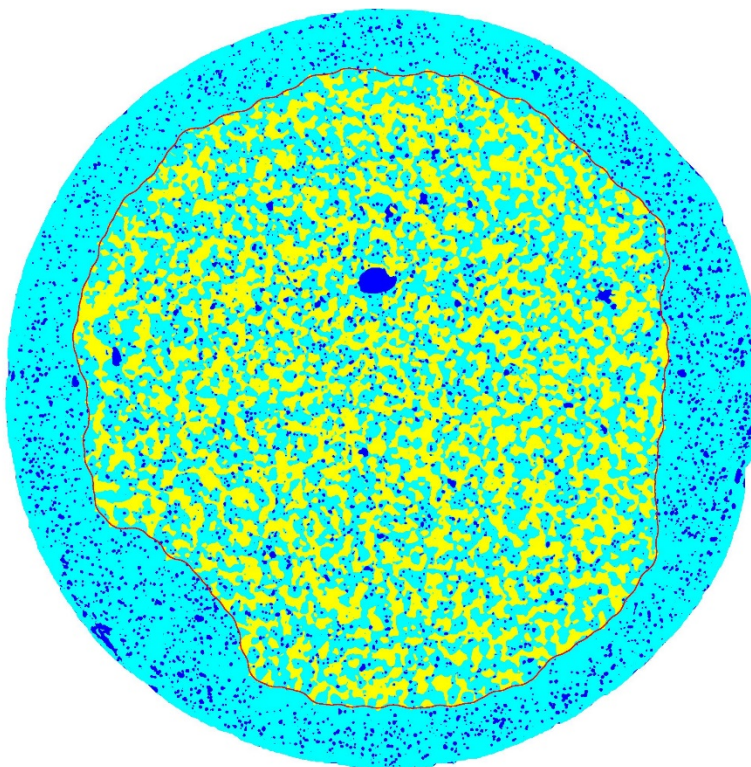


Figure 3. Statistical distribution of void phase volume percent in LEU03 kernels as measured by optical microscopy.

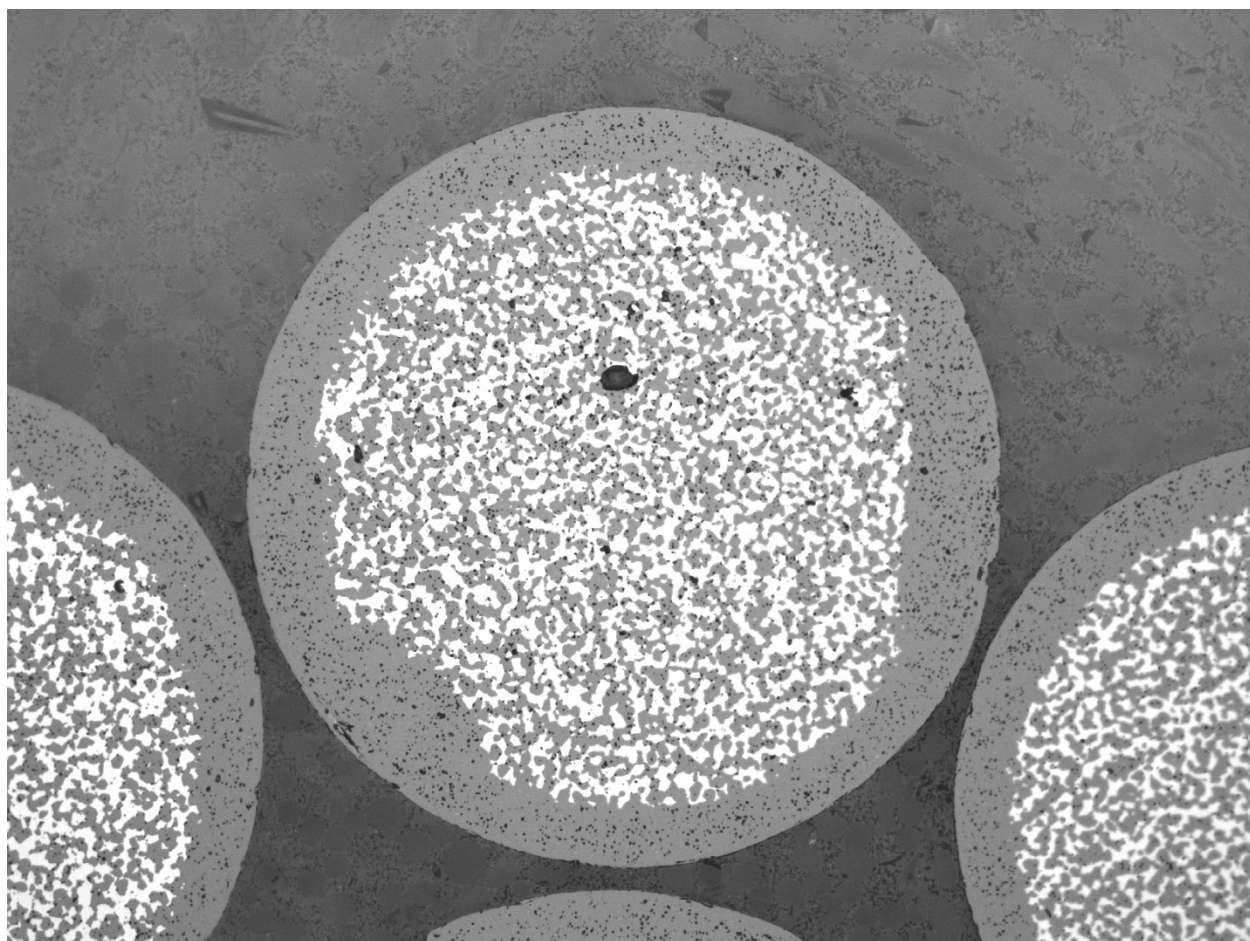
3. REFERENCES

- [1] G. Helmreich, J. Hunn, J. McMurray and B. D.R., "Enhanced Method for Analysis of Individual UCO Kernel Phase Fractions," *Nuclear Engineering and Design*, 2020.
- [2] G. Helmreich, K. Montoya, W. Cureton, E. Lopez-Honorato, T. Gerczak and J. Hunn, *Quality Control Methods for Measurement of UCO Kernel Composition and SiC Microstructure*, ORNL/TM-2023/3205, Oak Ridge National Laboratory, Oak Ridge, 2023.

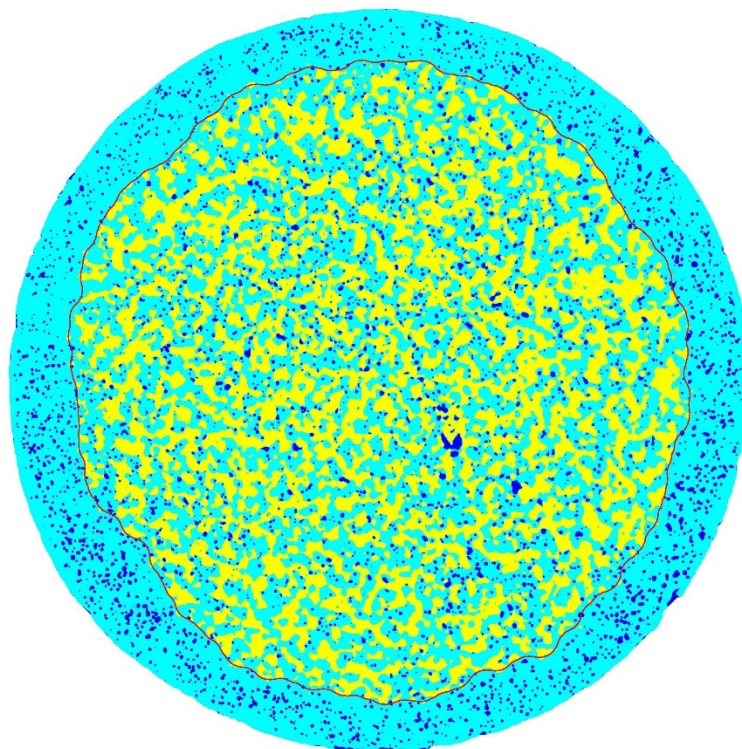
APPENDIX A. OPTICAL MICROSCOPY IMAGES OF LEU03 KERNELS



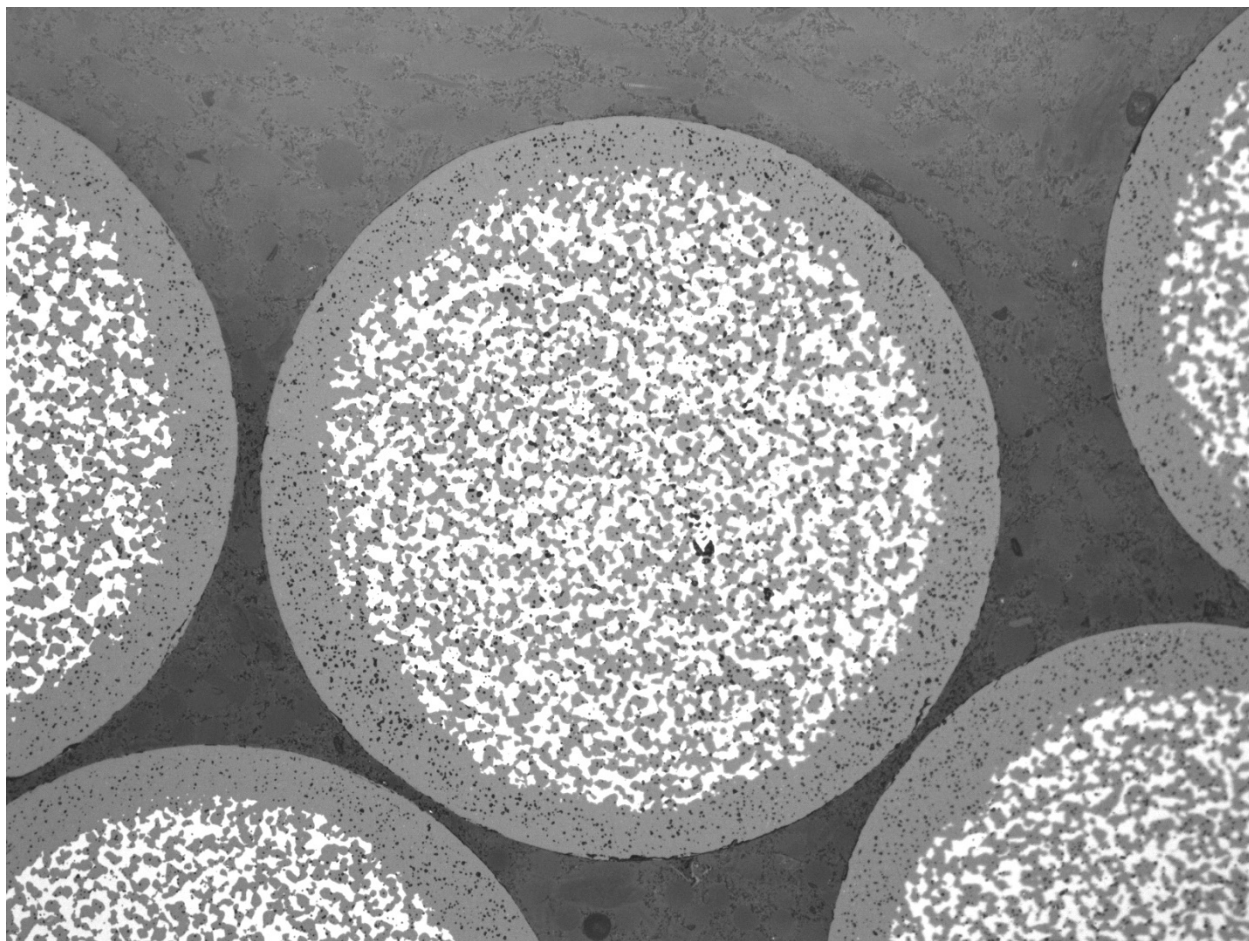
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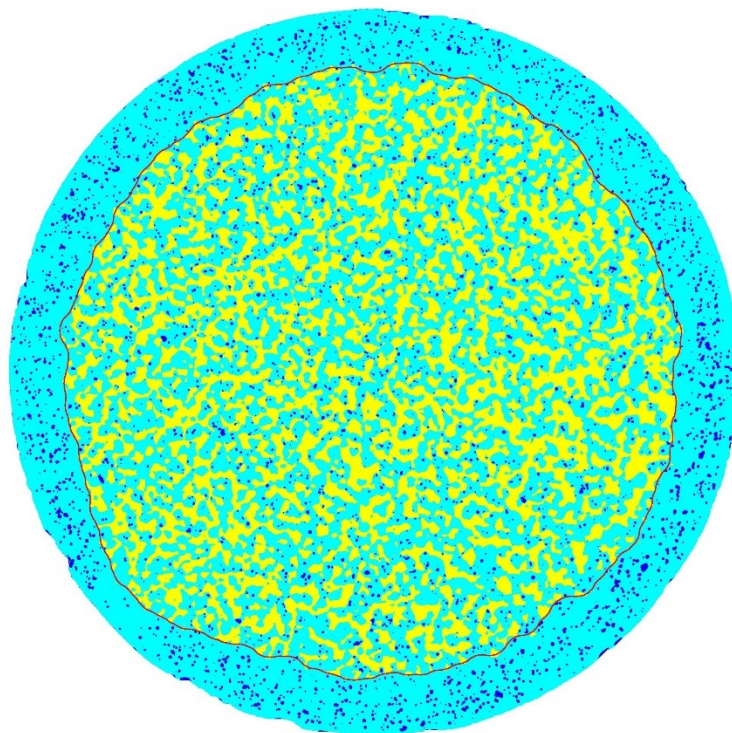
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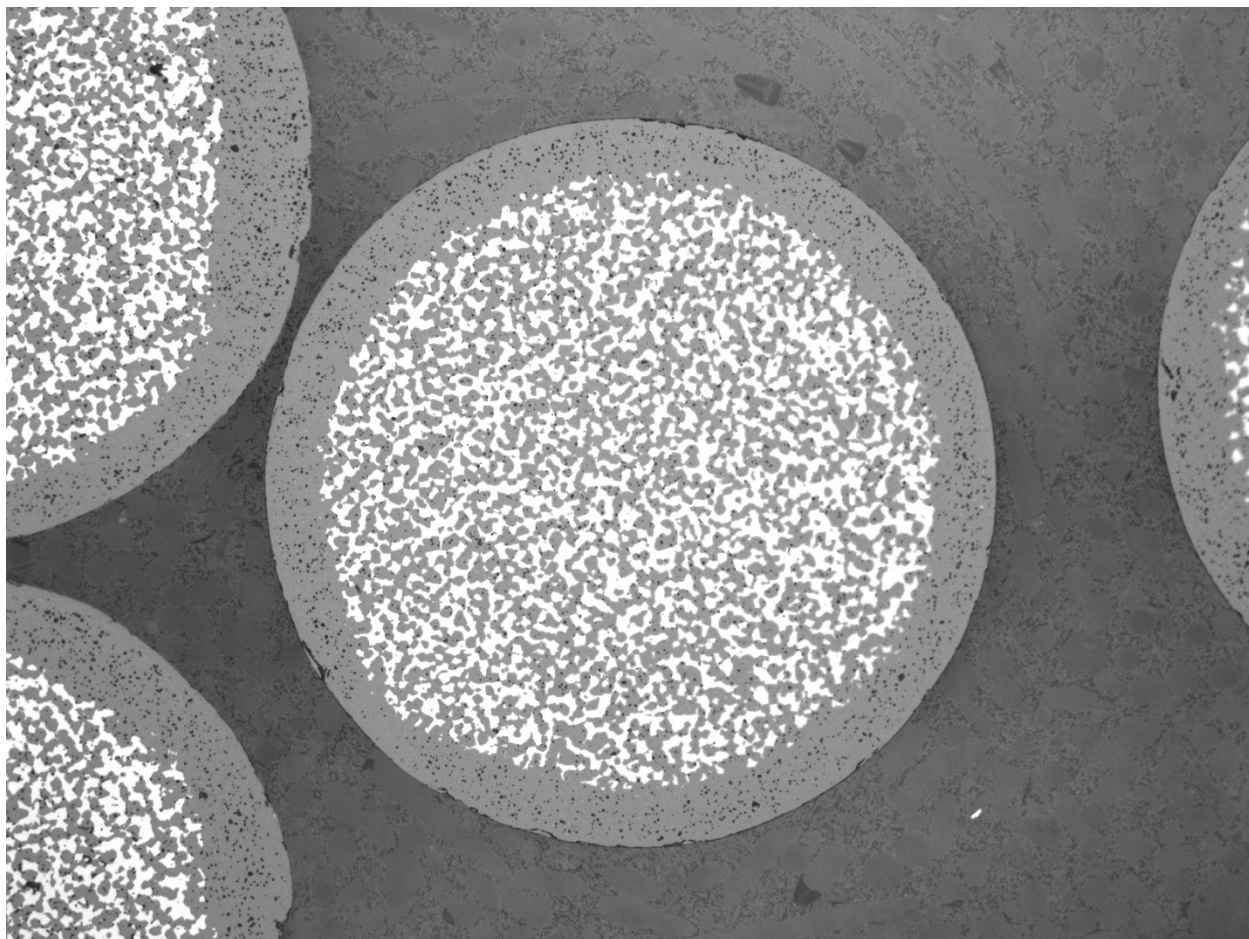
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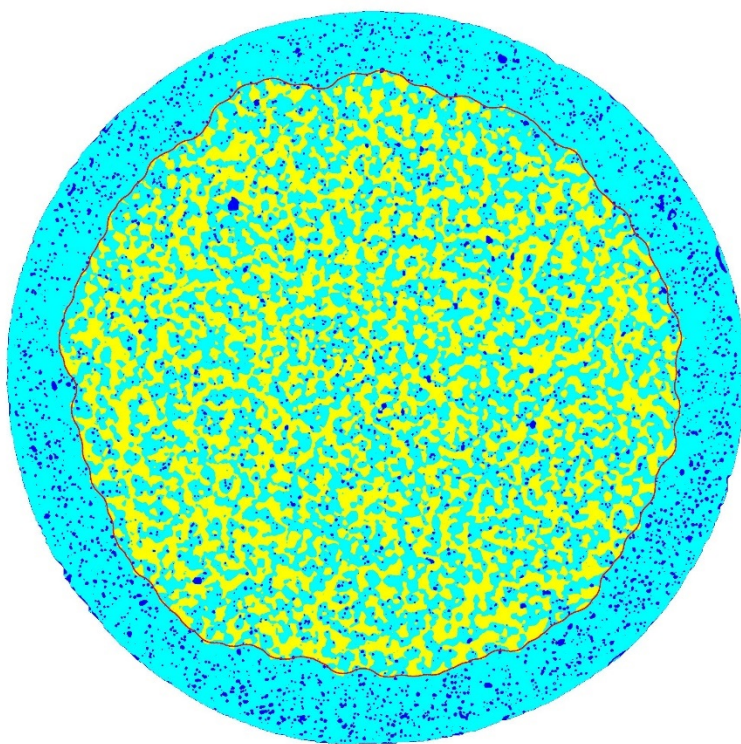
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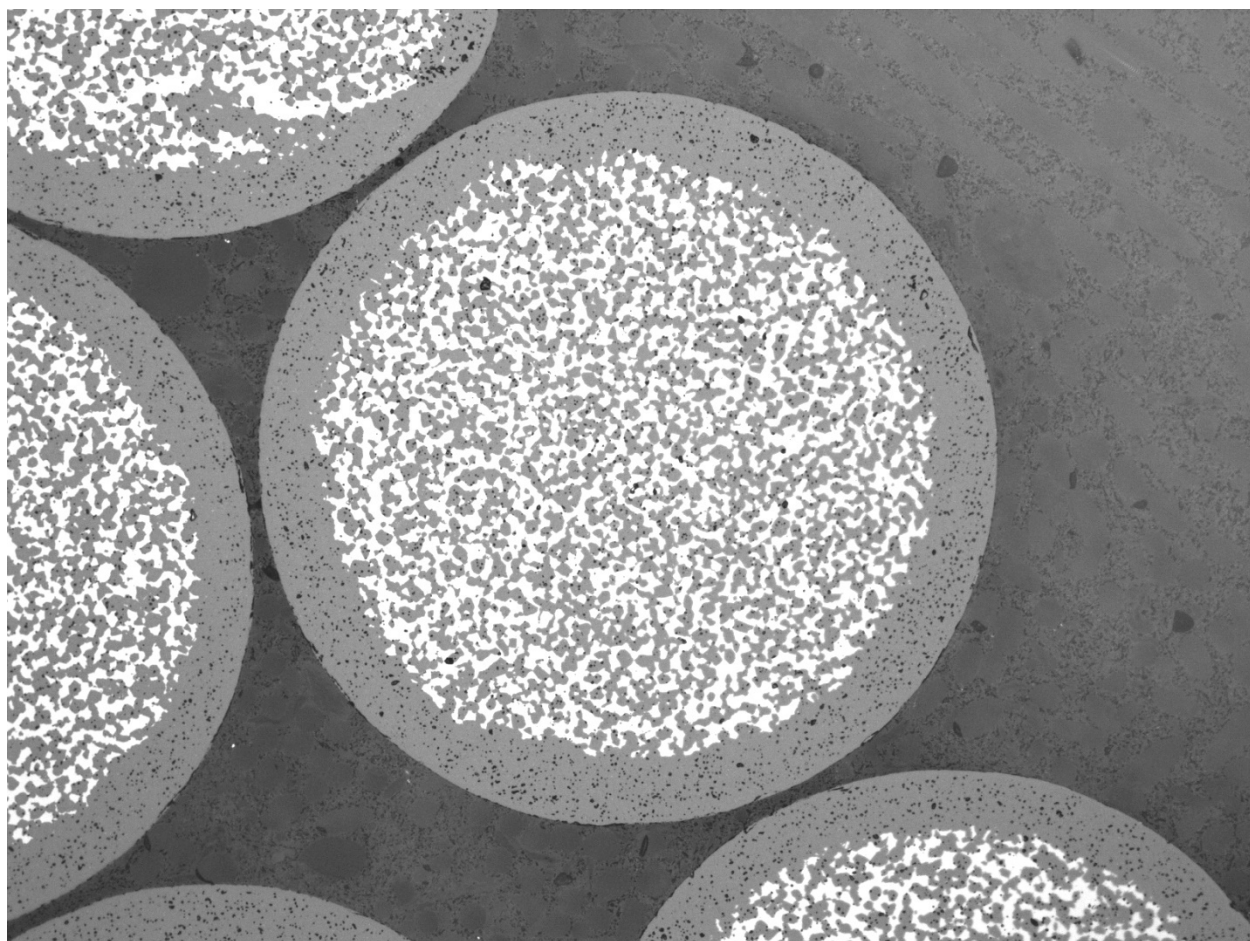
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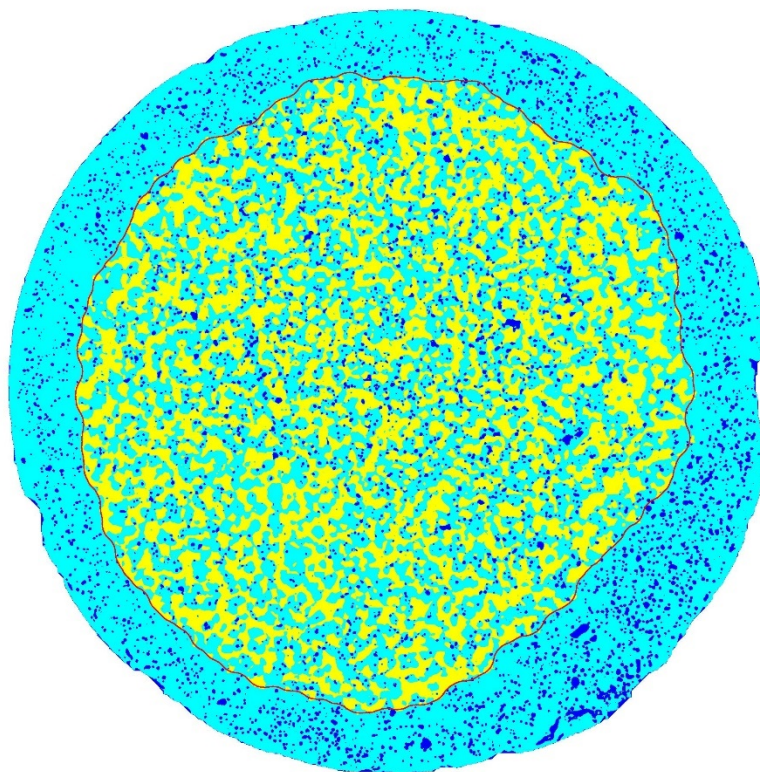
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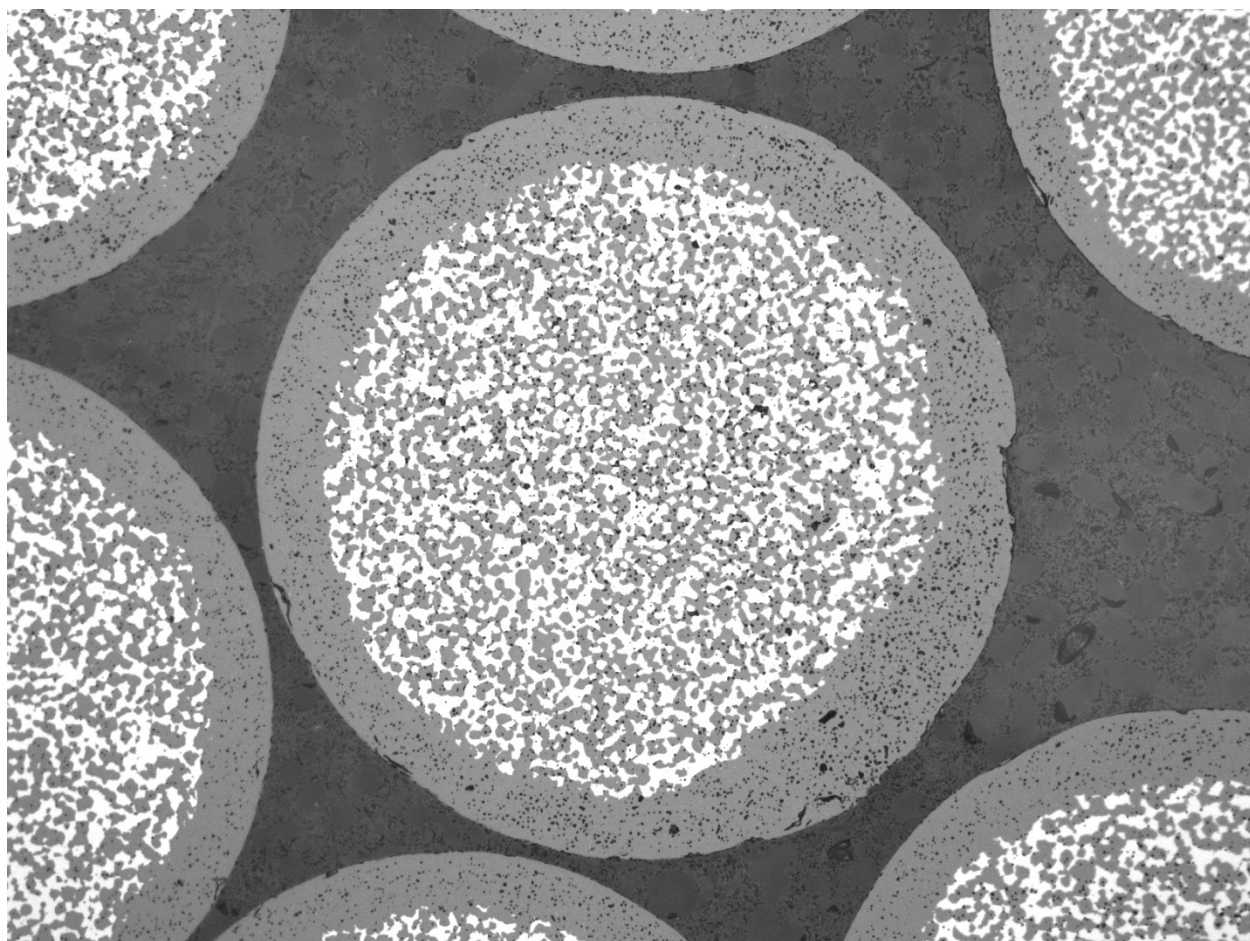
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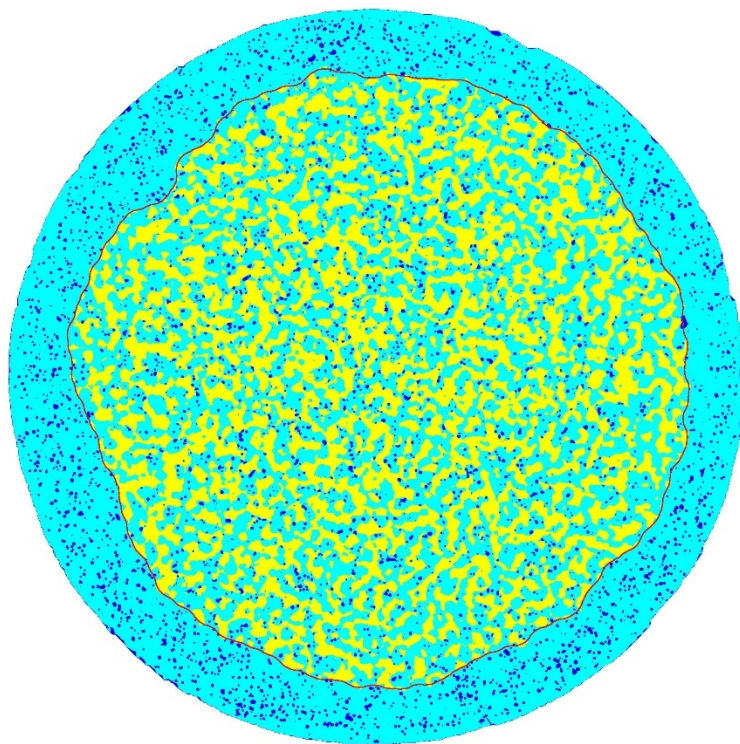
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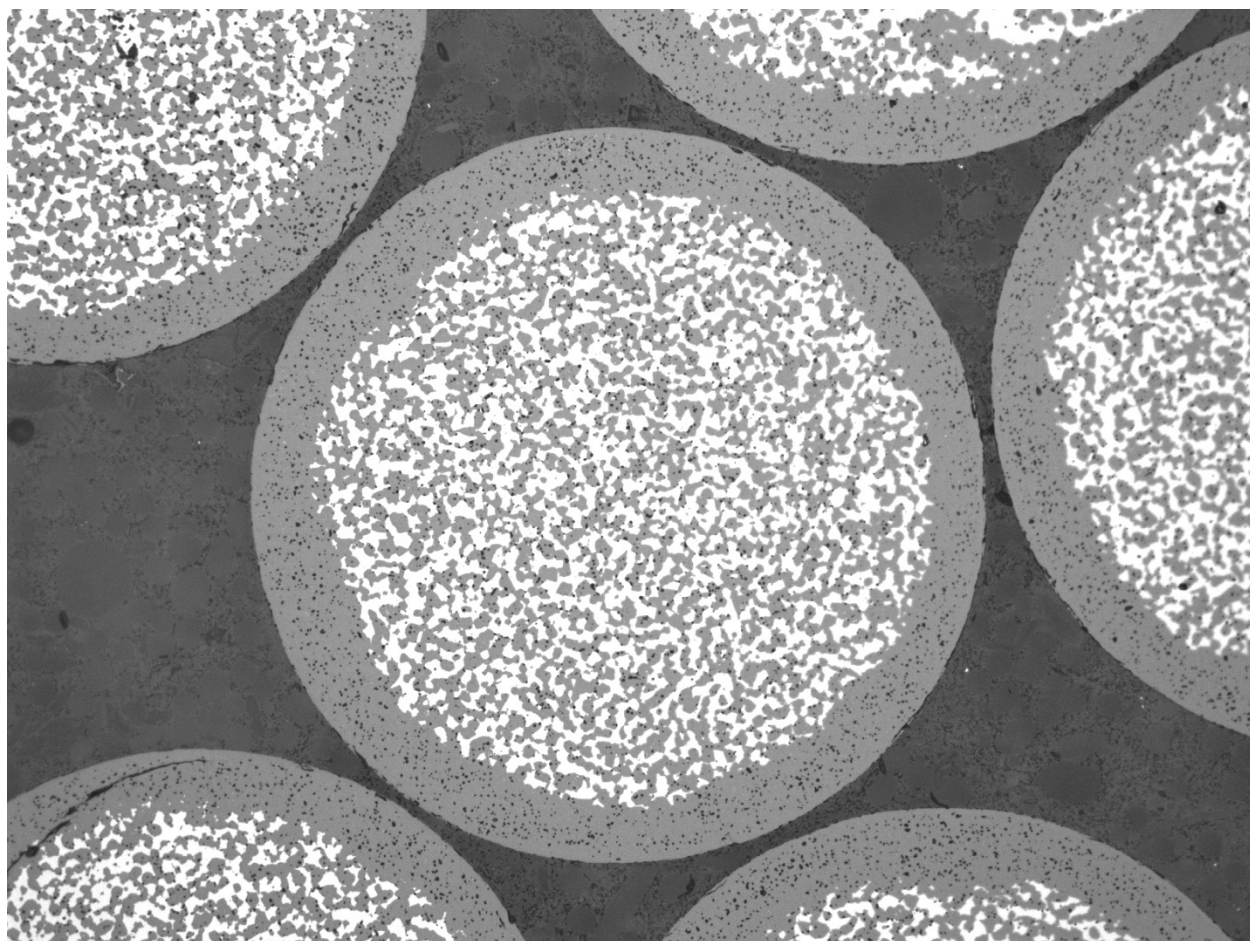
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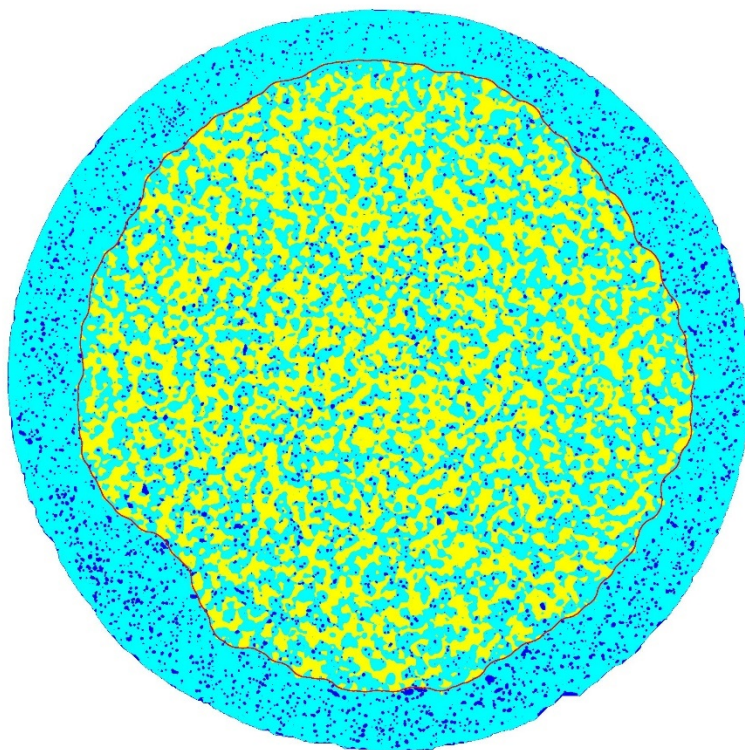
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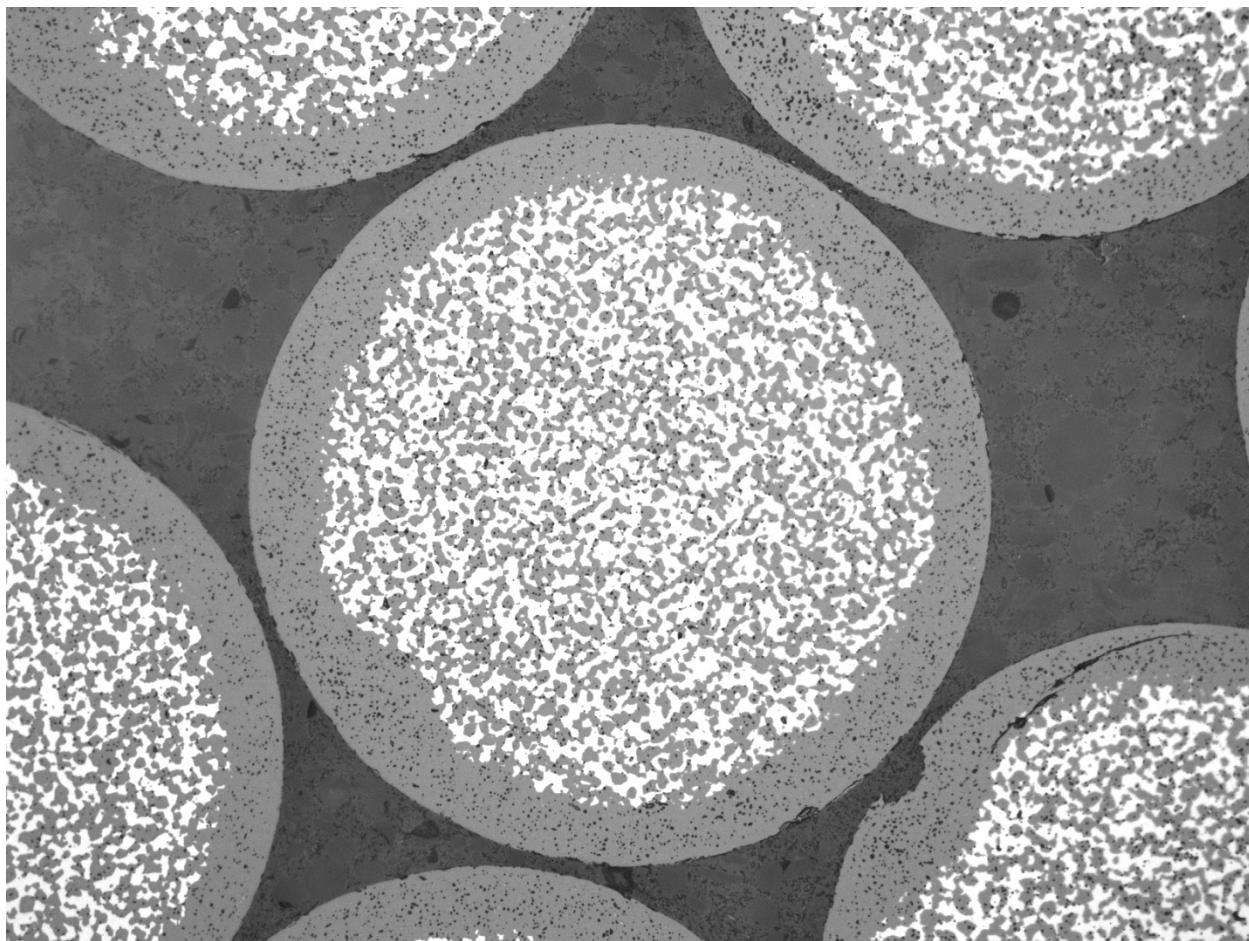
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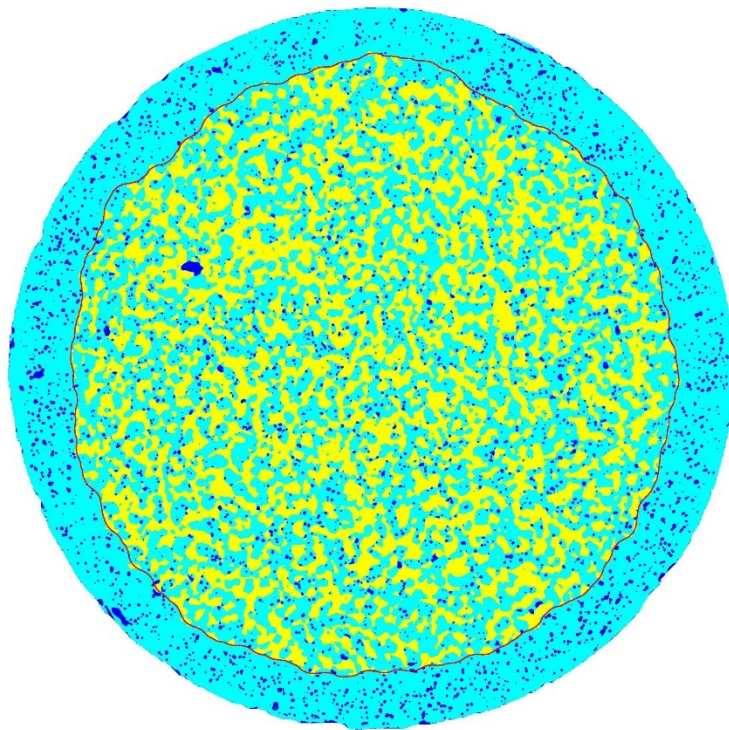
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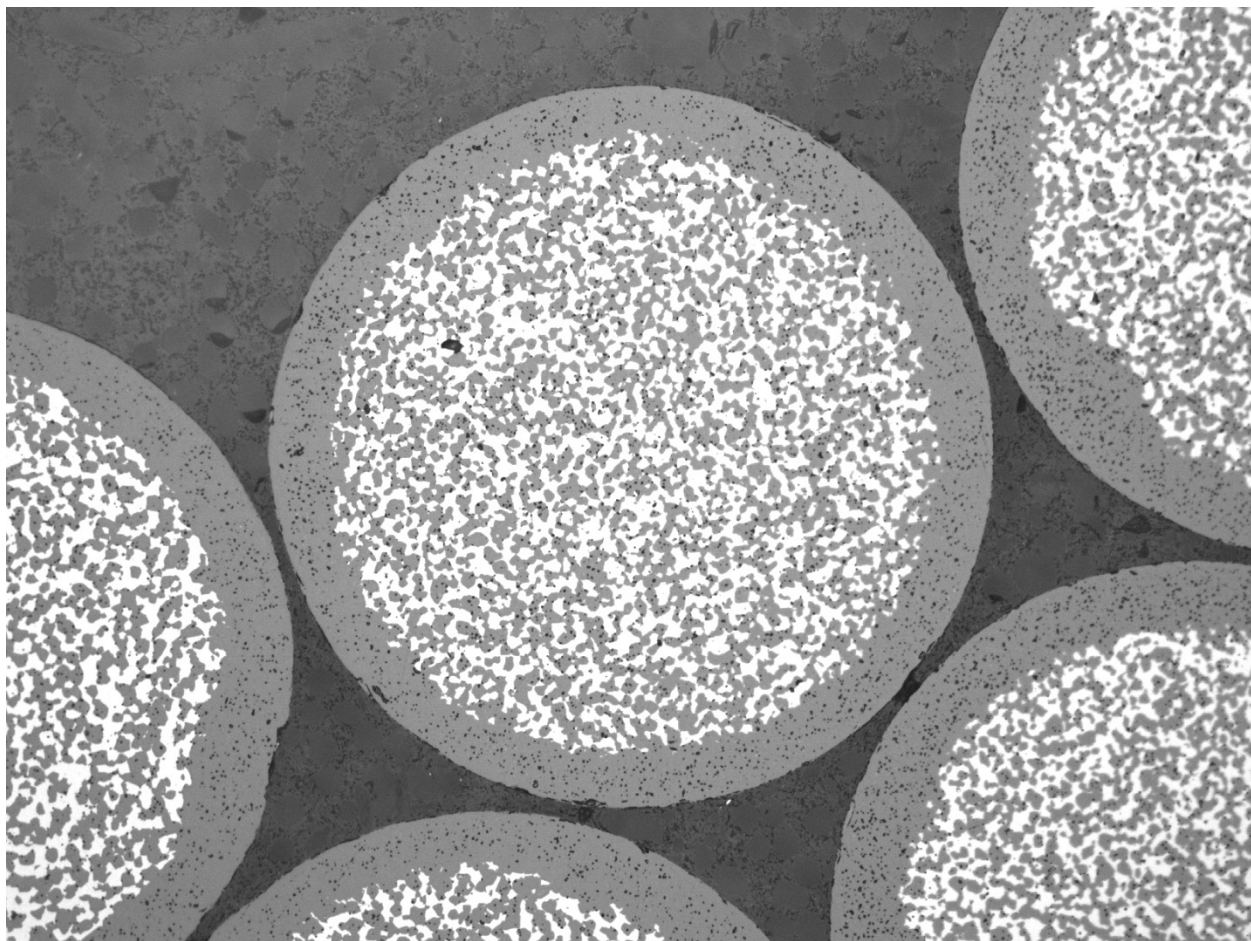
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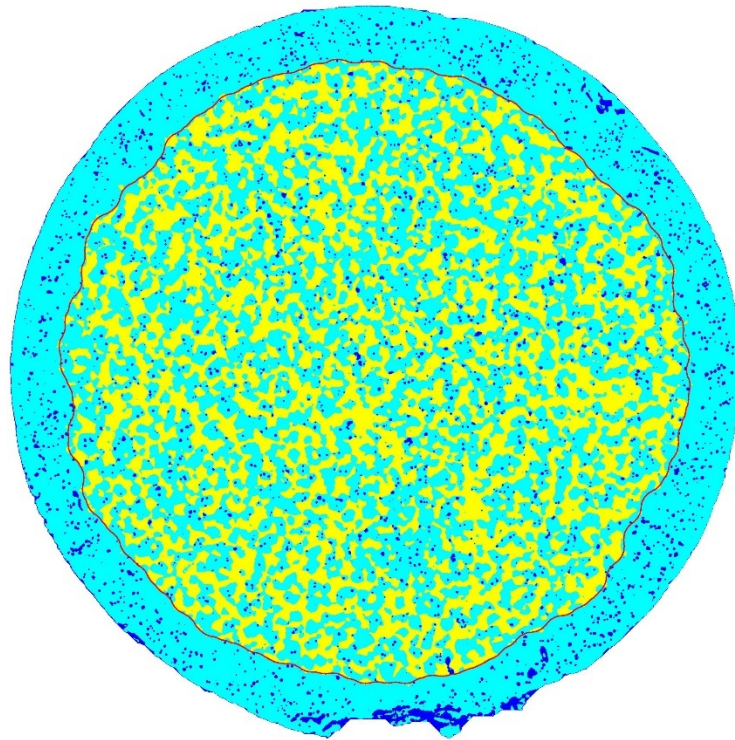
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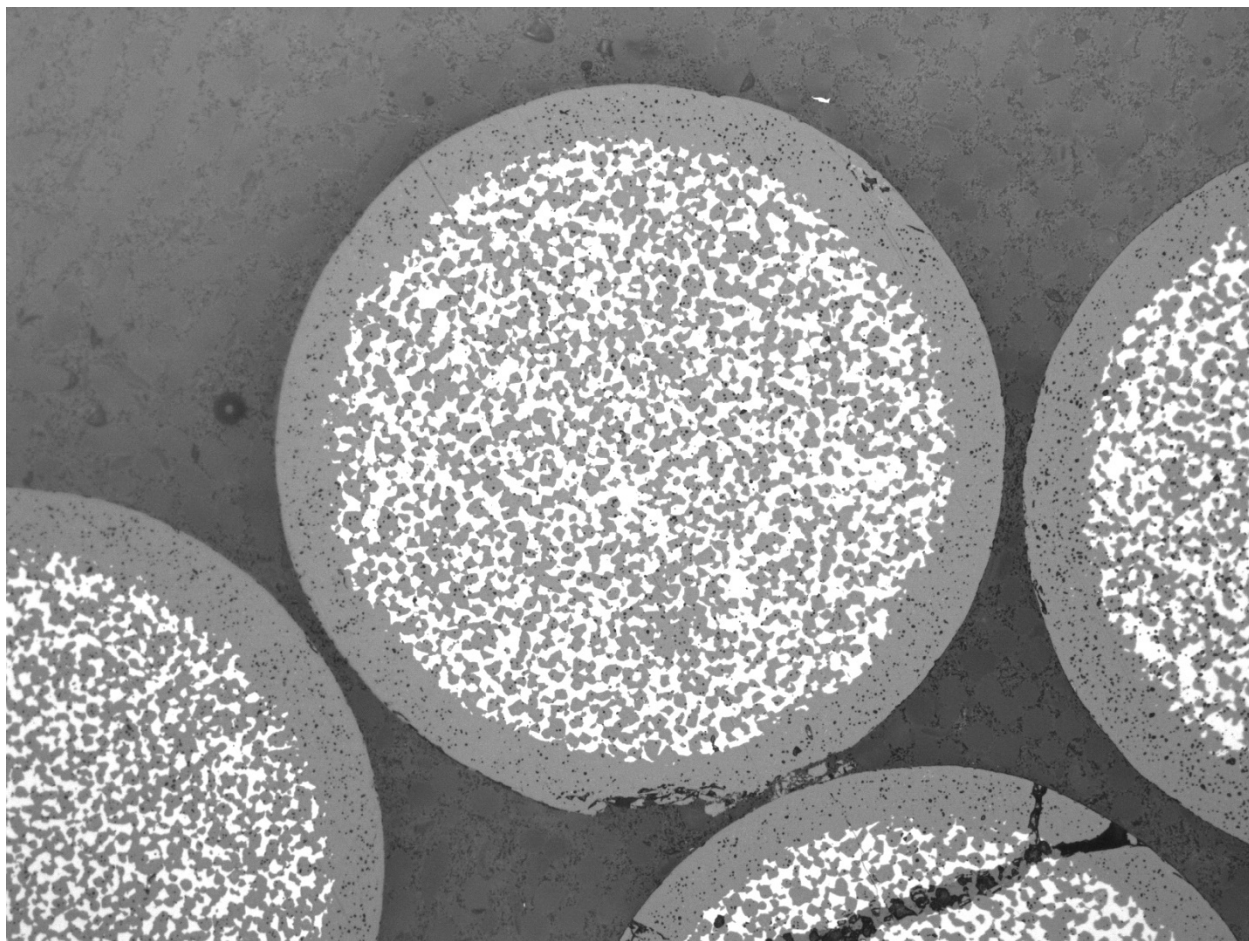
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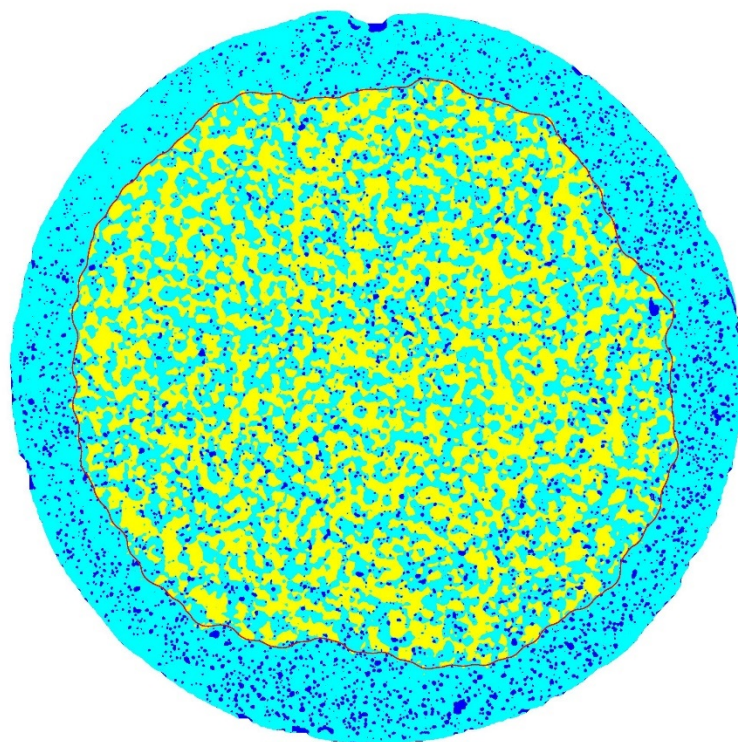
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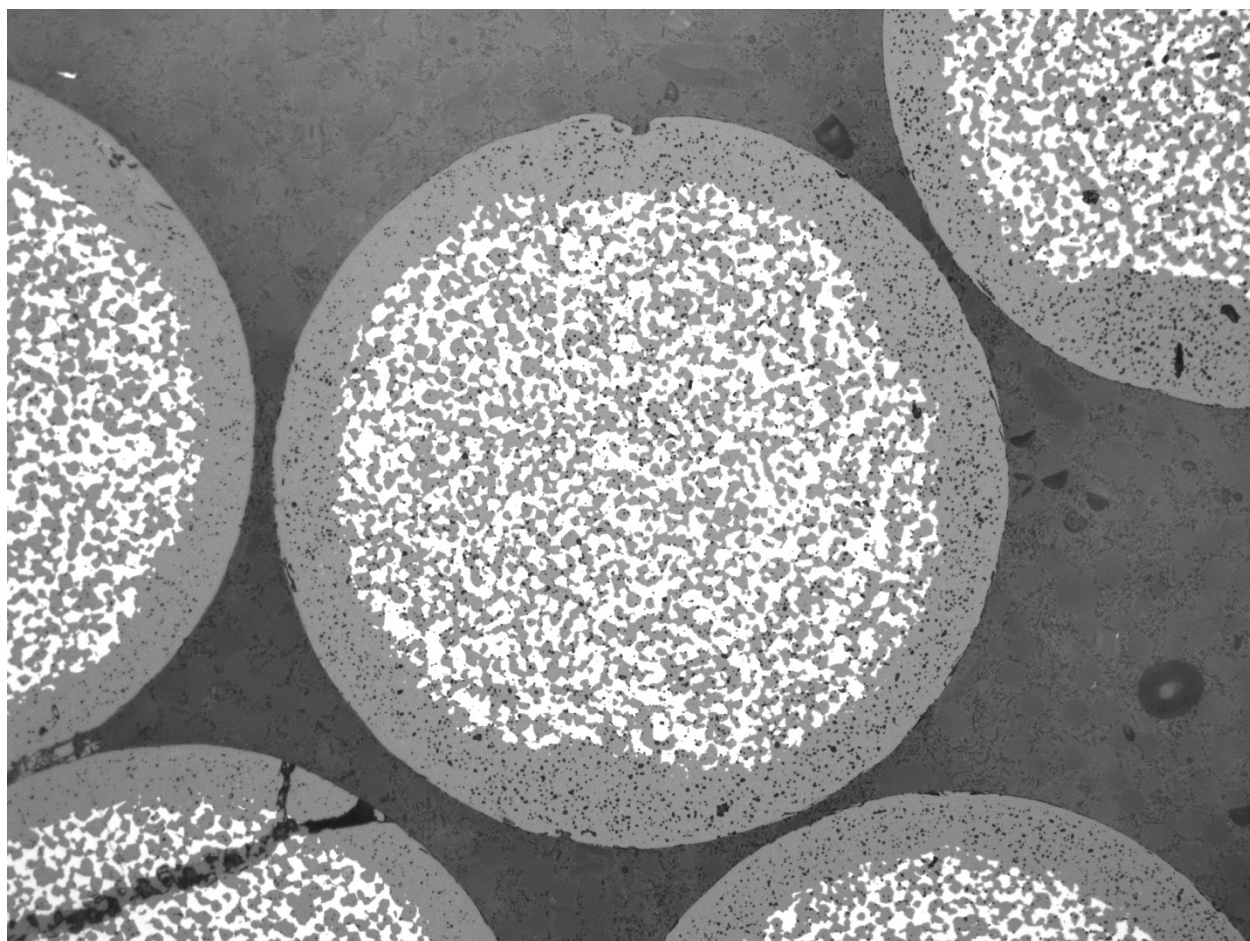
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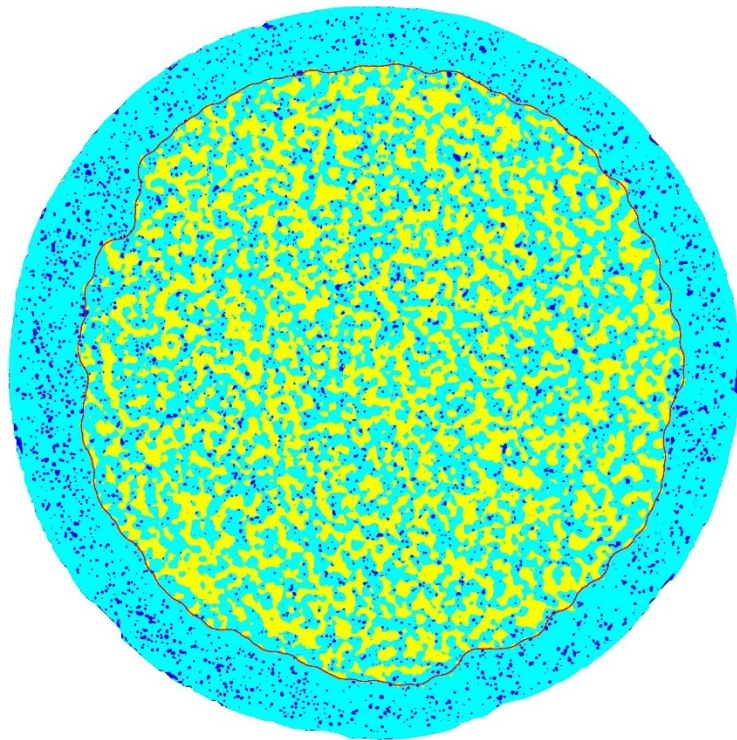
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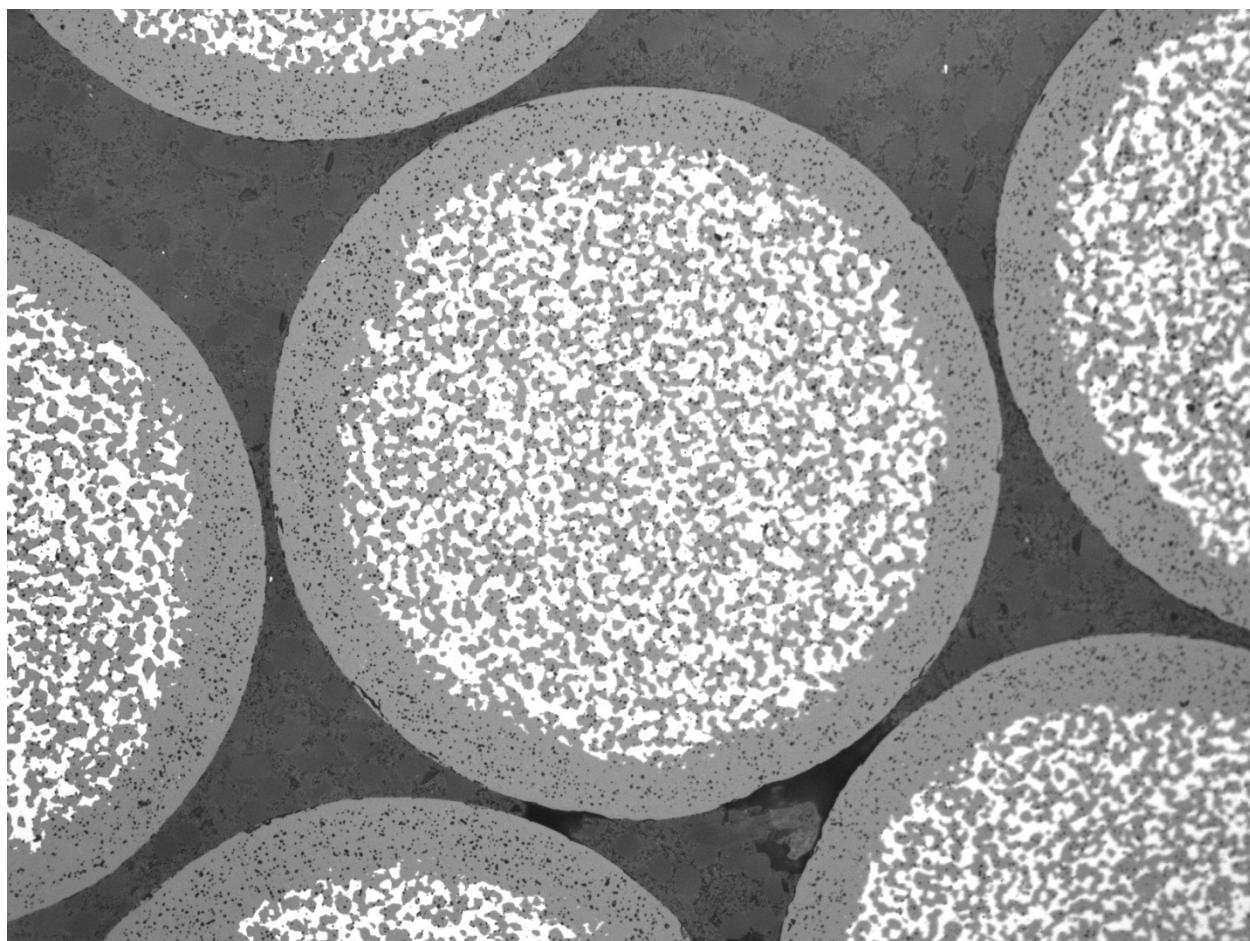
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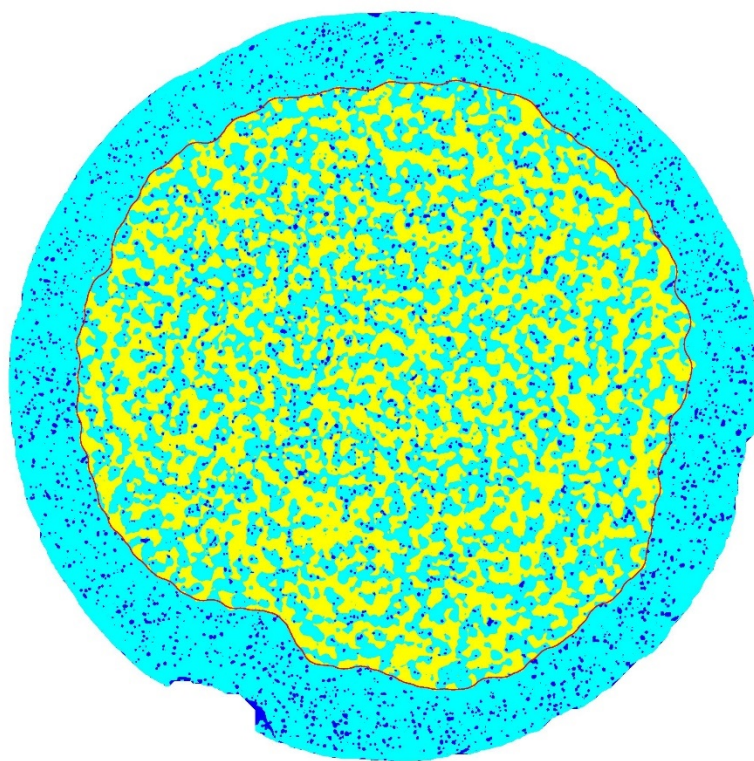
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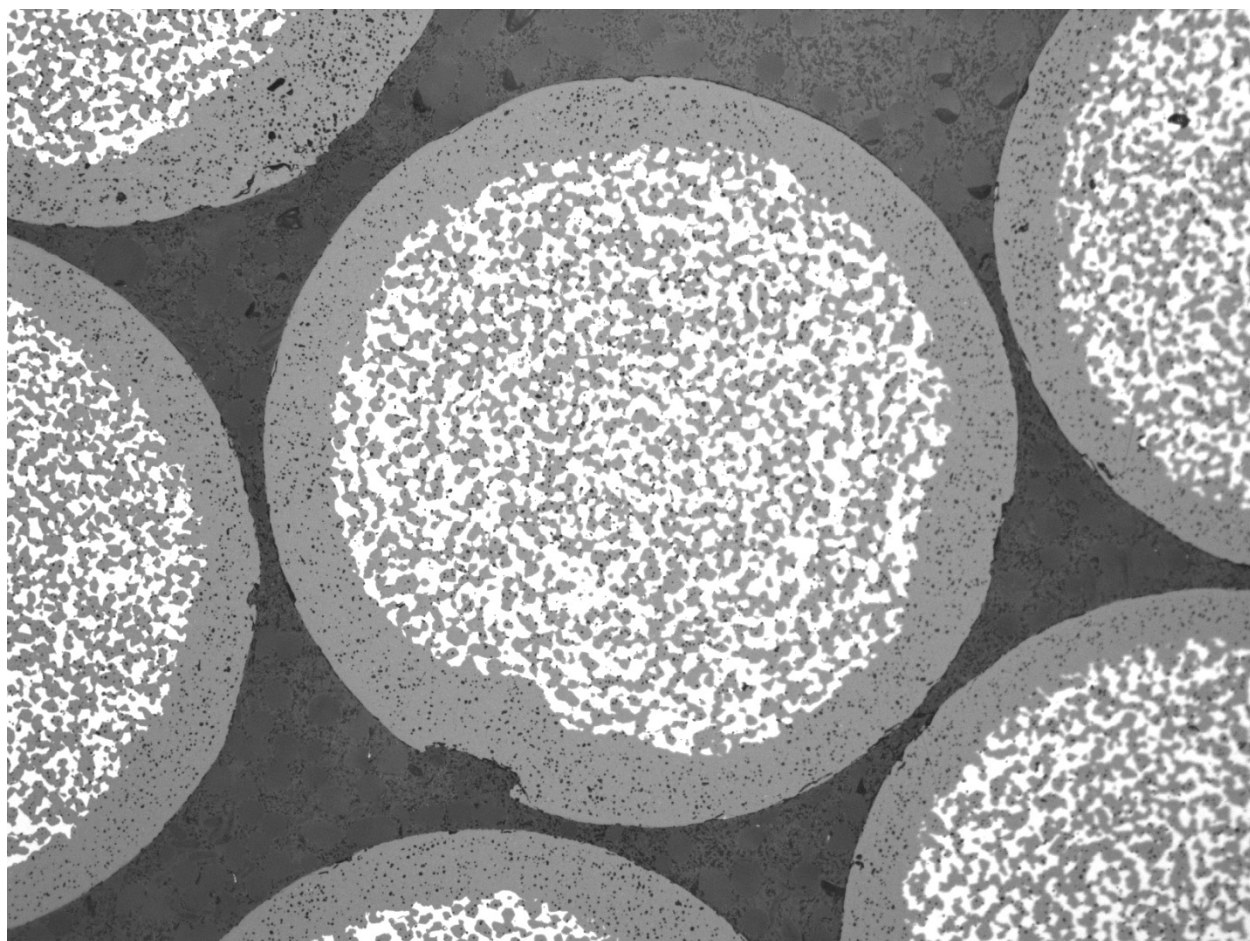
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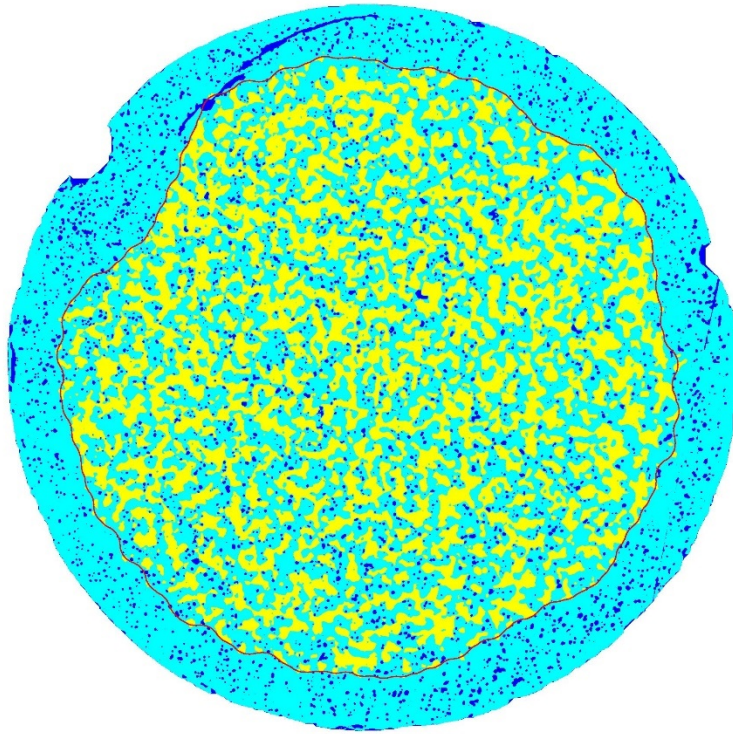
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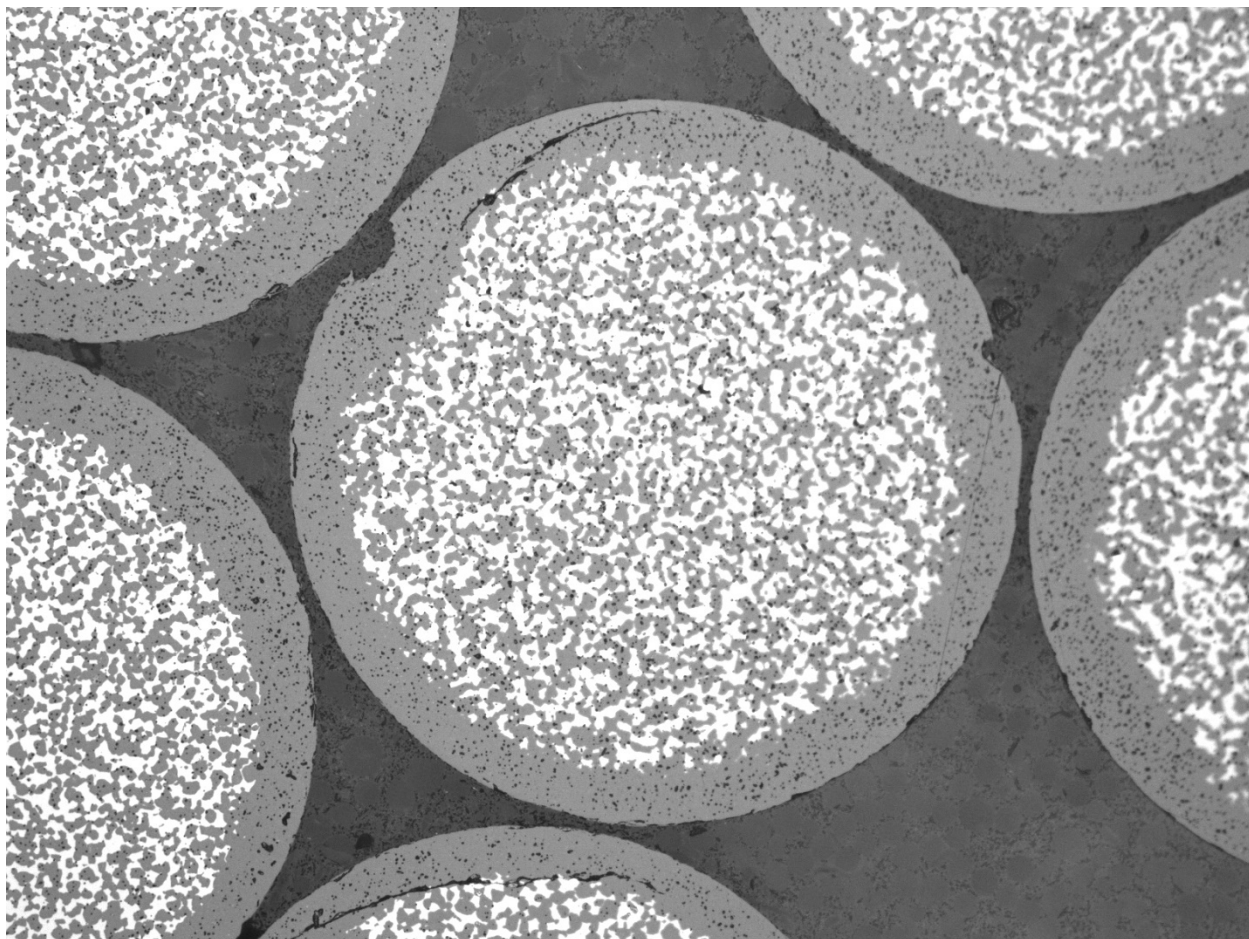
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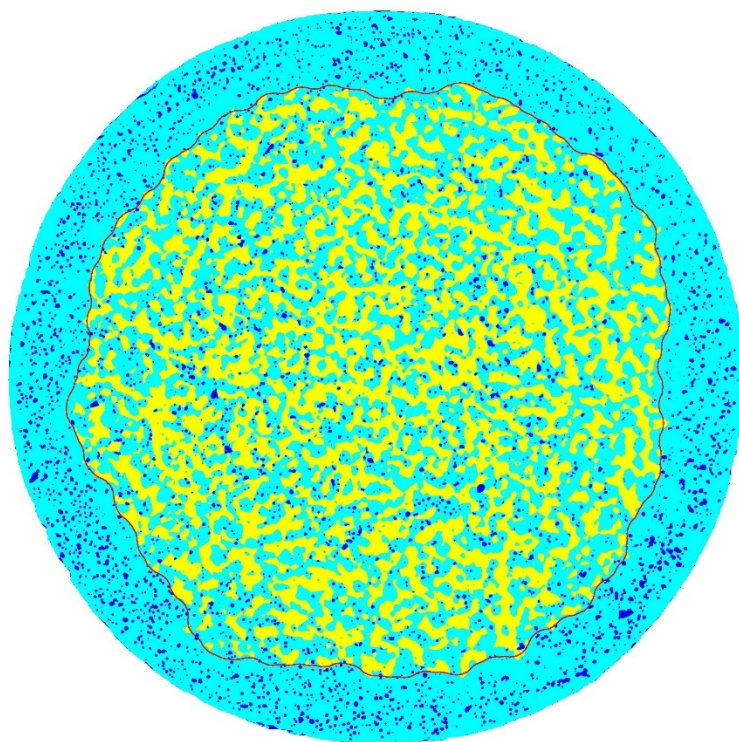
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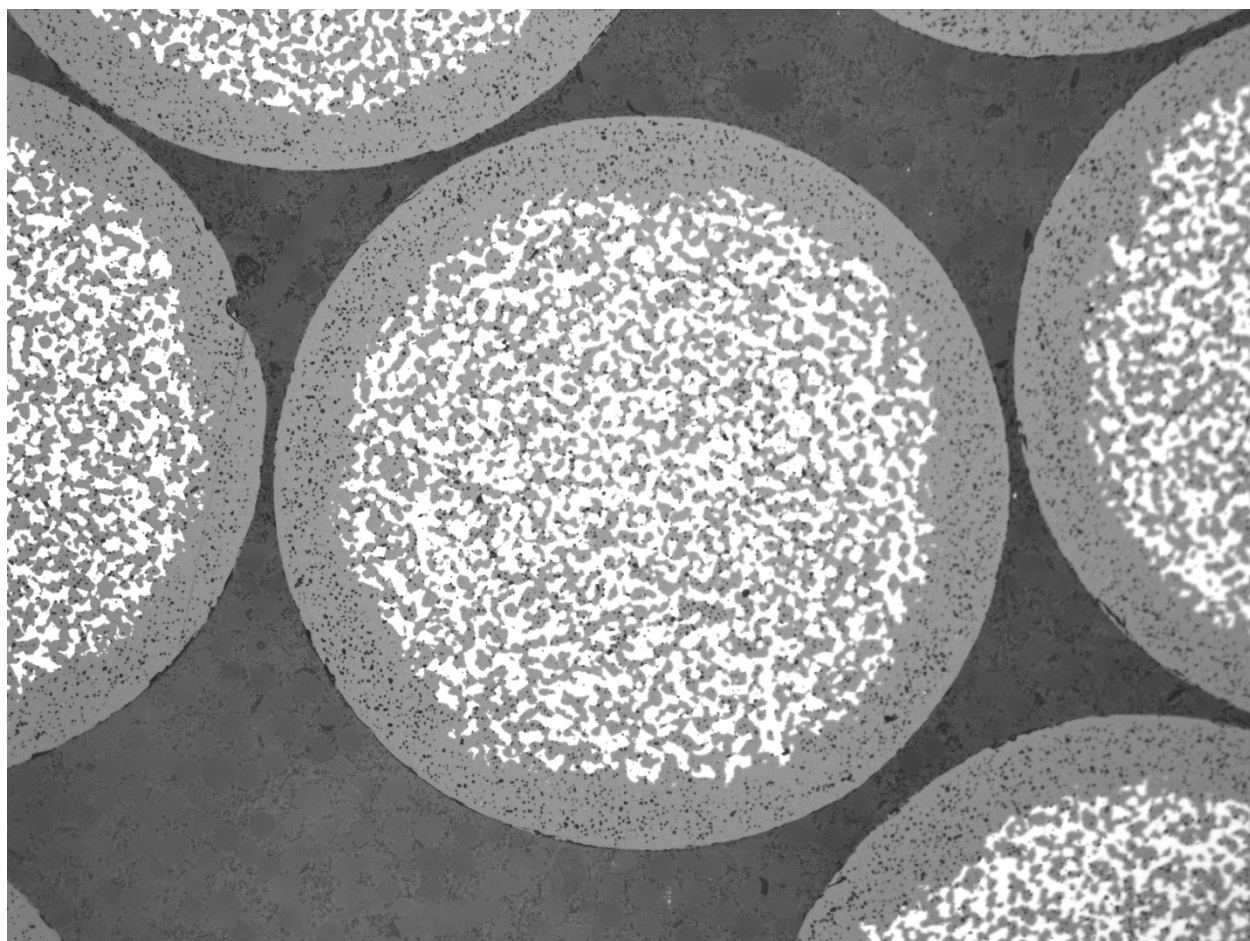
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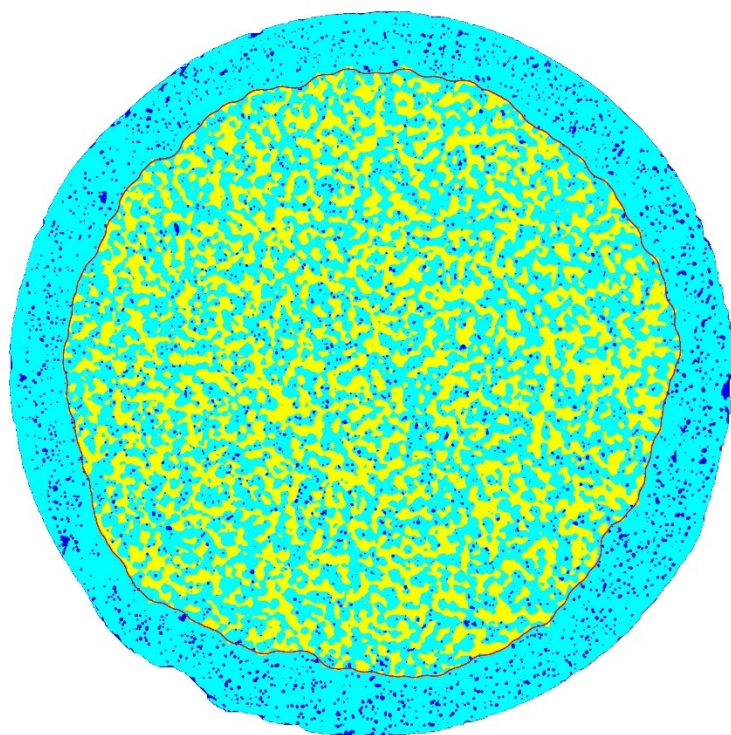
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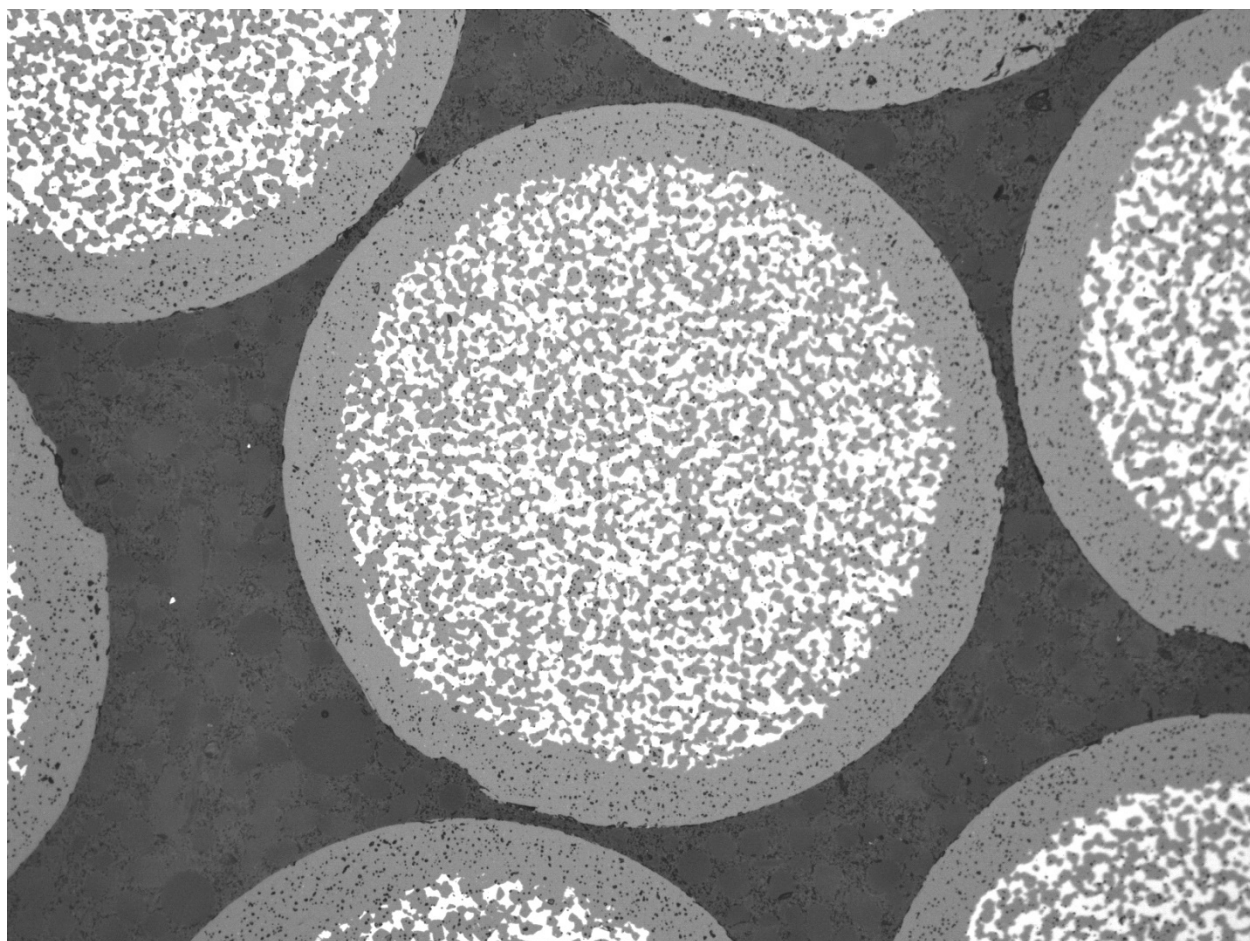
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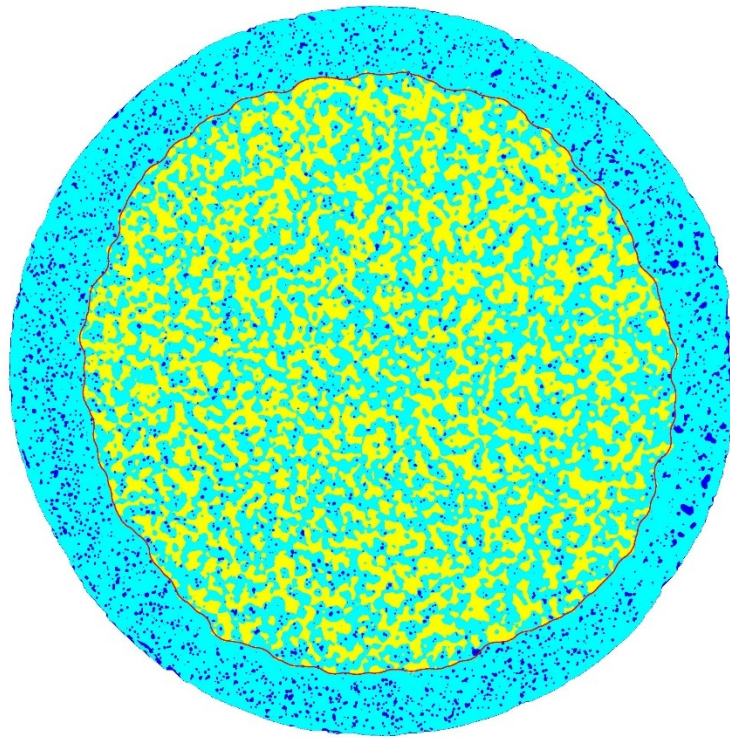
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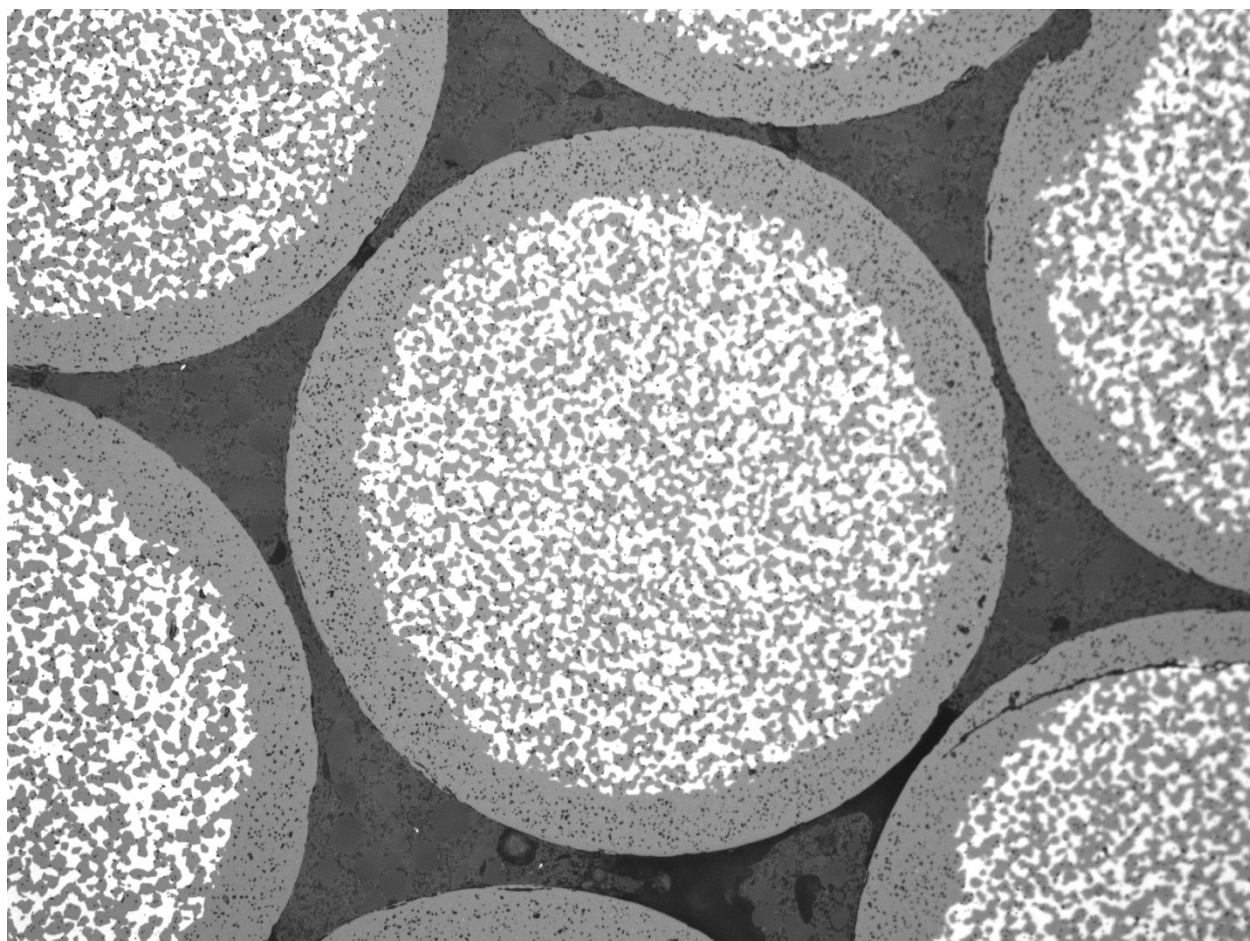
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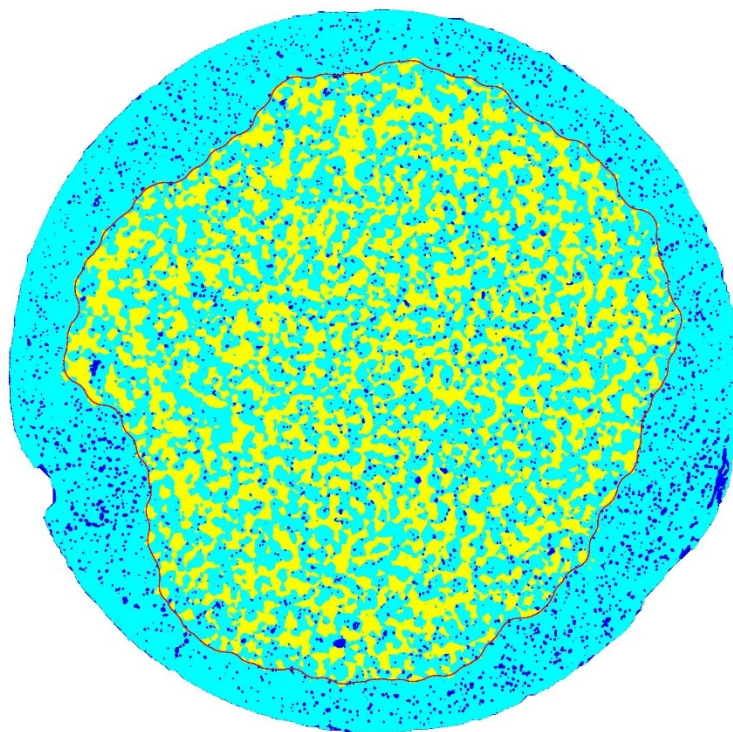
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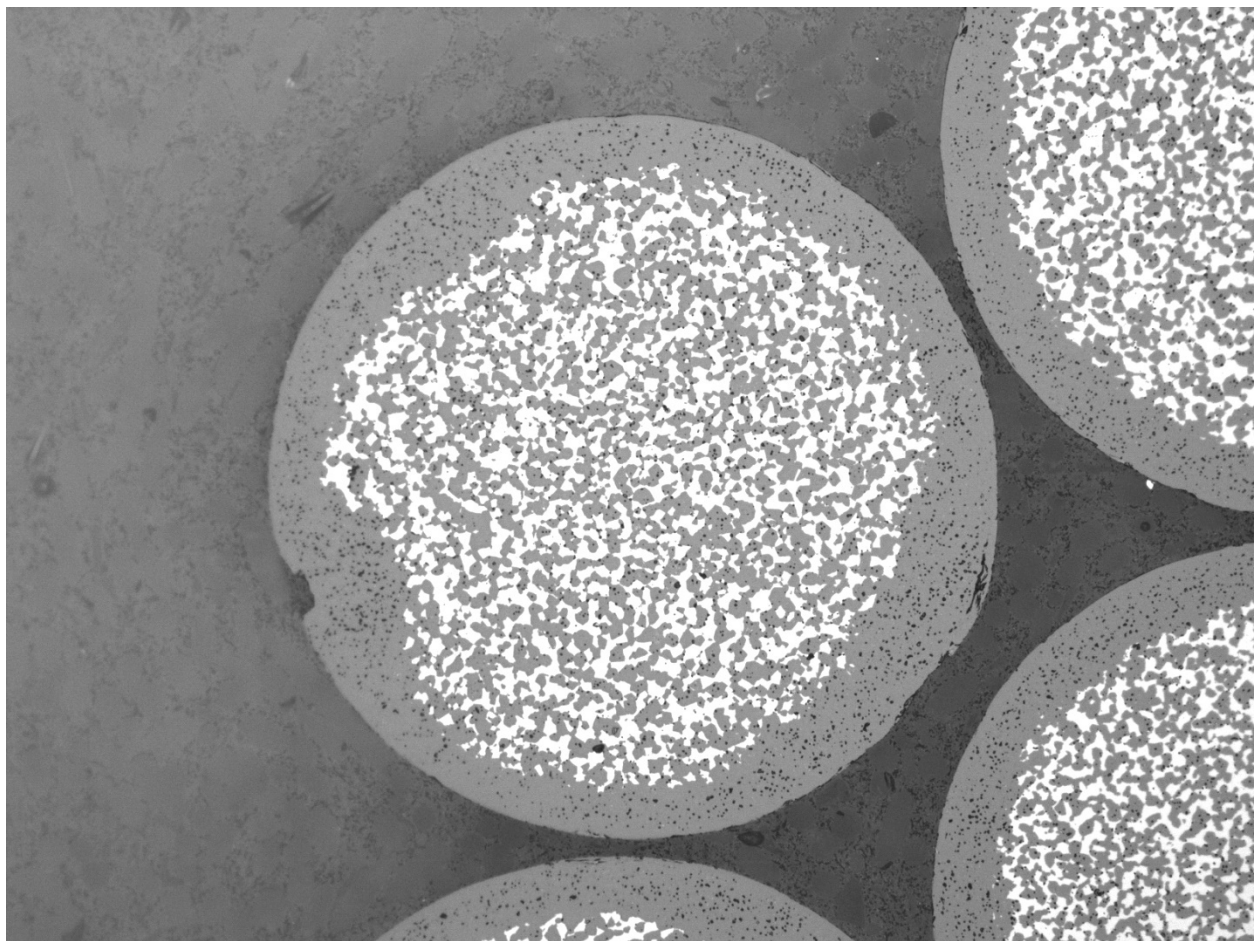
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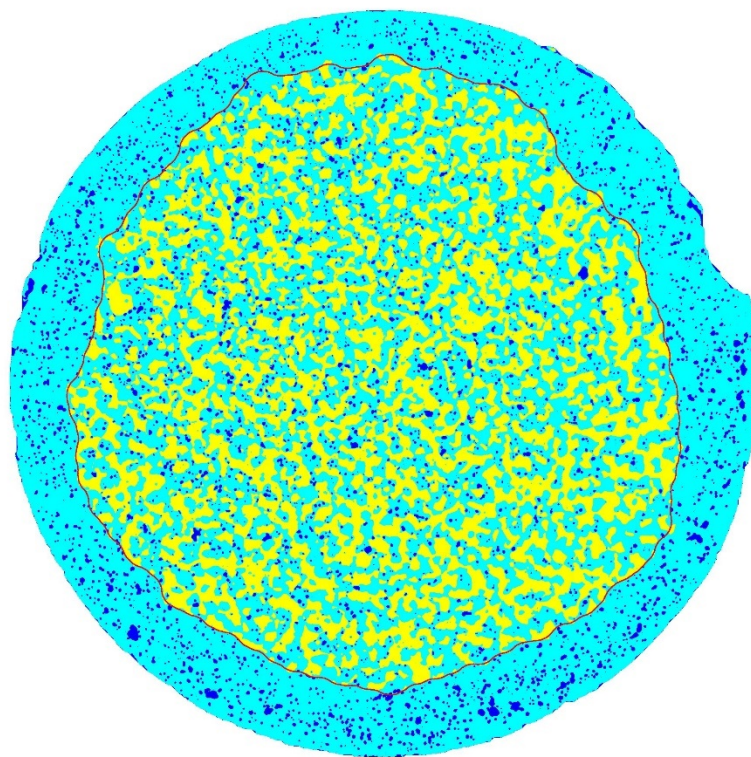
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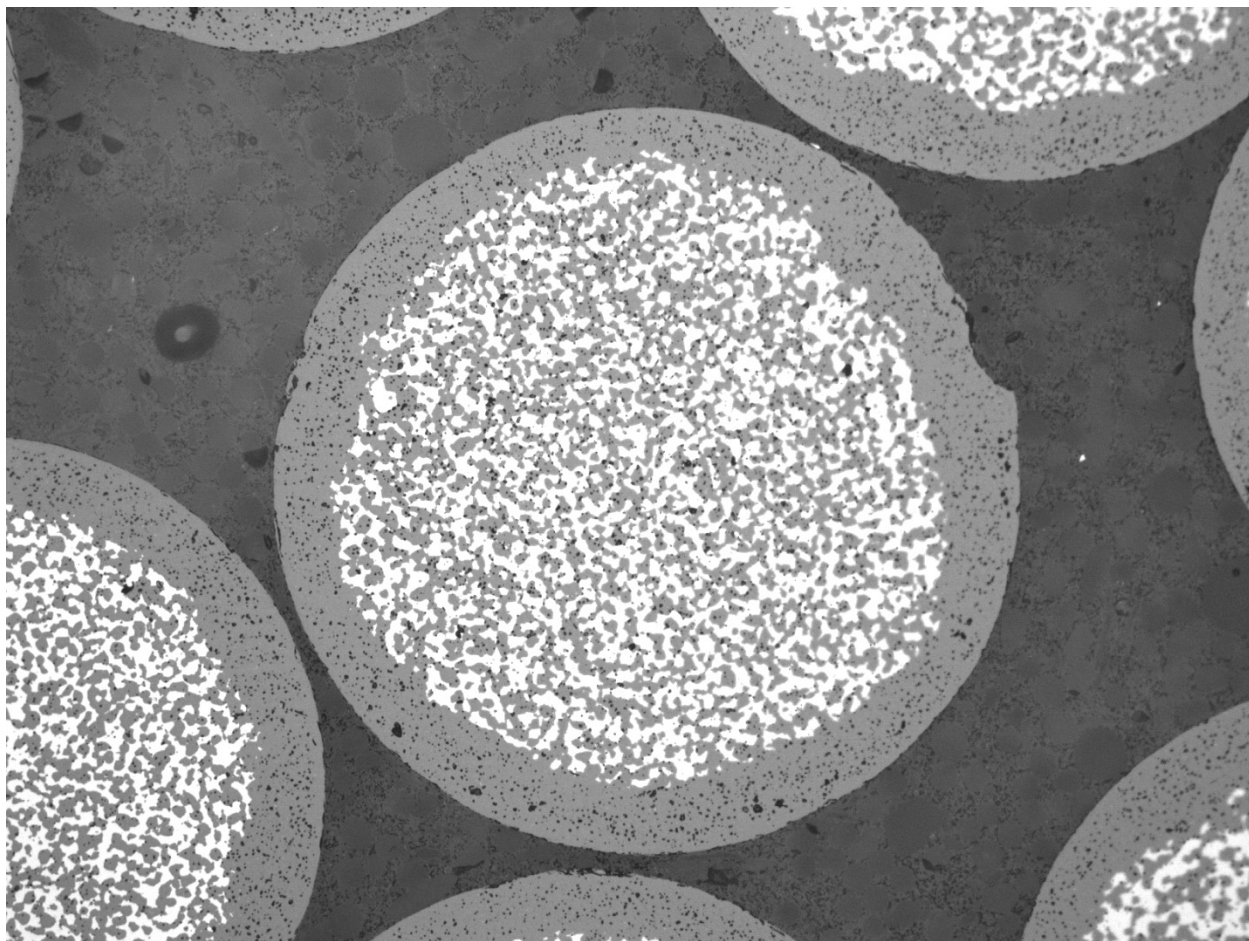
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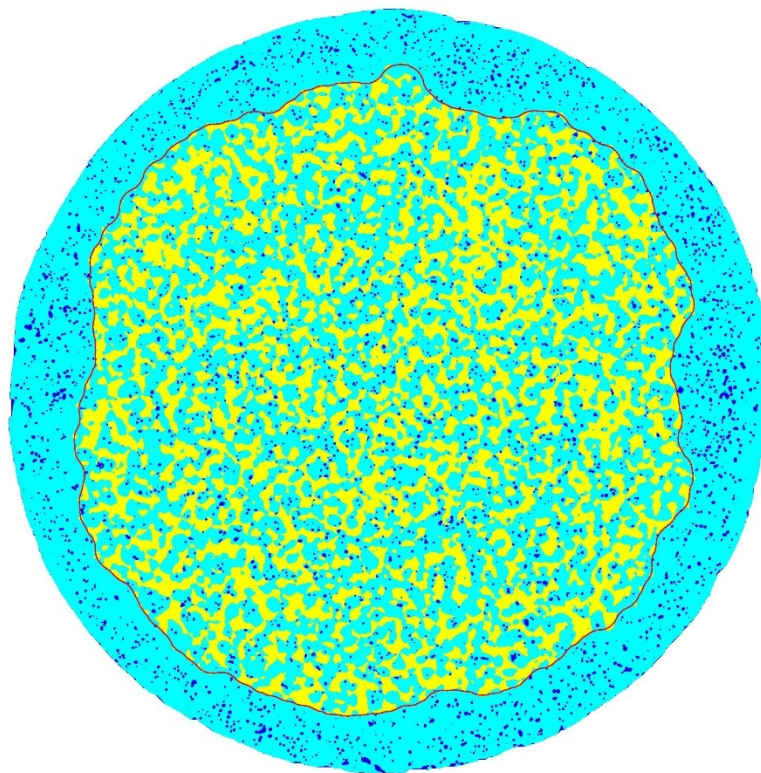
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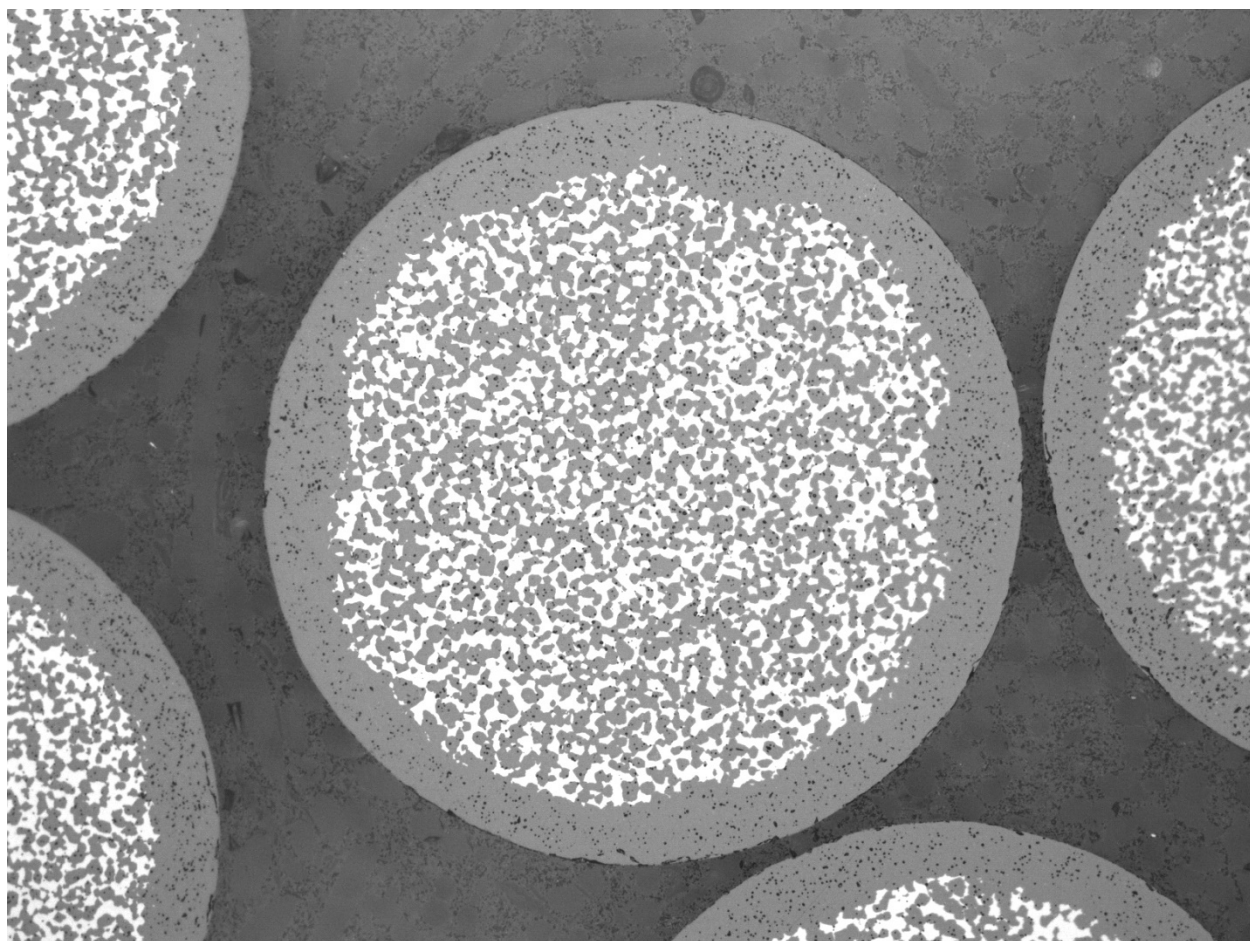
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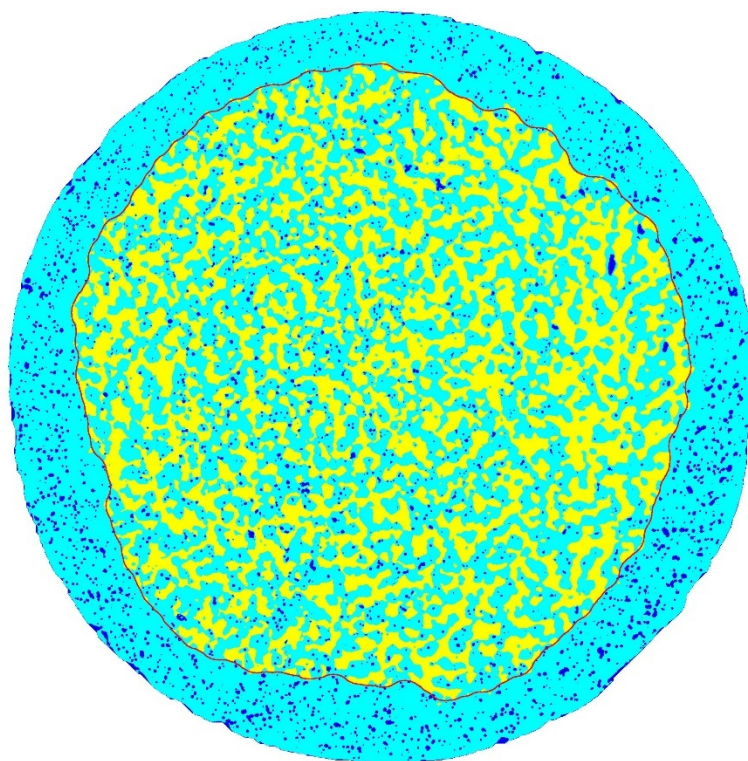
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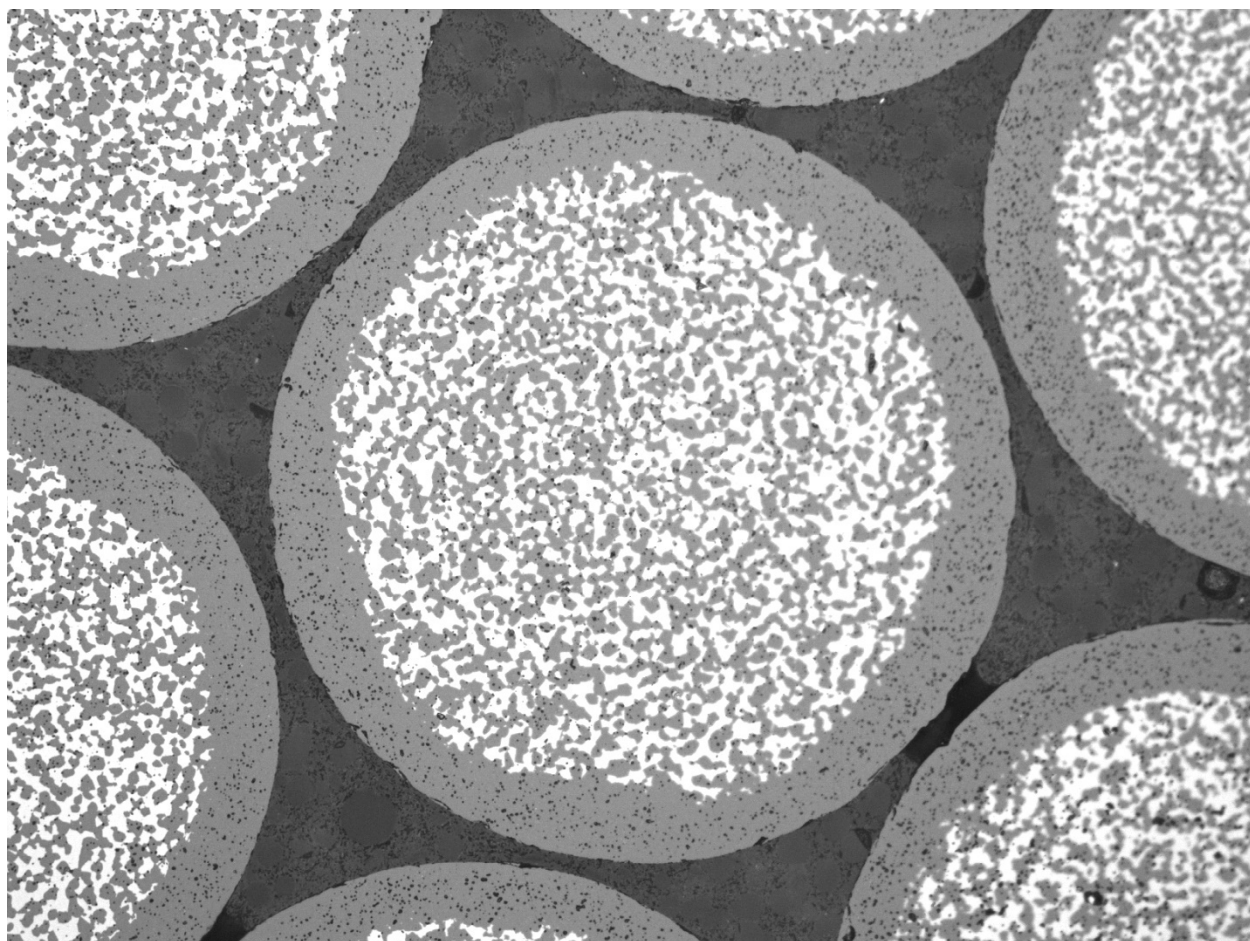
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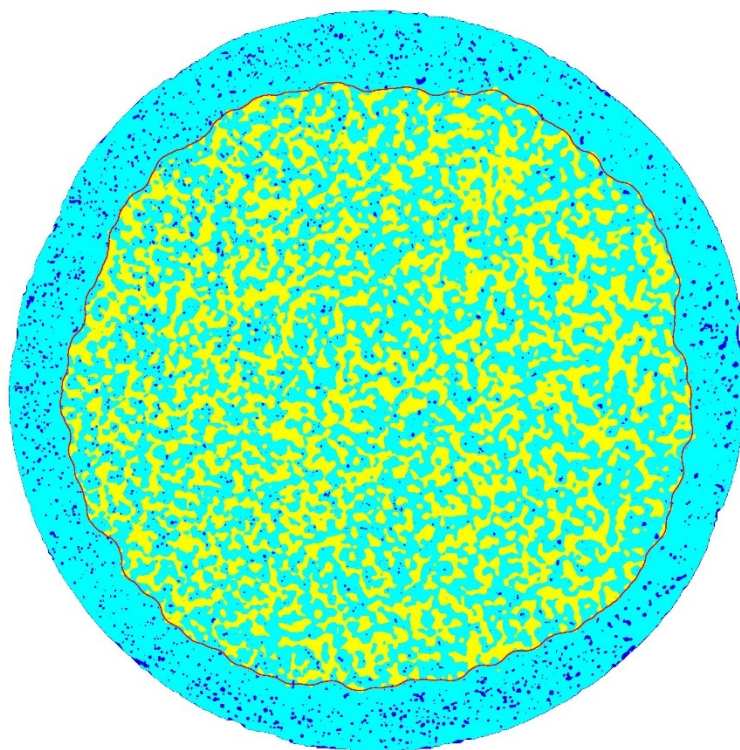
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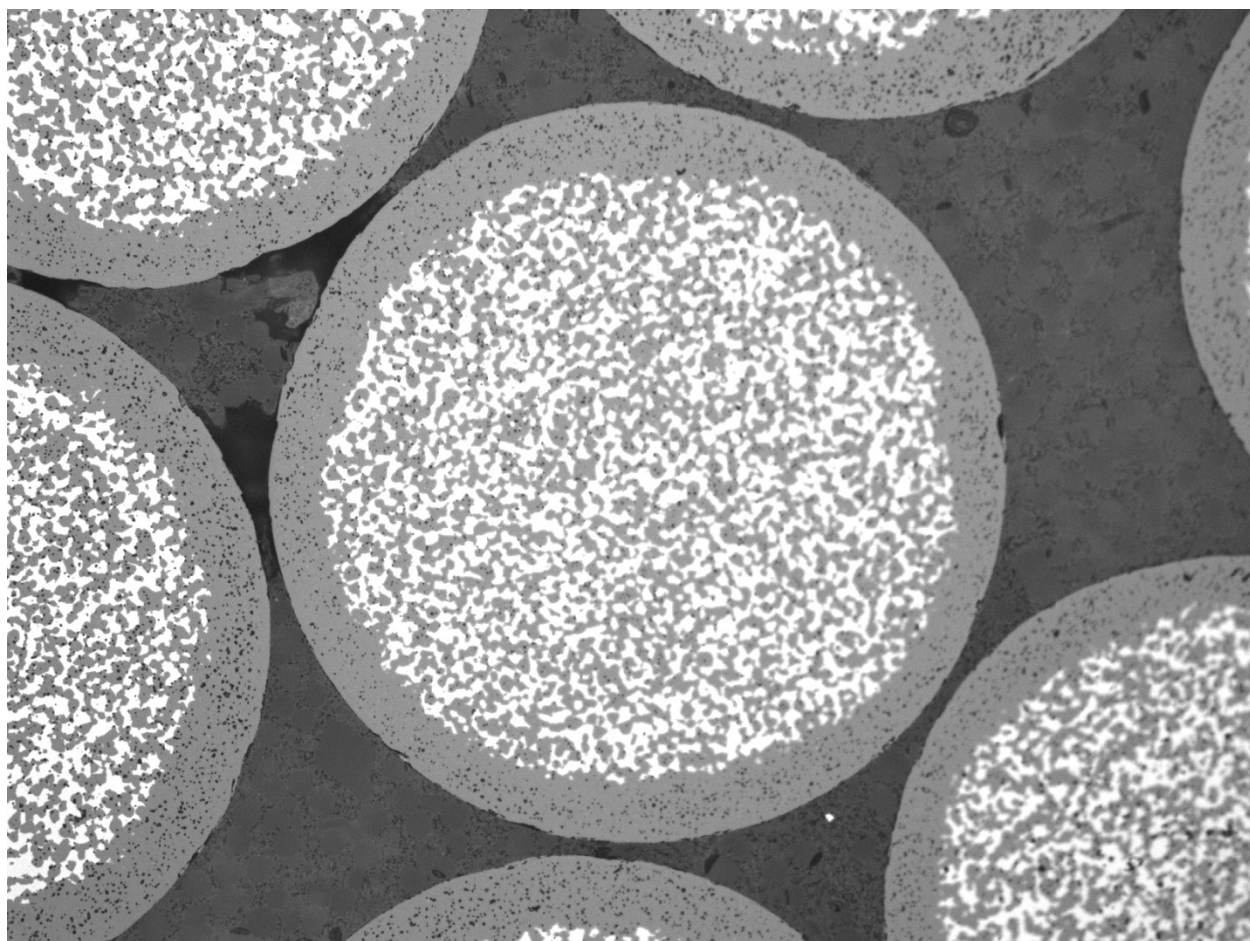
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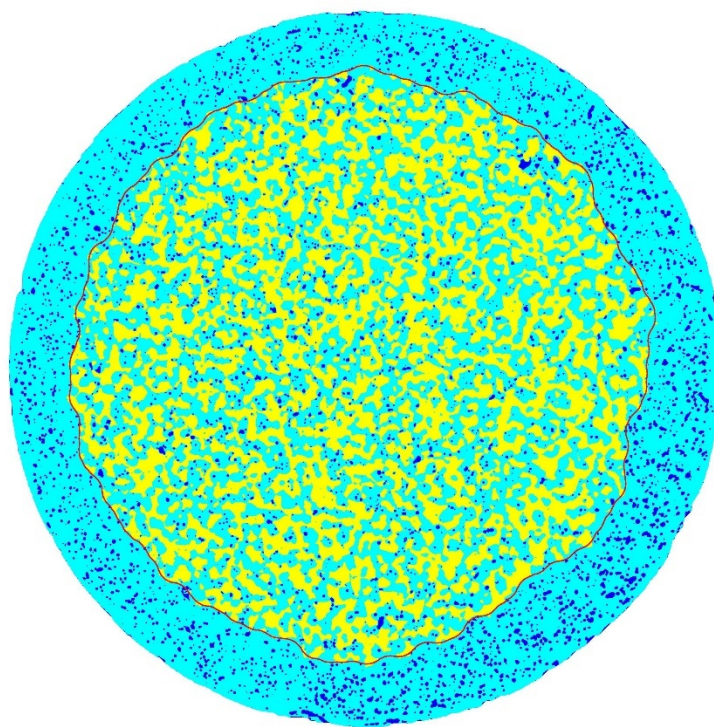
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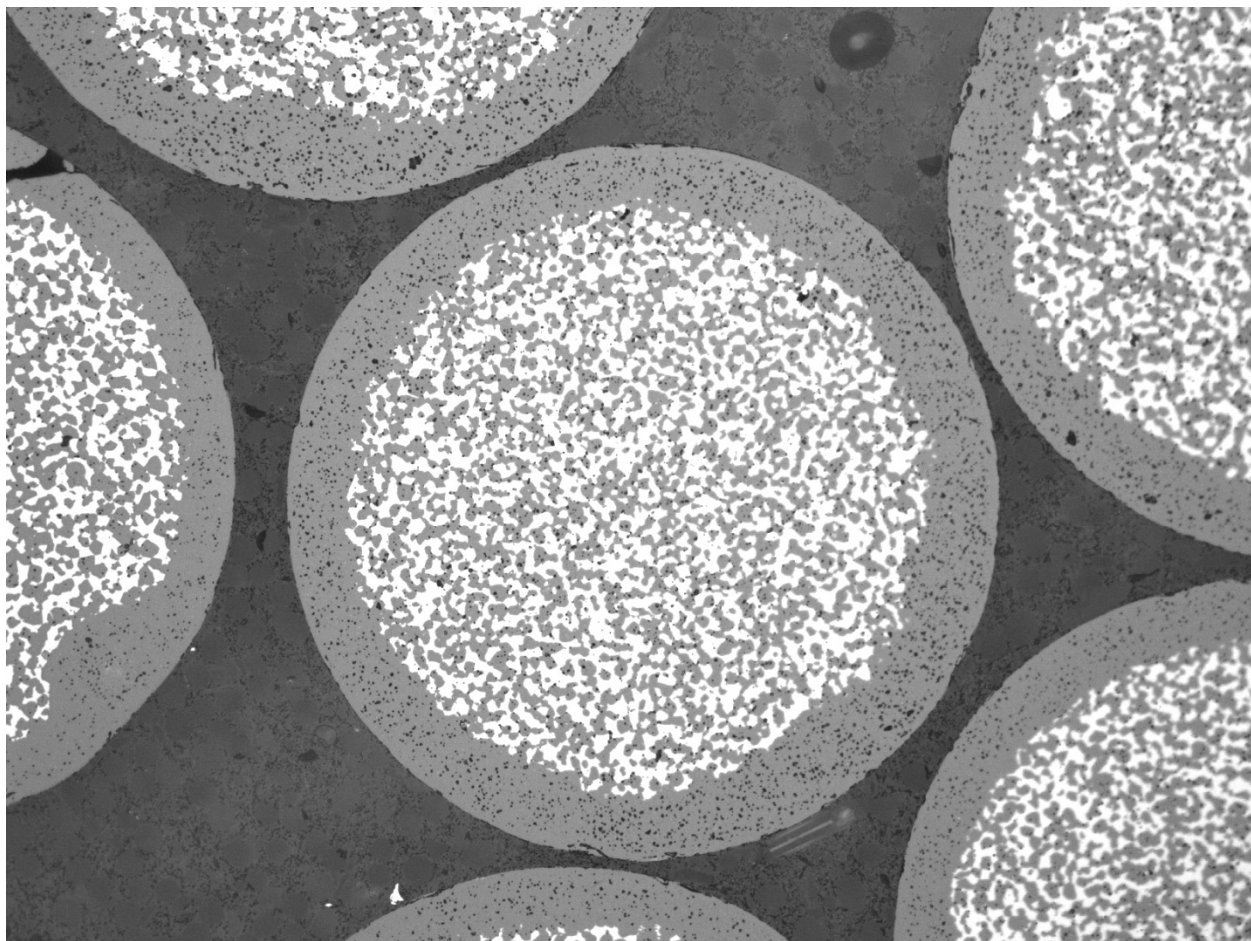
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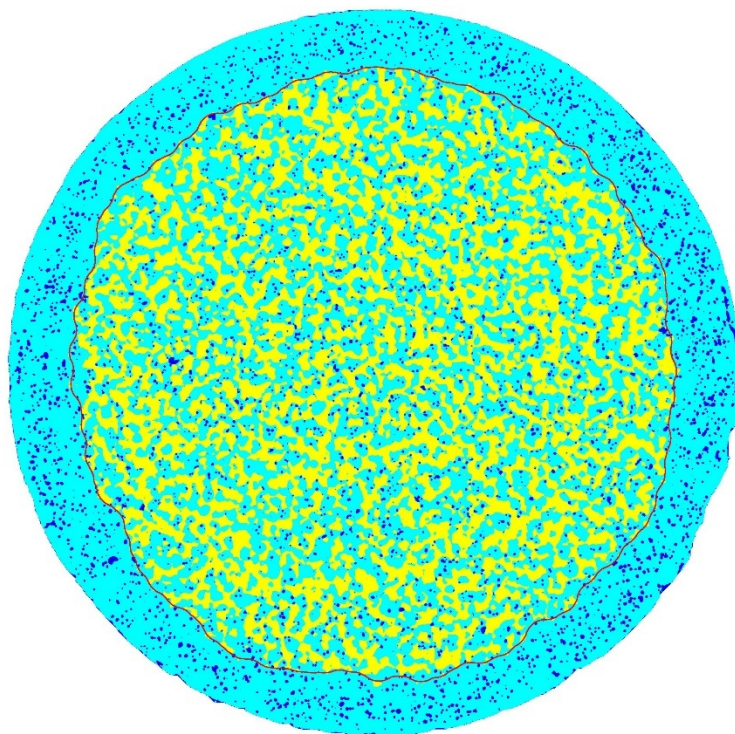
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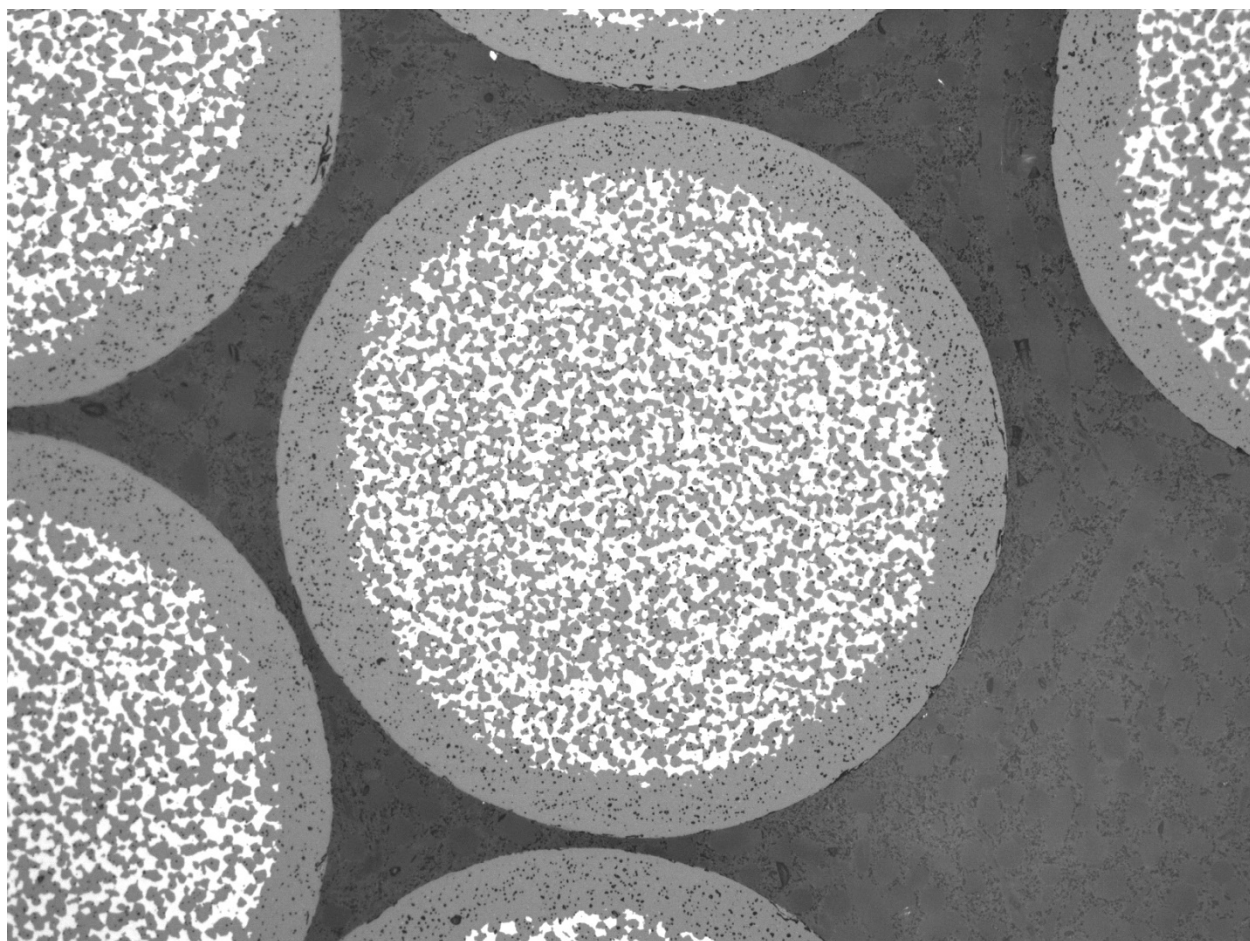
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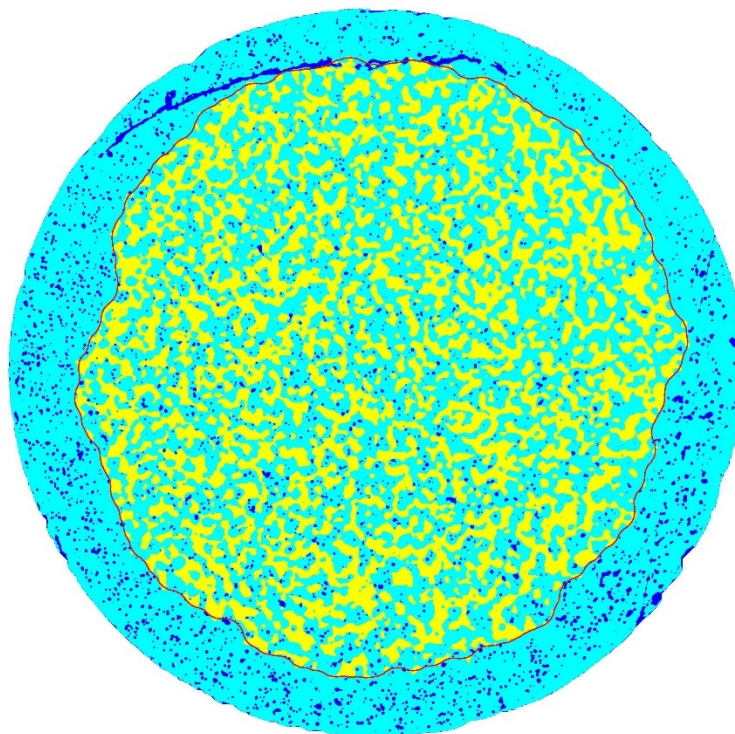
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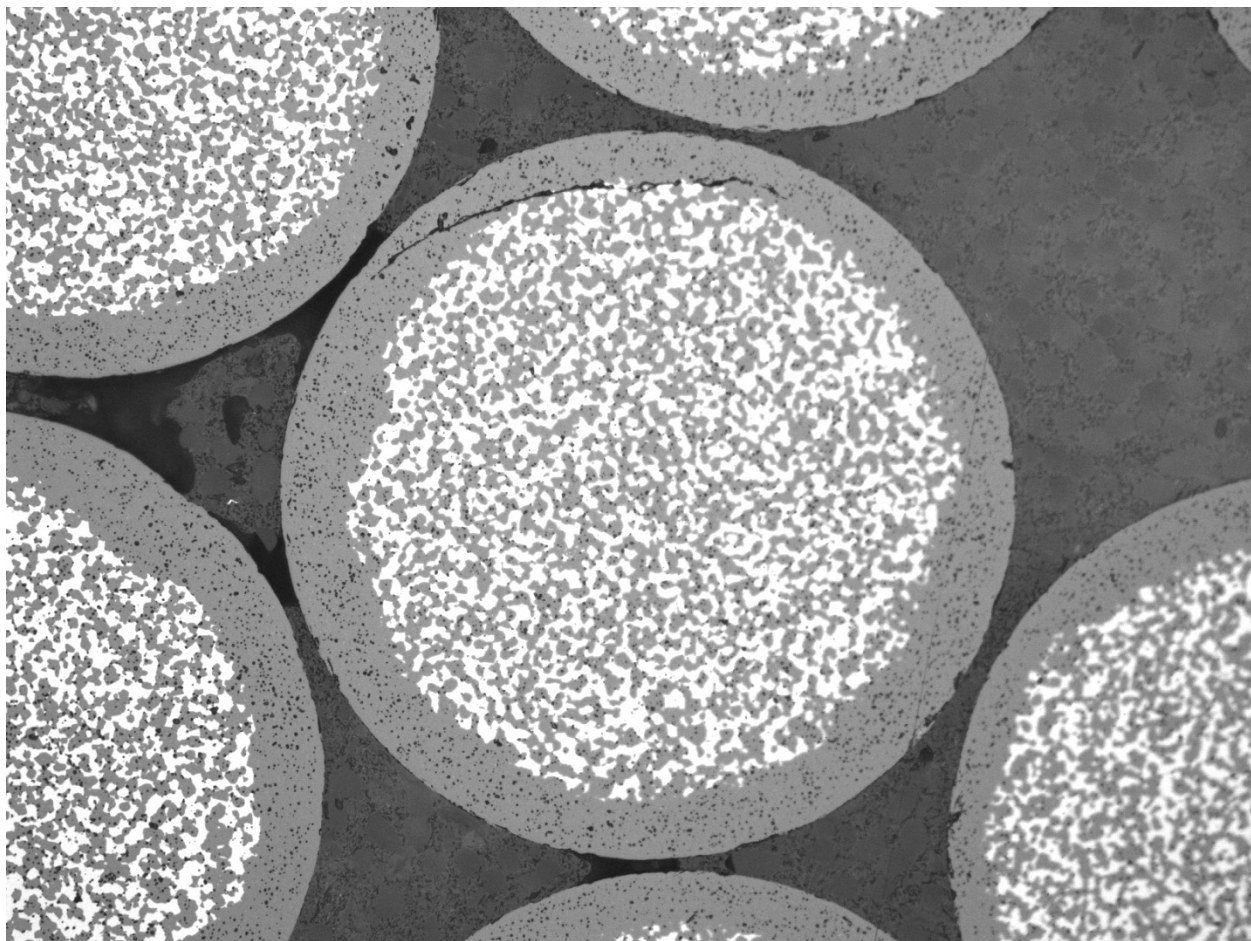
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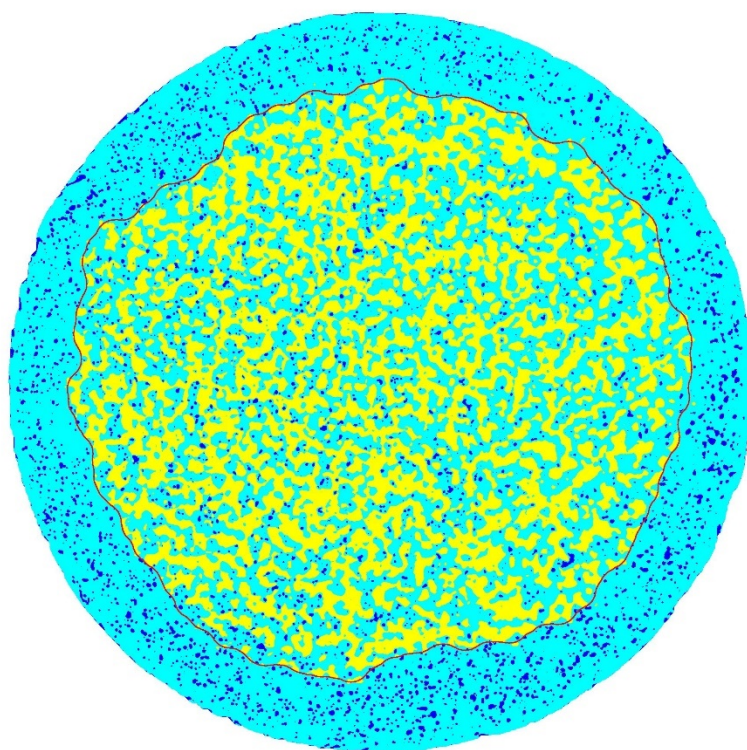
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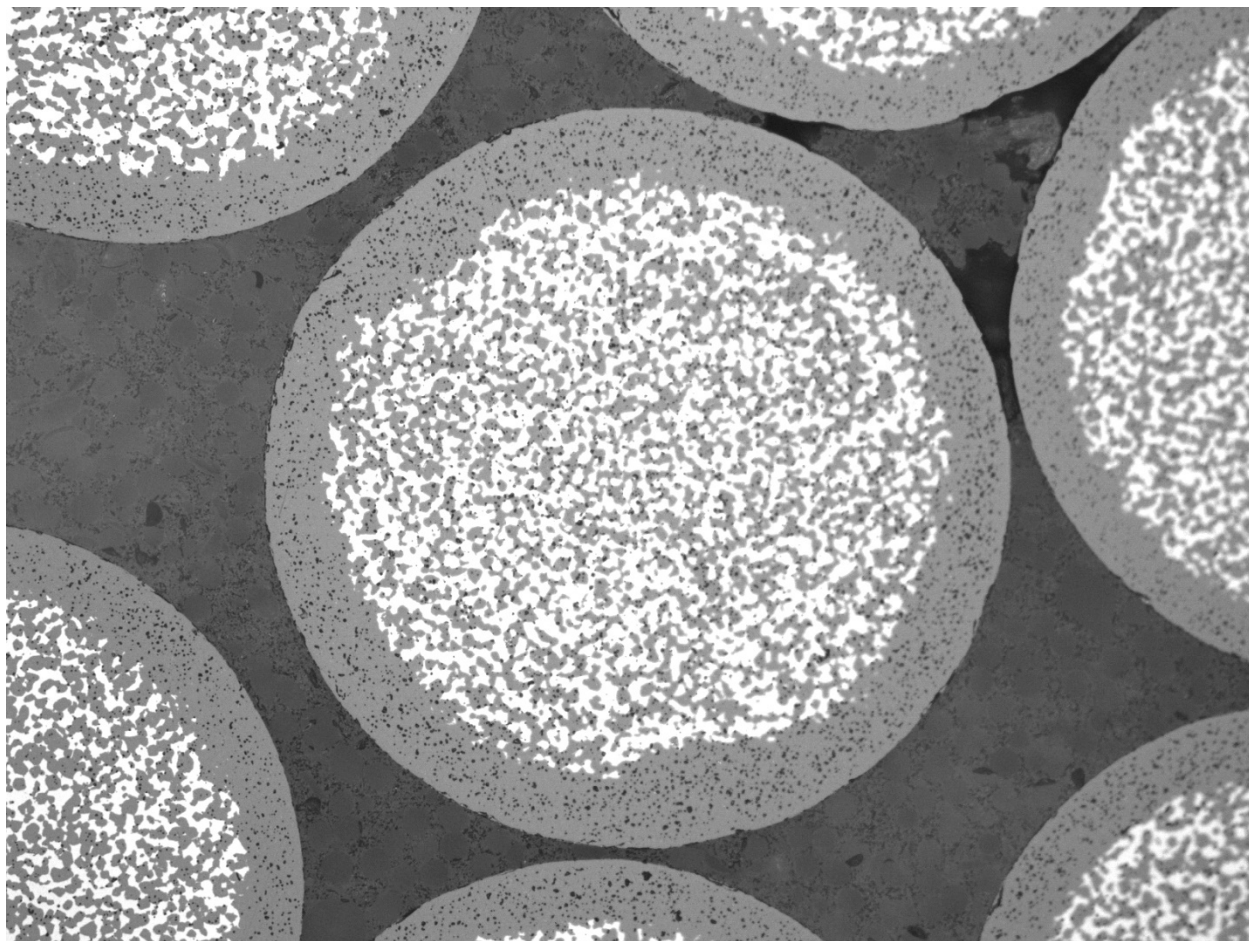
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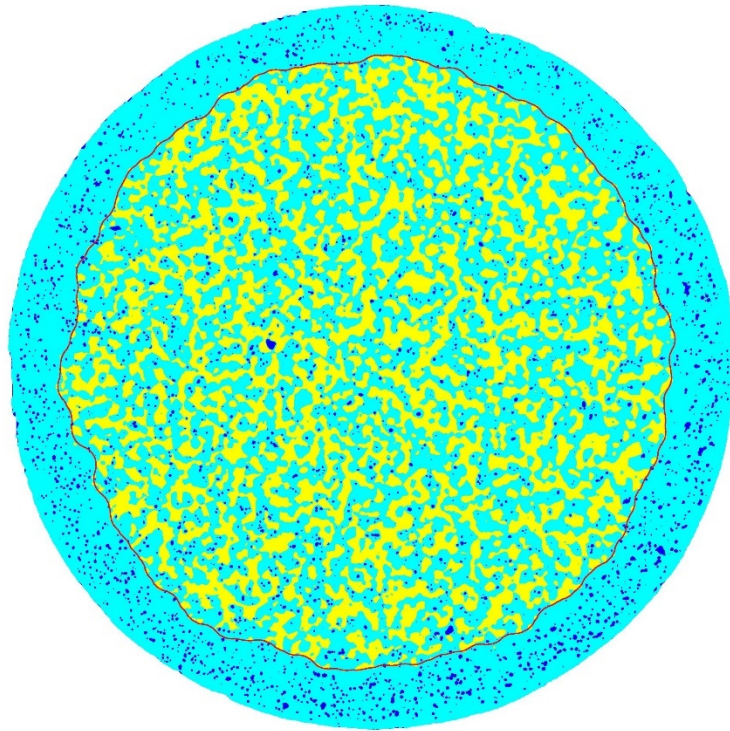
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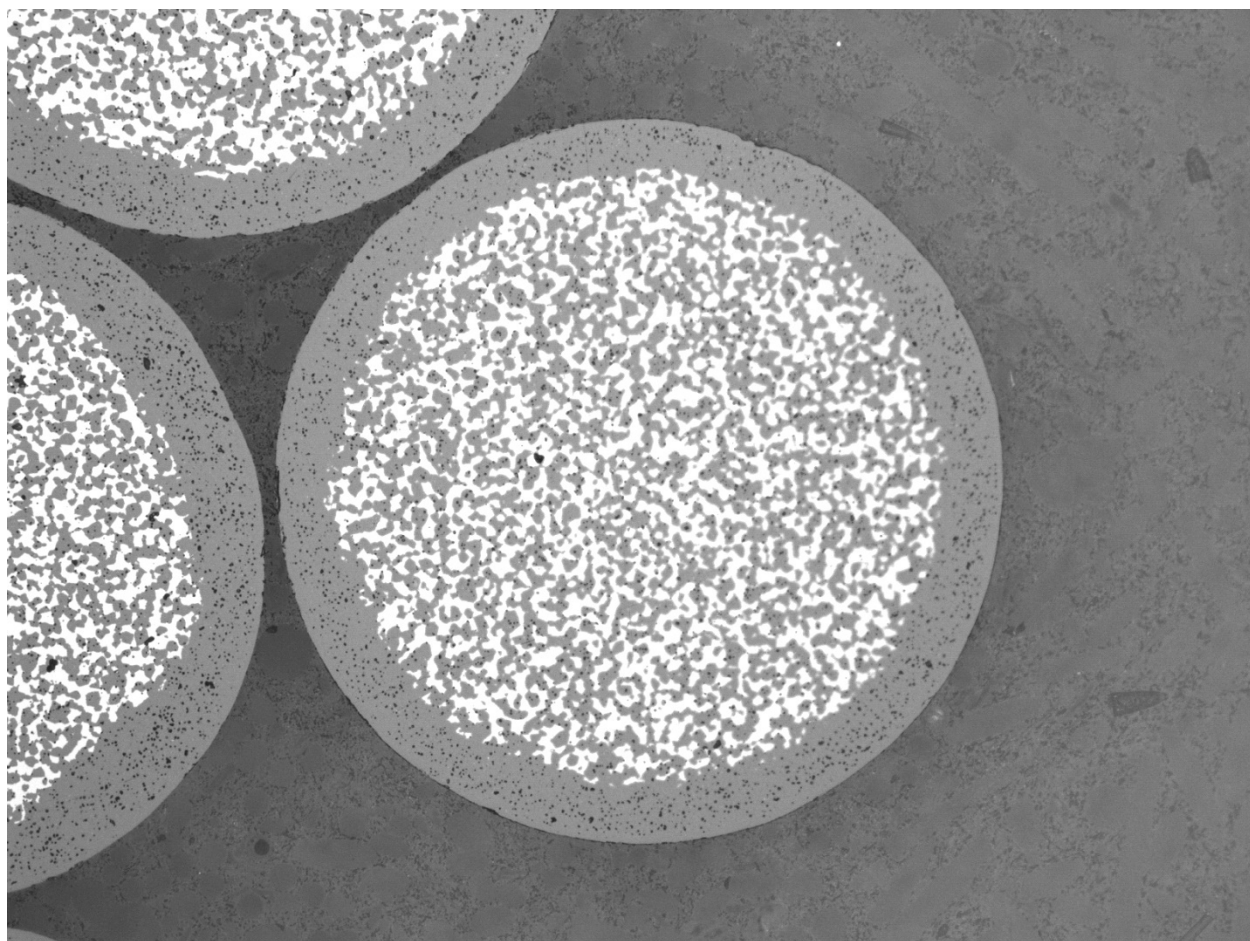
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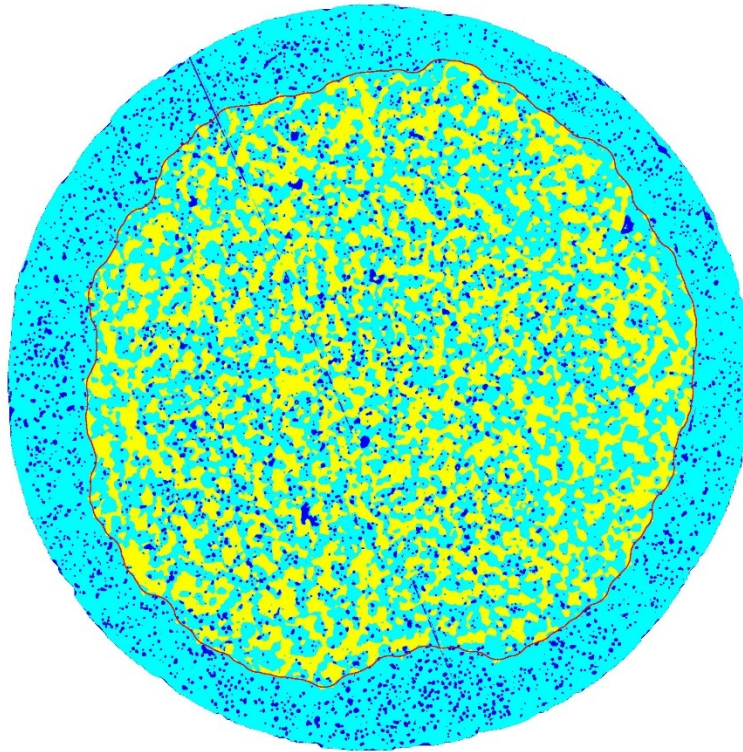
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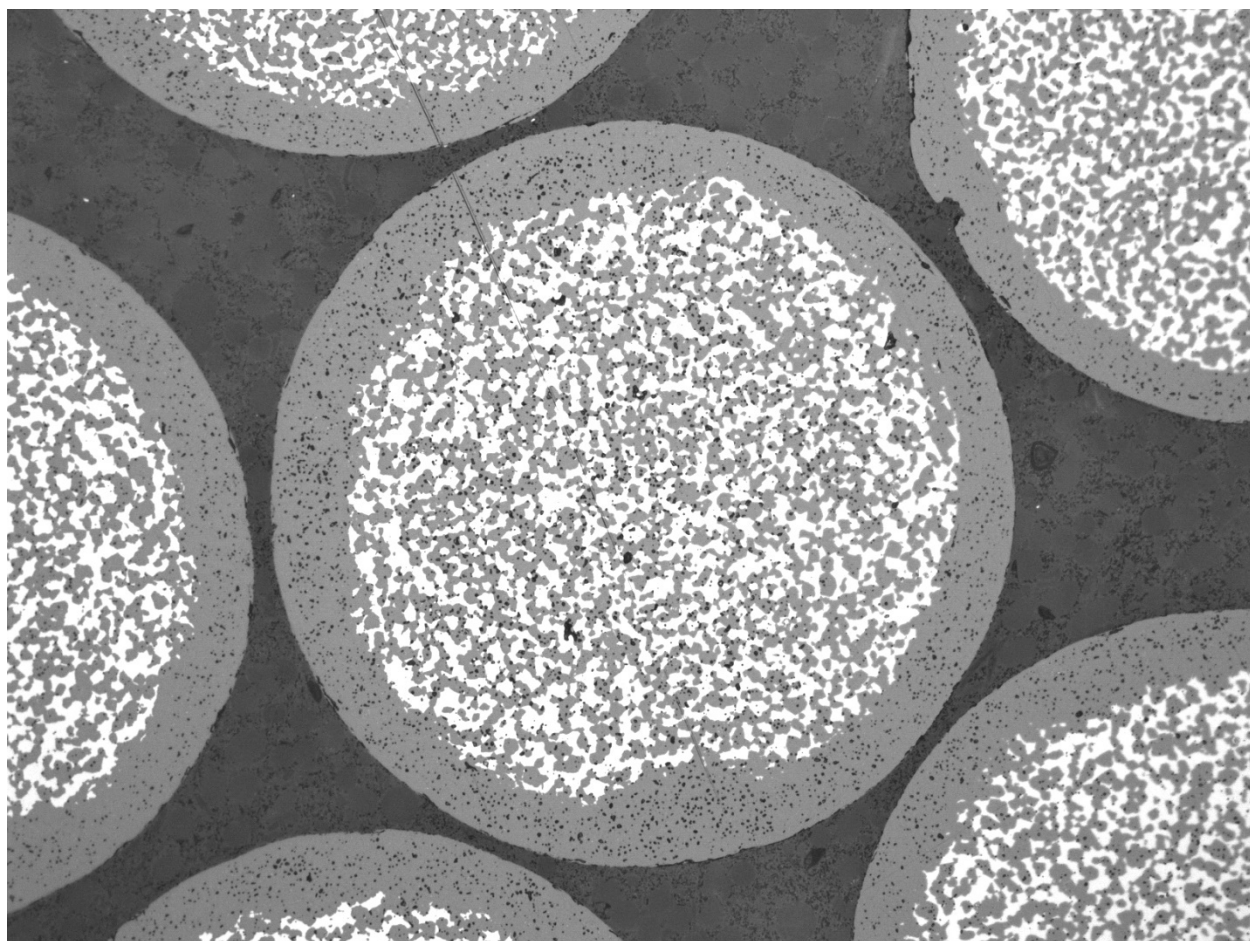
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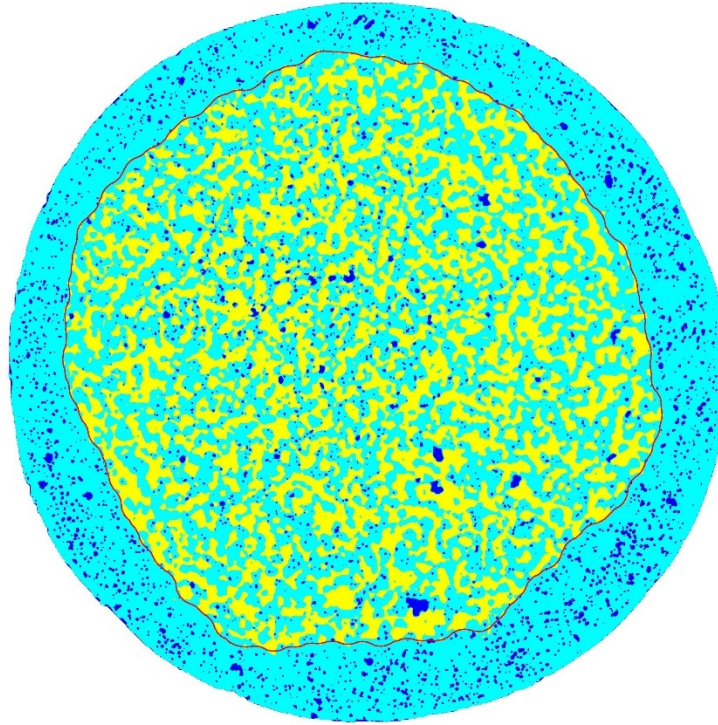
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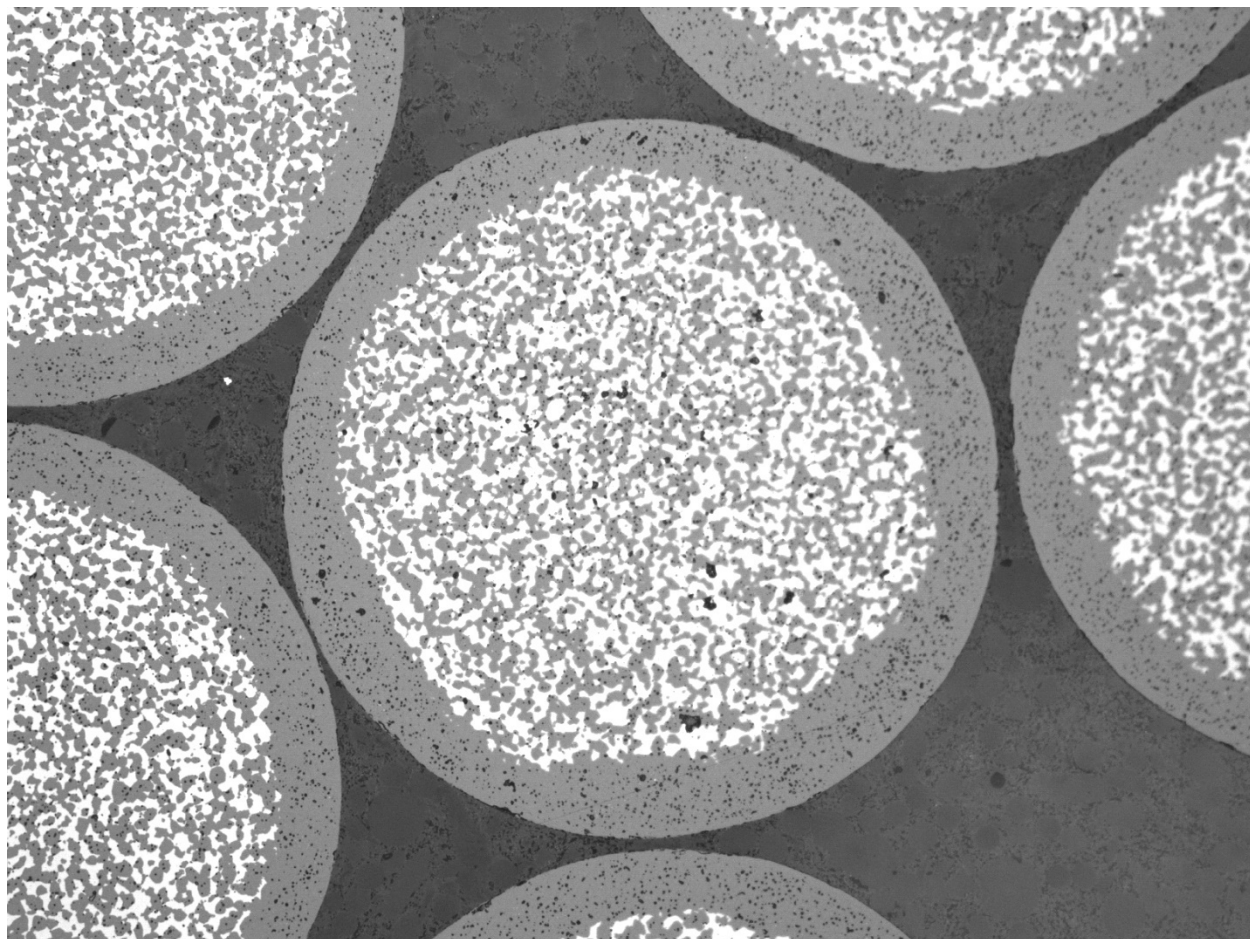
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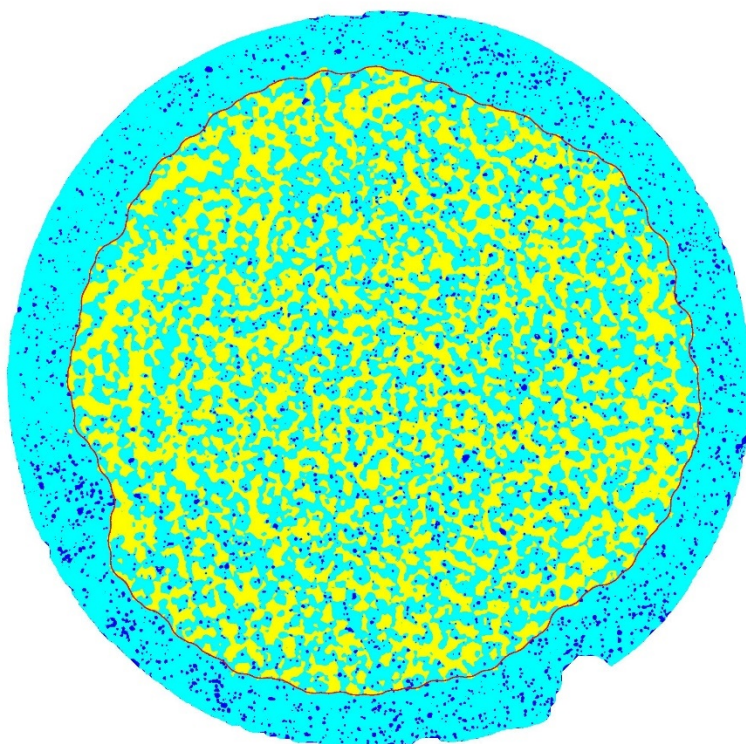
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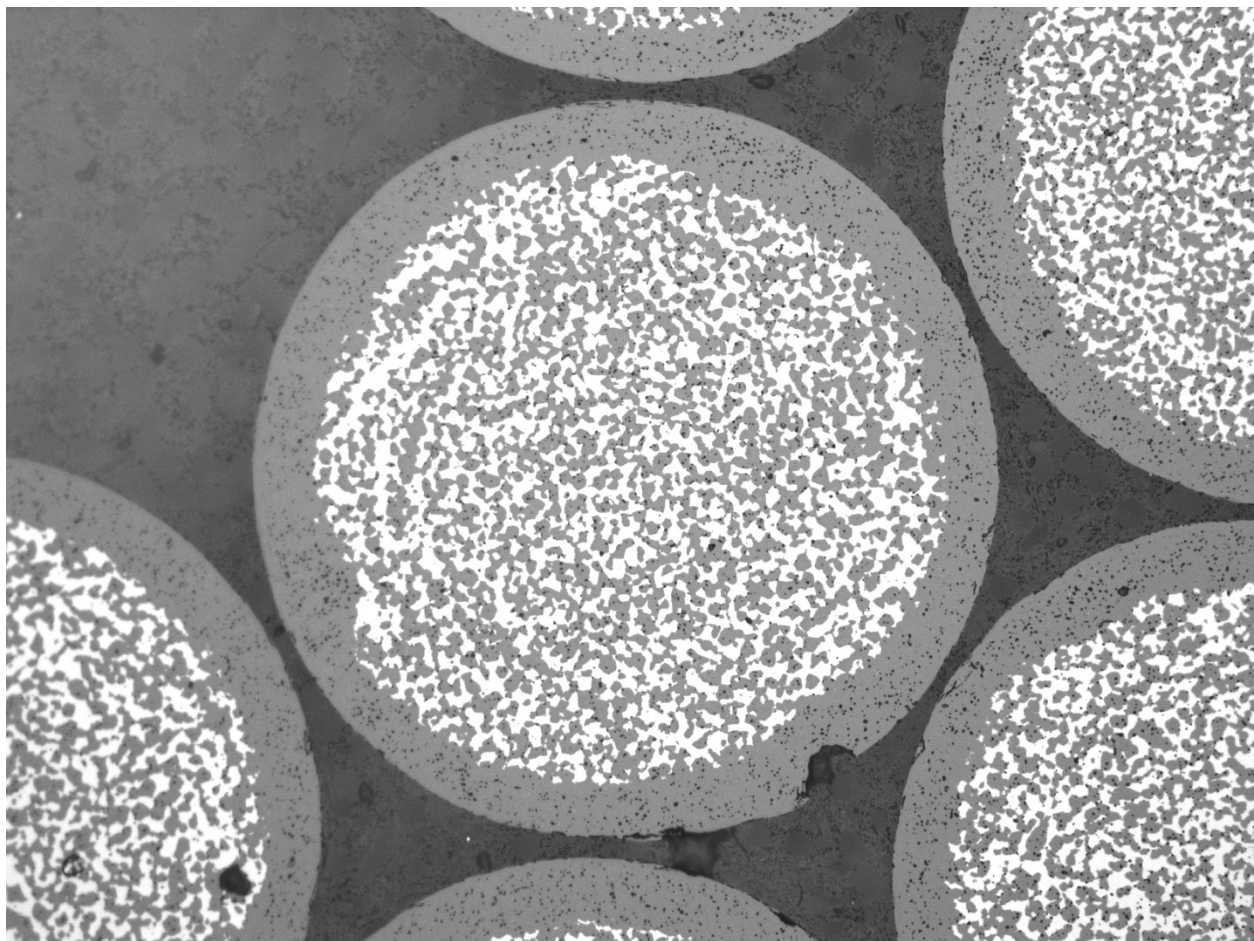
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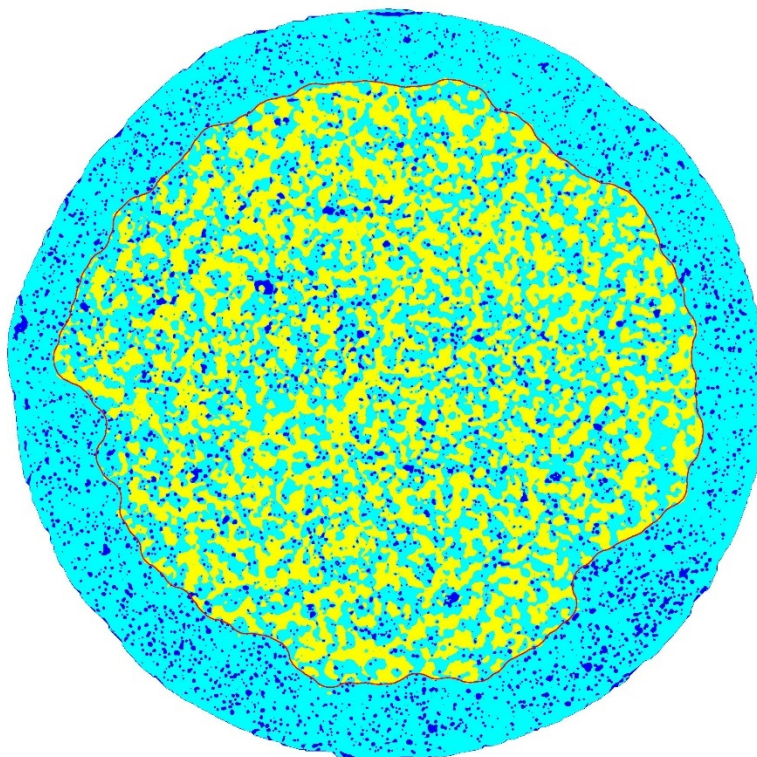
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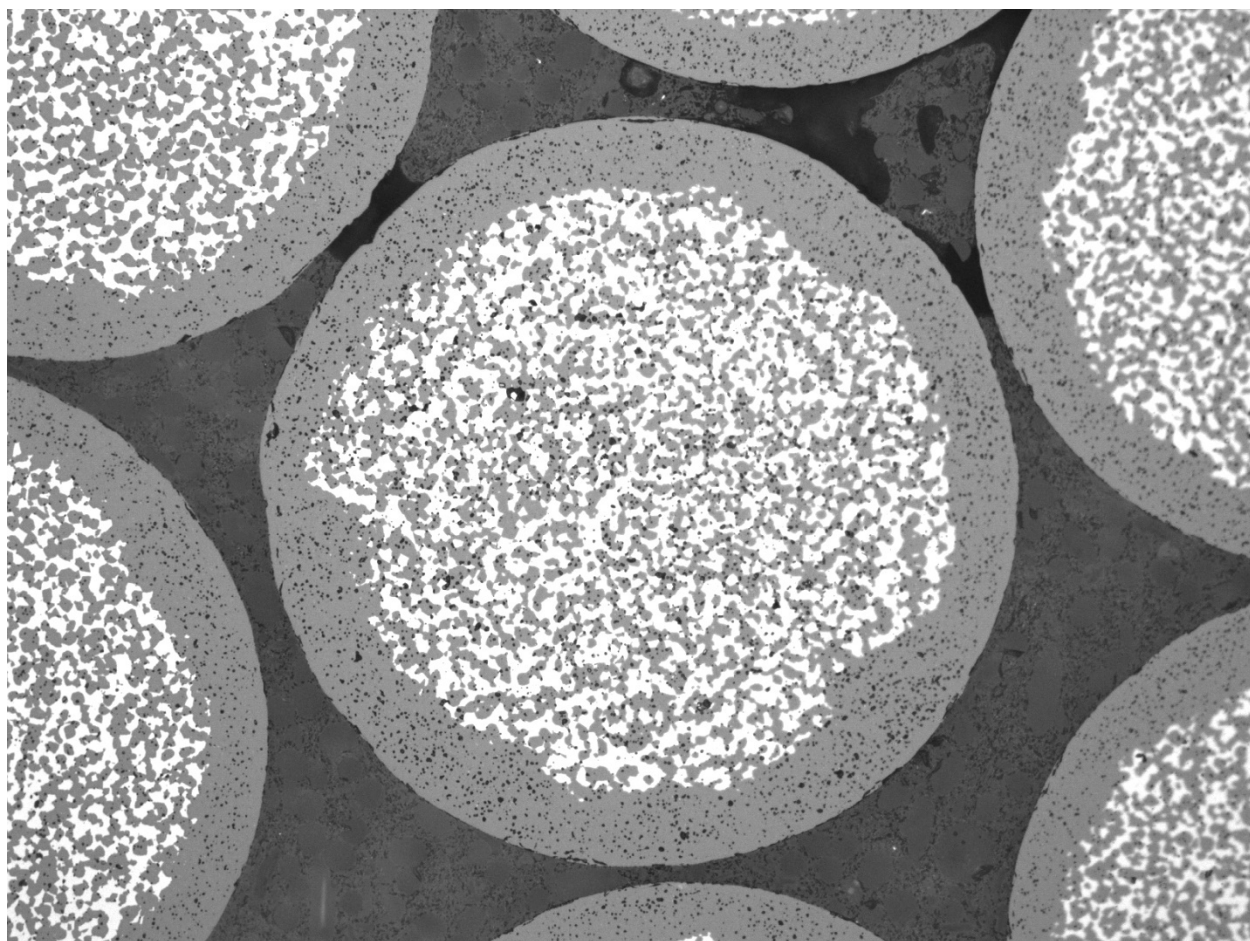
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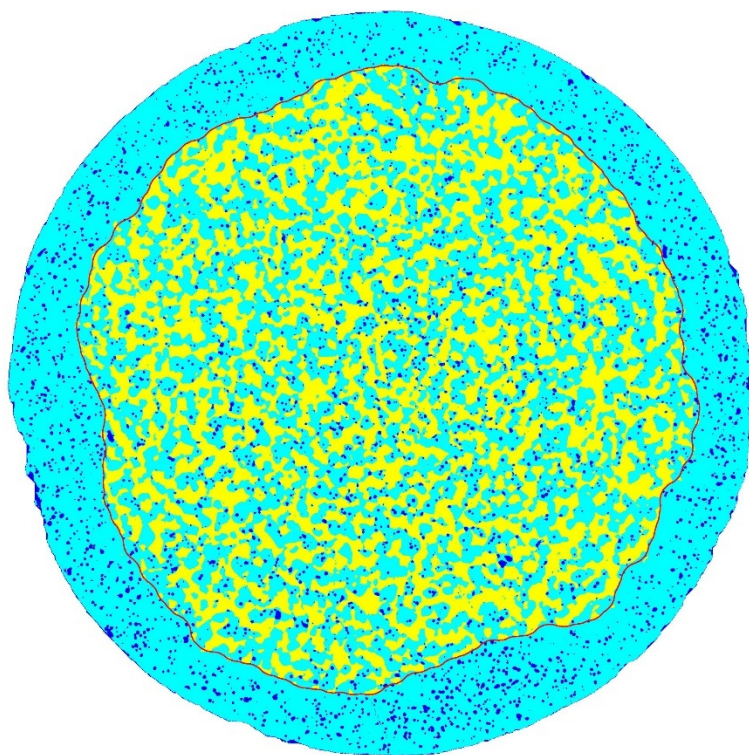
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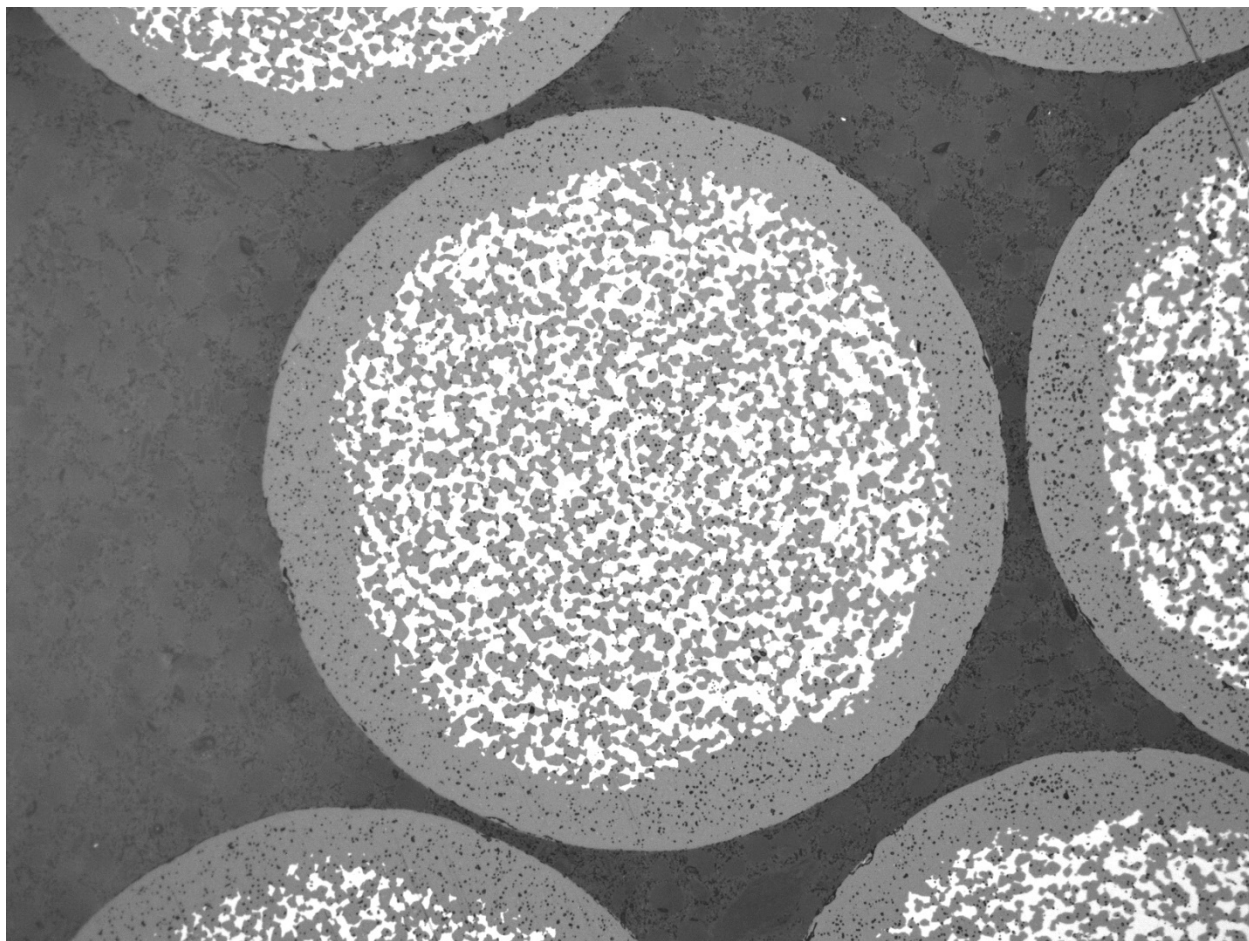
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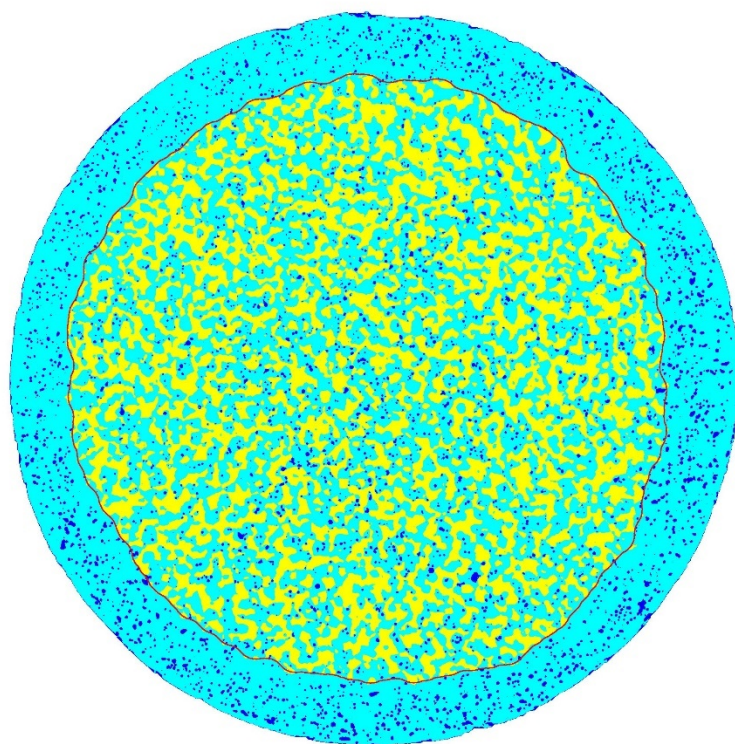
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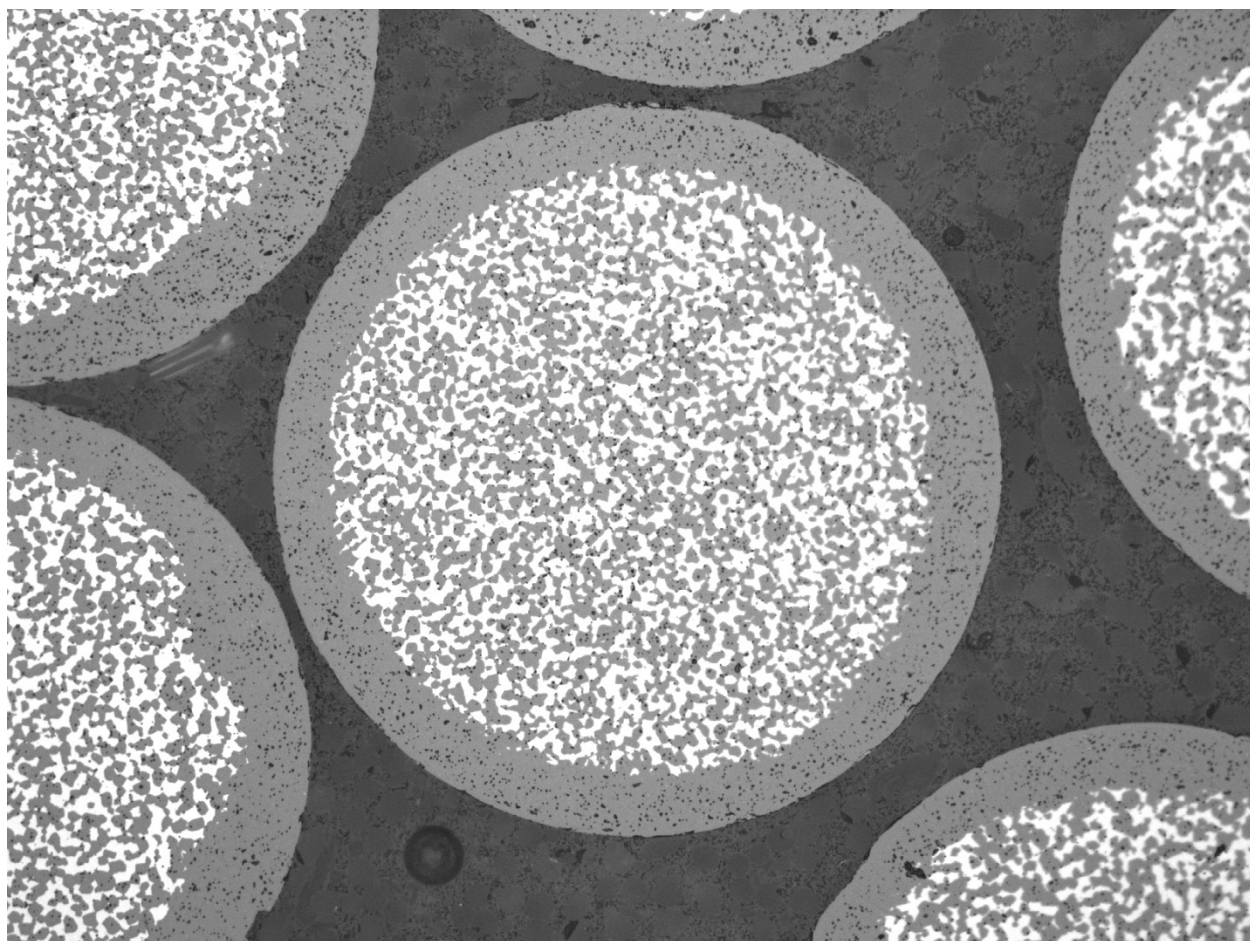
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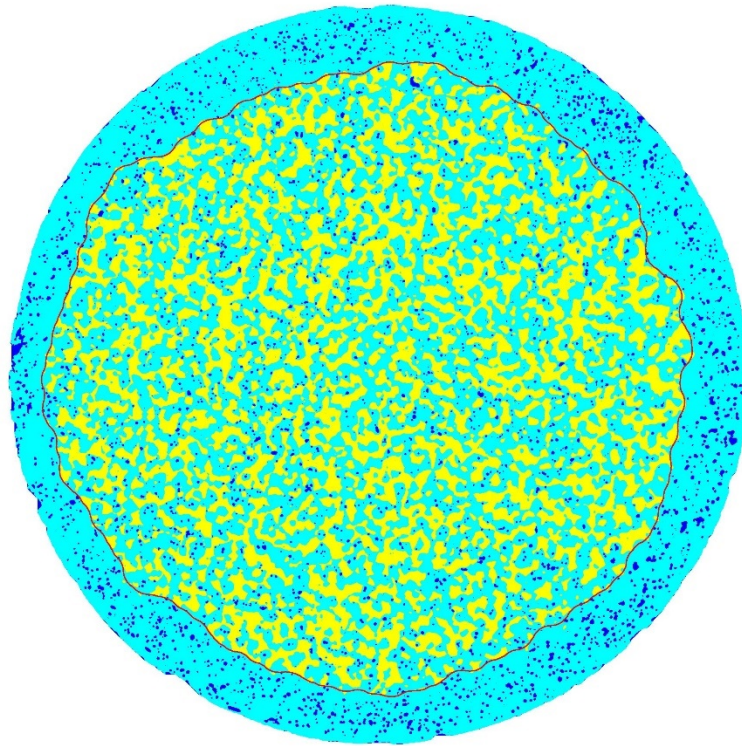
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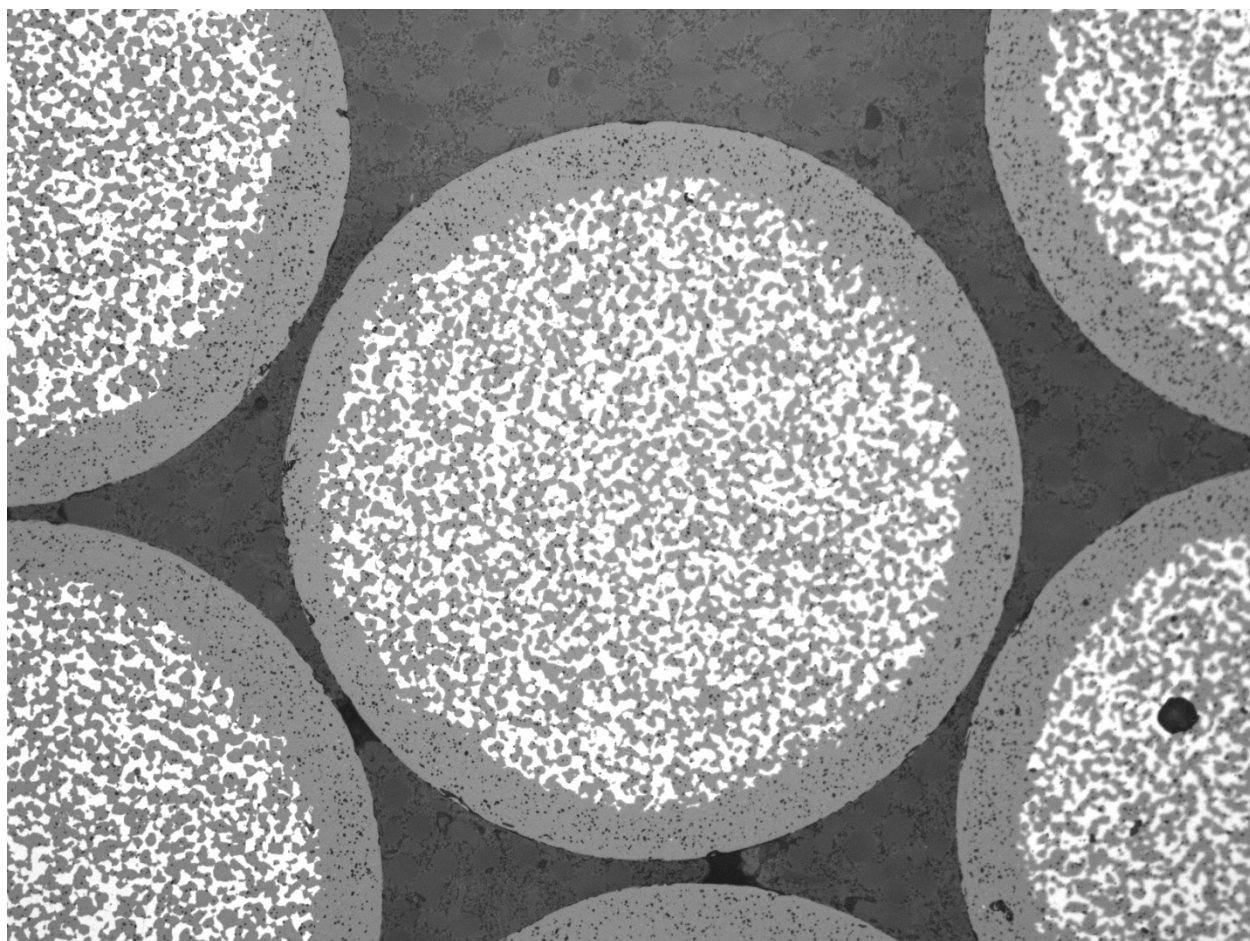
P17030905N044 segmented



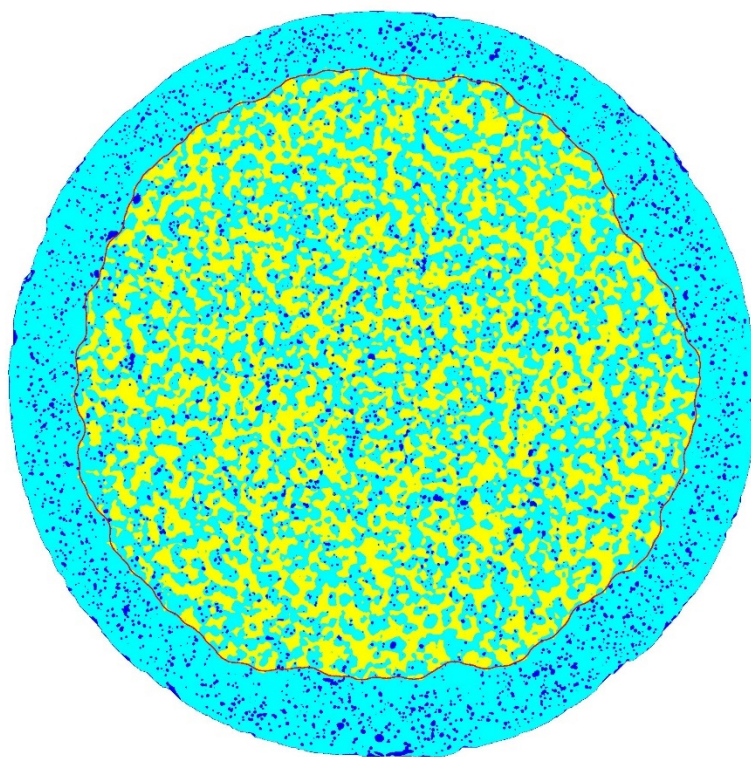
P17030905N044



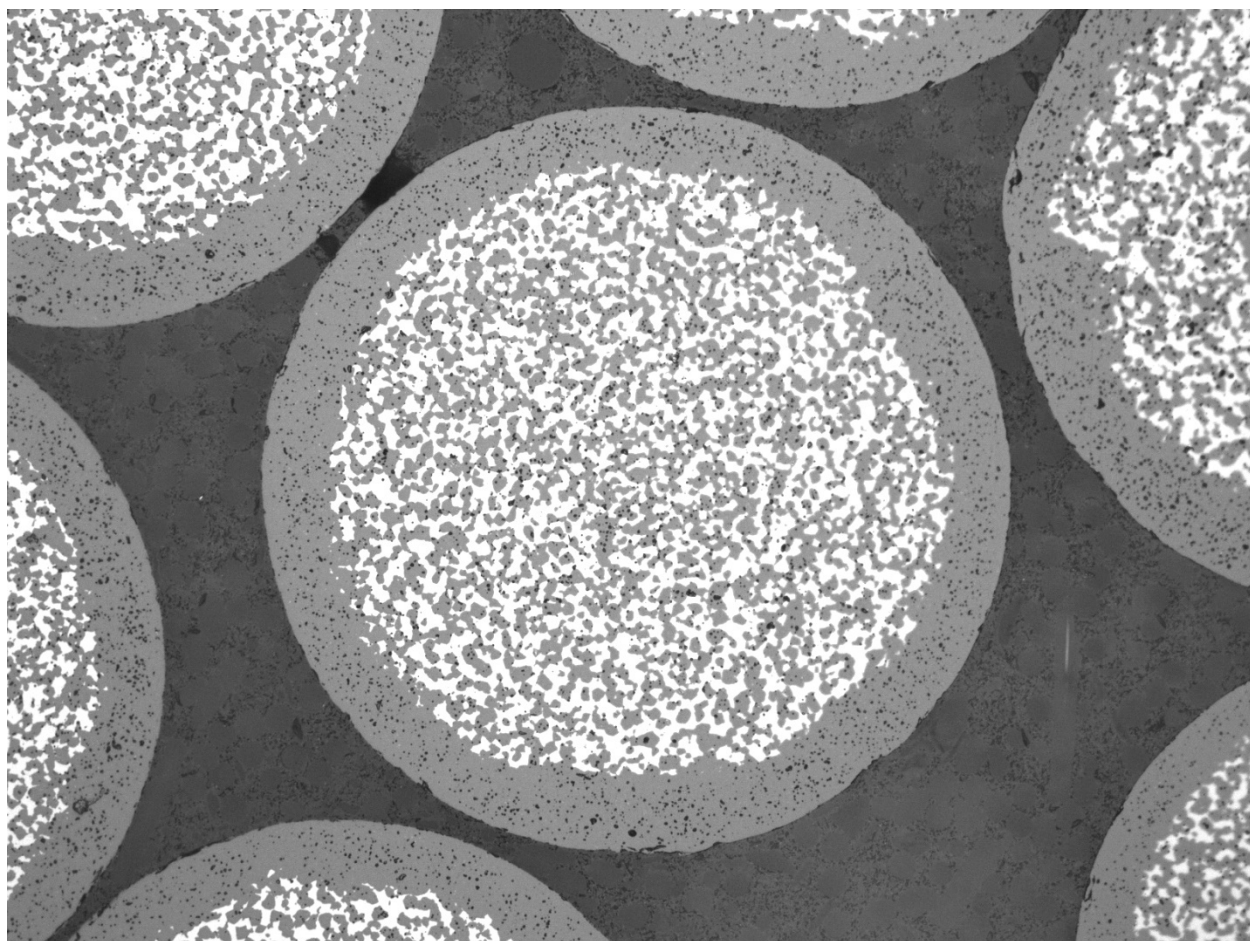
P17030905N045 segmented



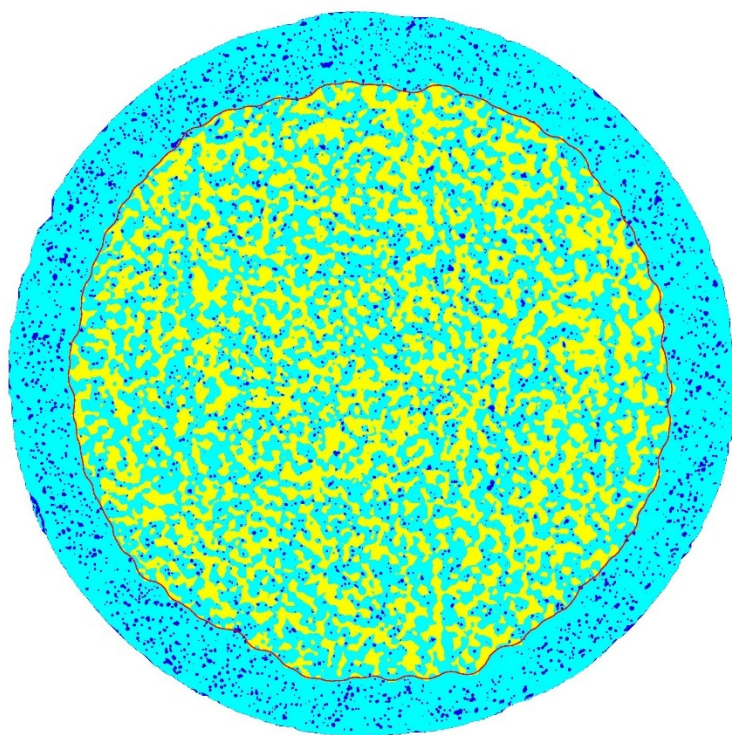
P17030905N045



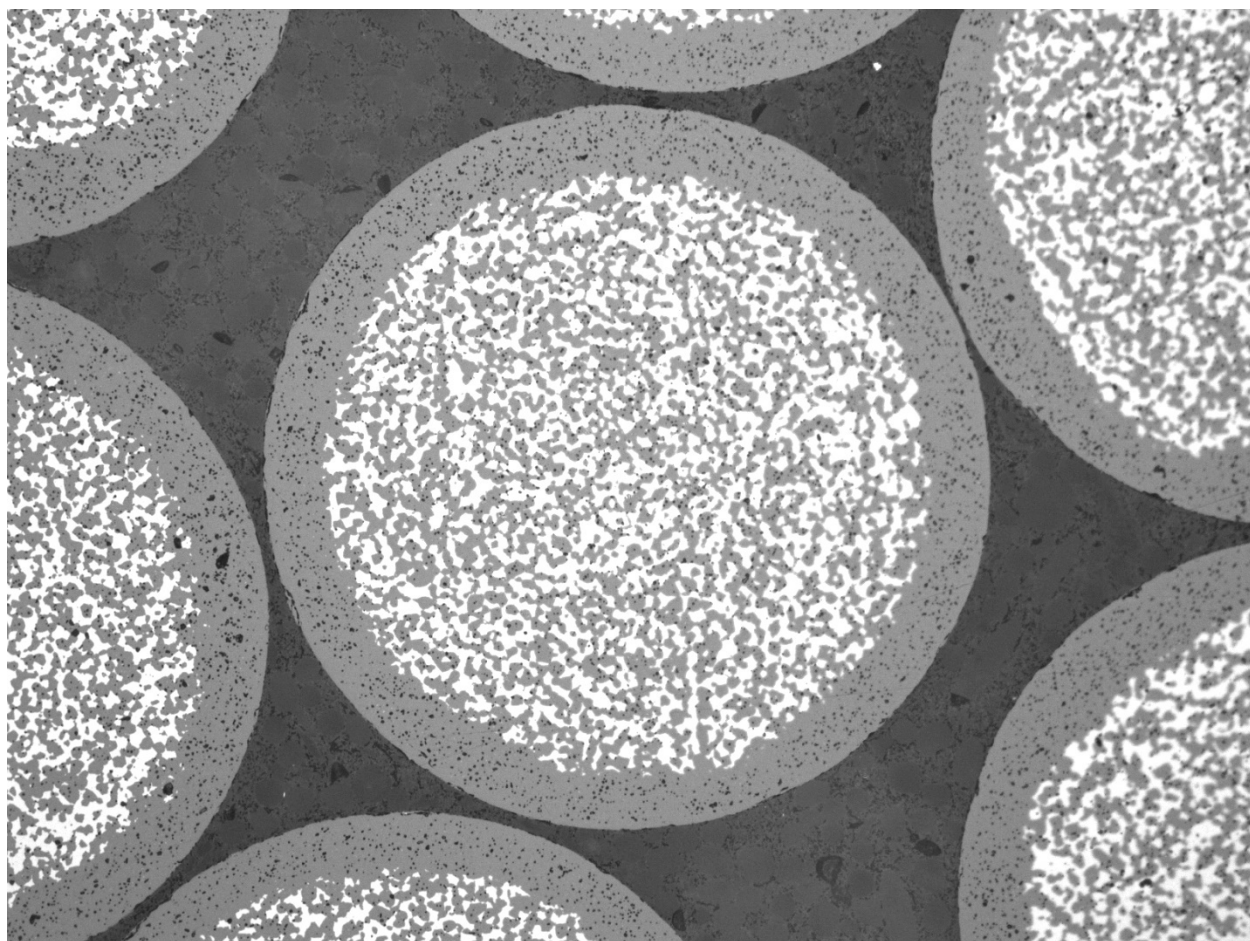
P17030905N046 segmented



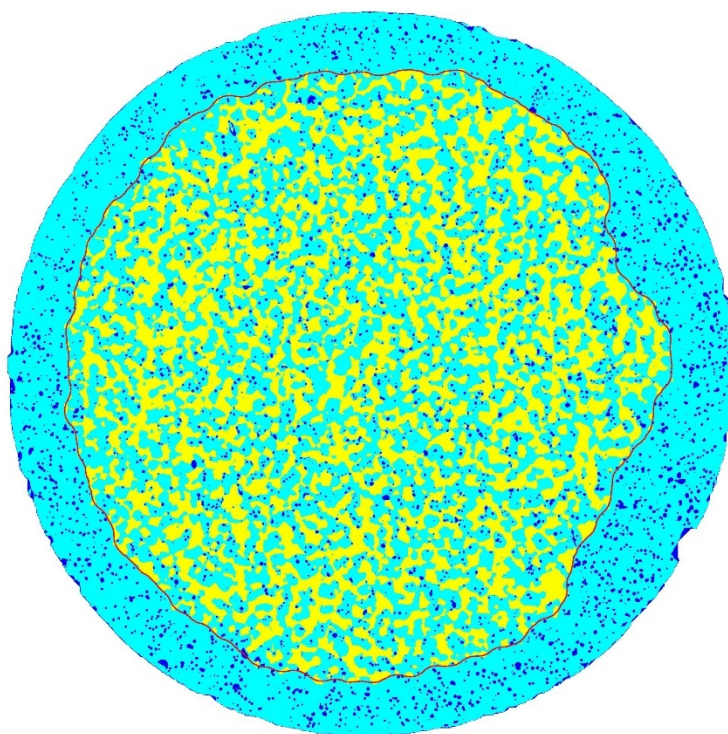
P17030905N046



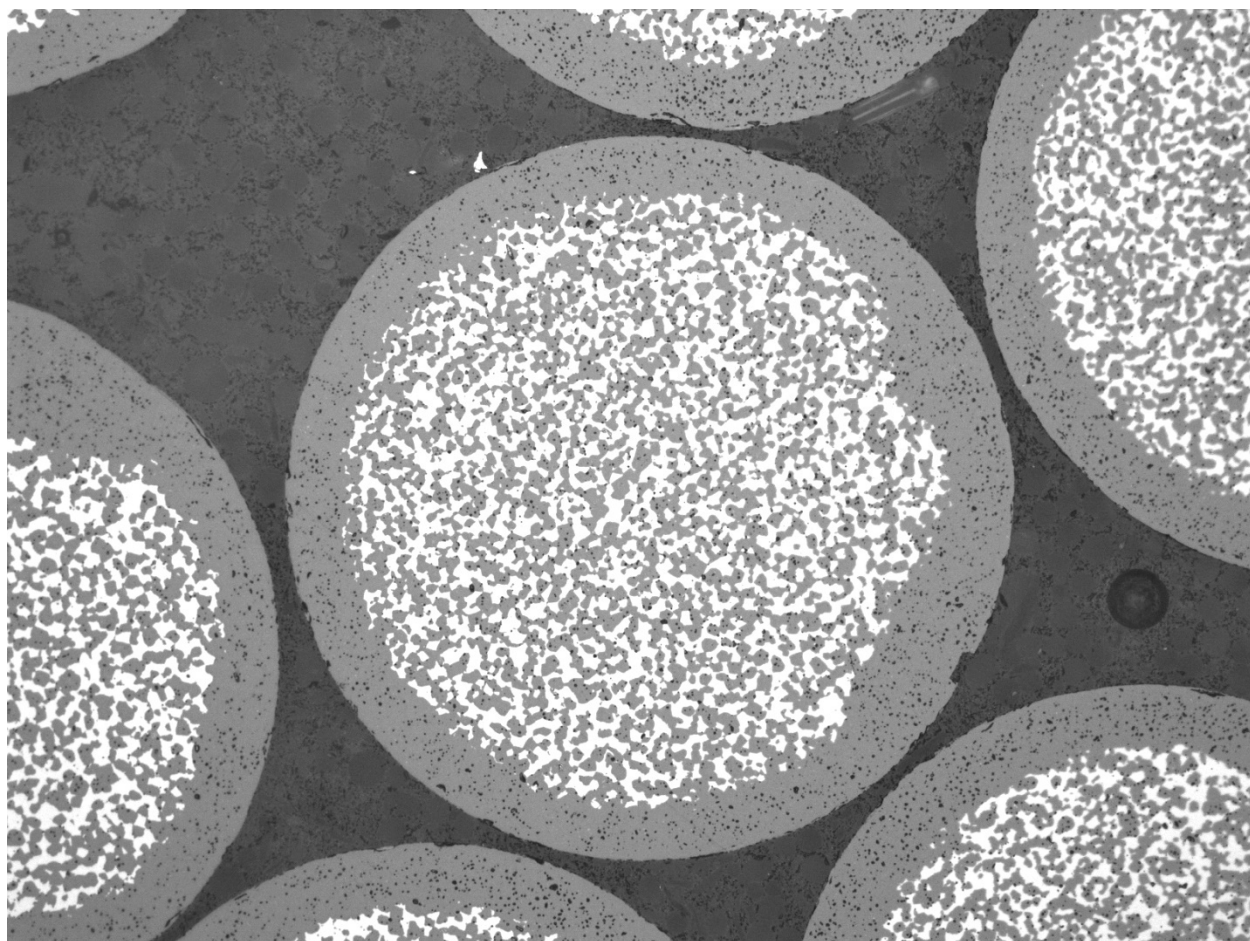
P17030905N047 segmented



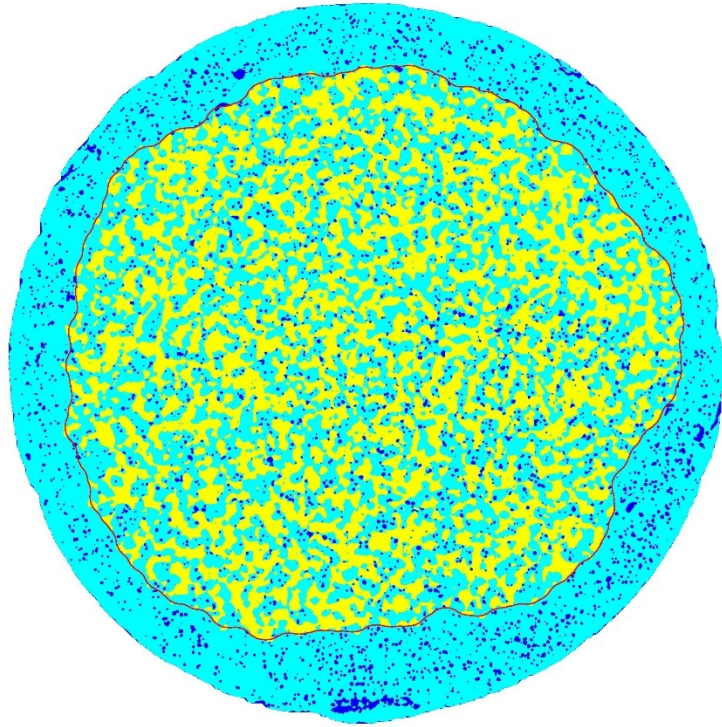
P17030905N047



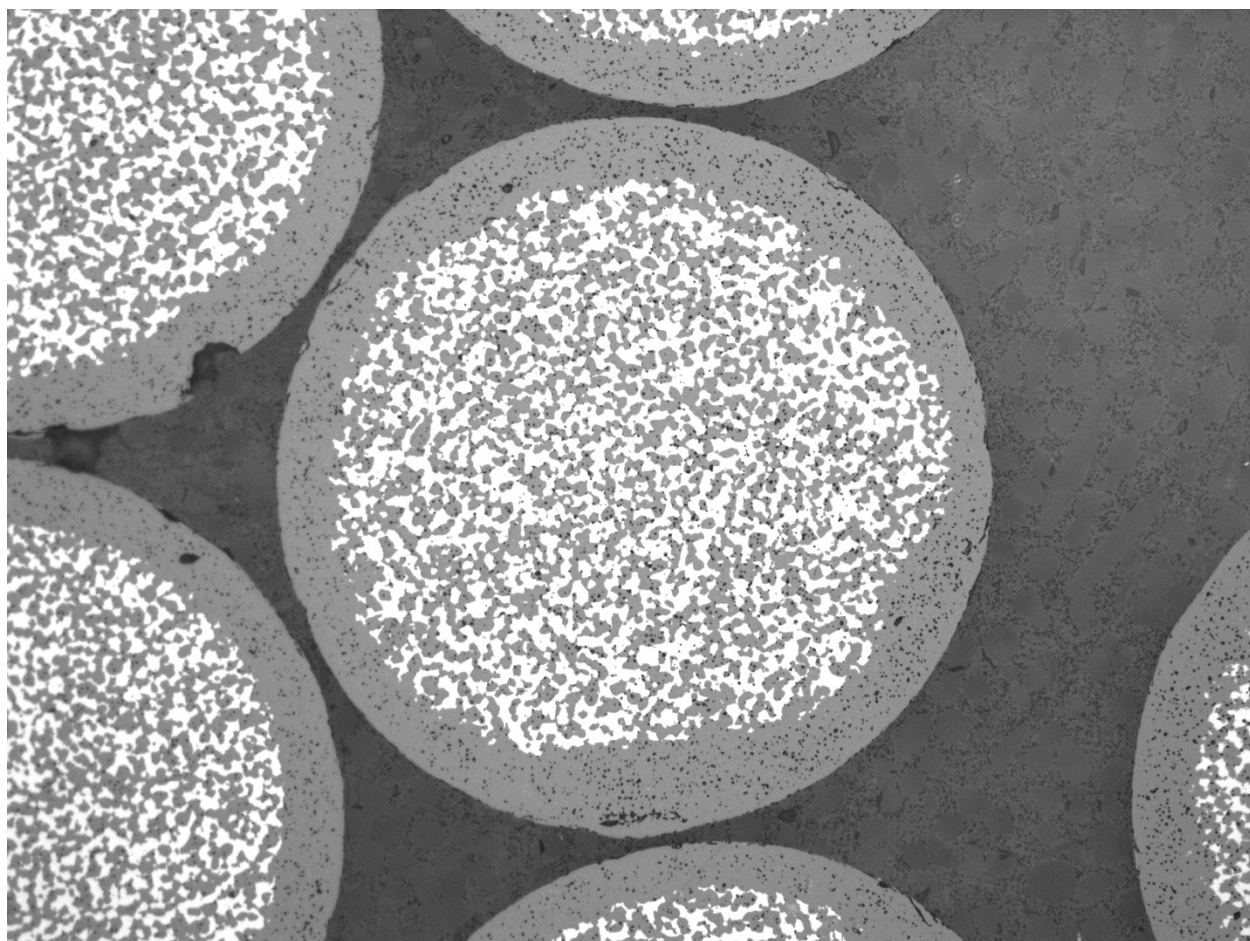
P17030905N048 segmented



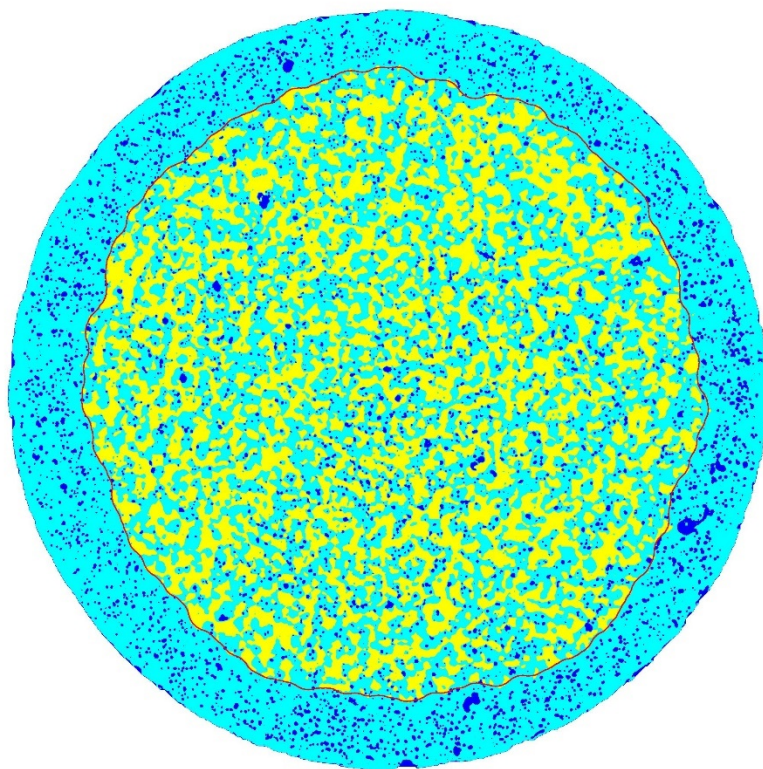
P17030905N048



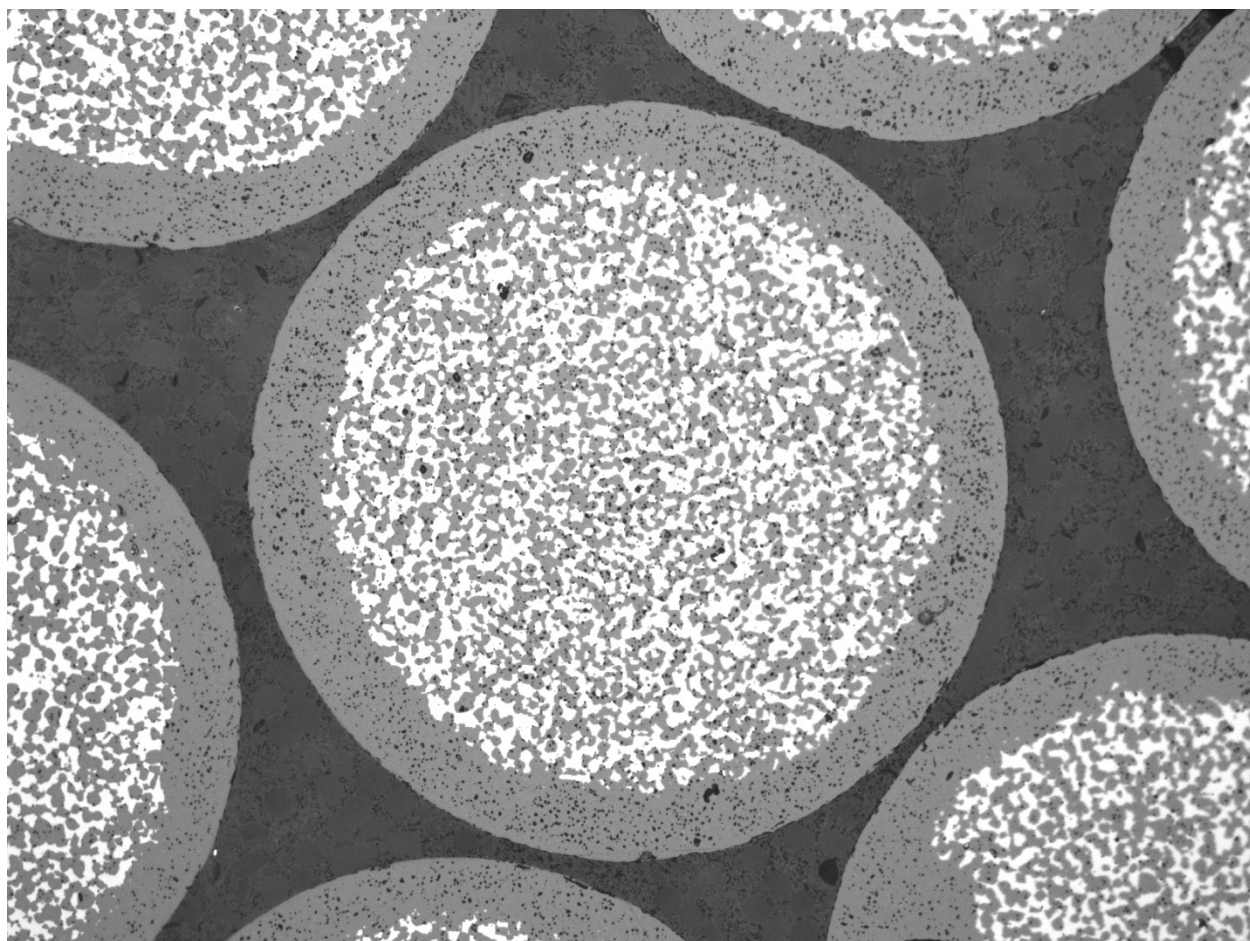
P17030905N050 segmented



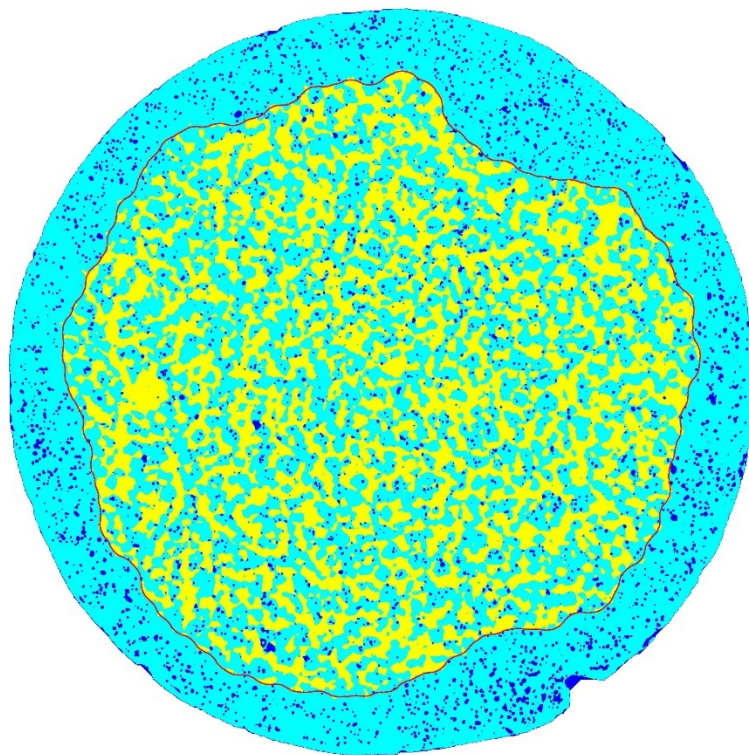
P17030905N050



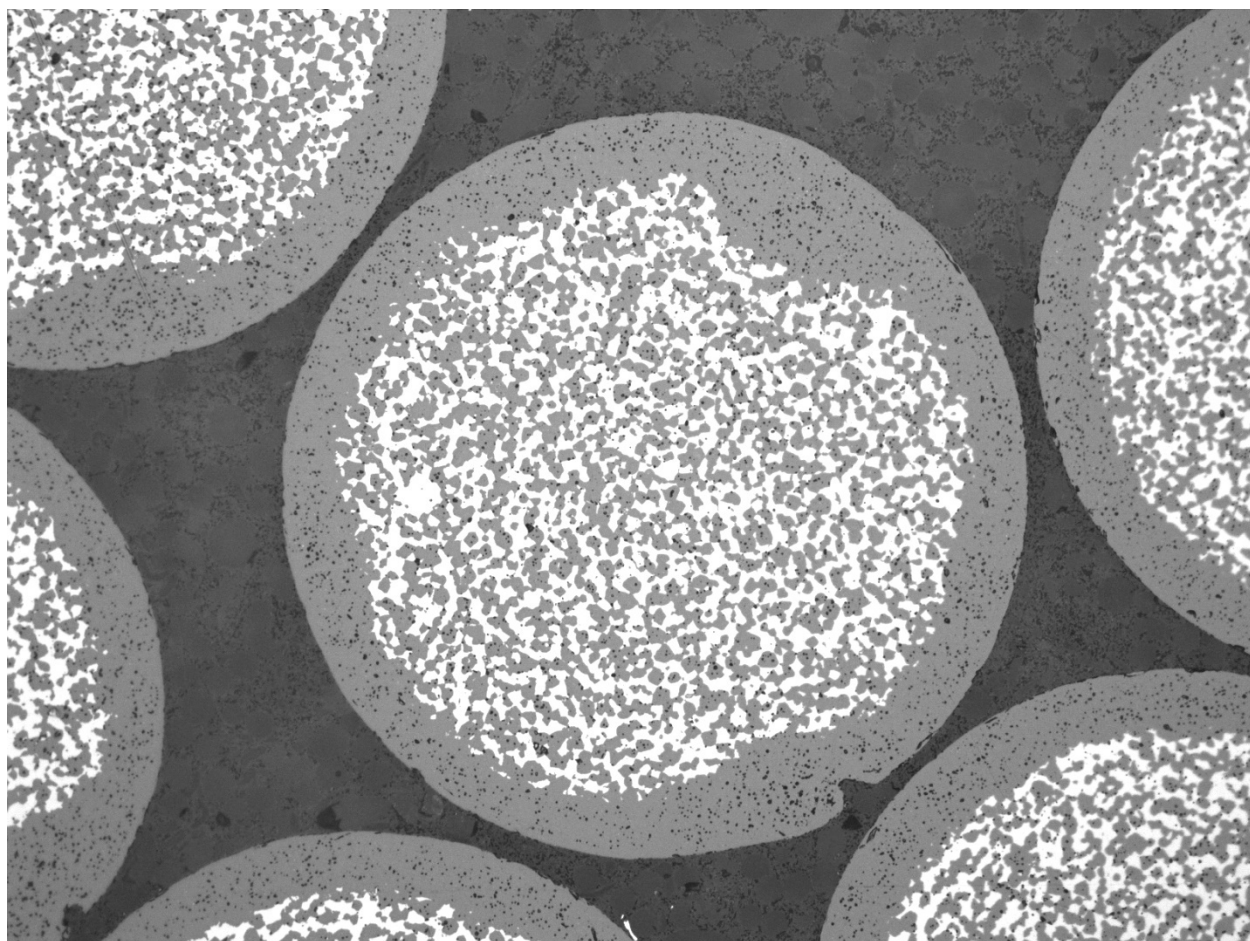
P17030905N051 segmented



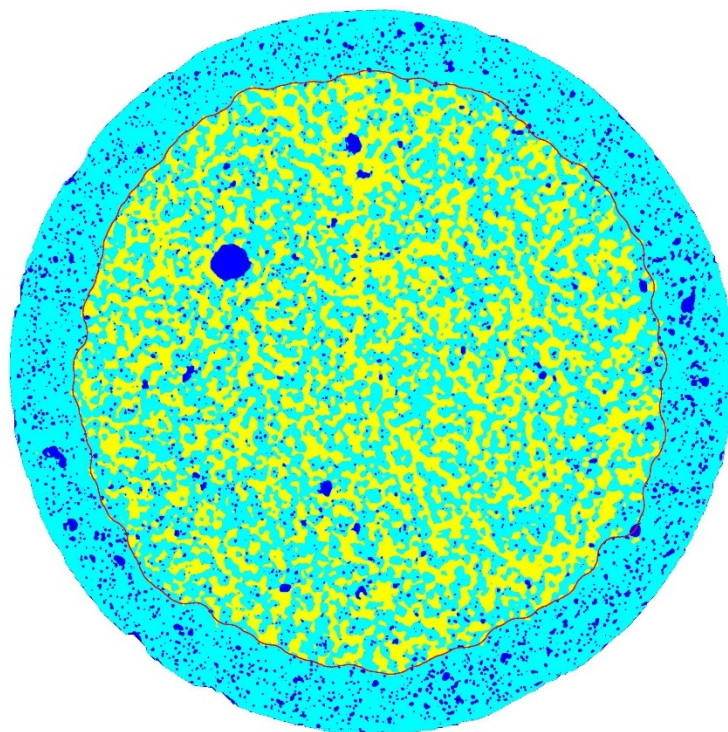
P17030905N051



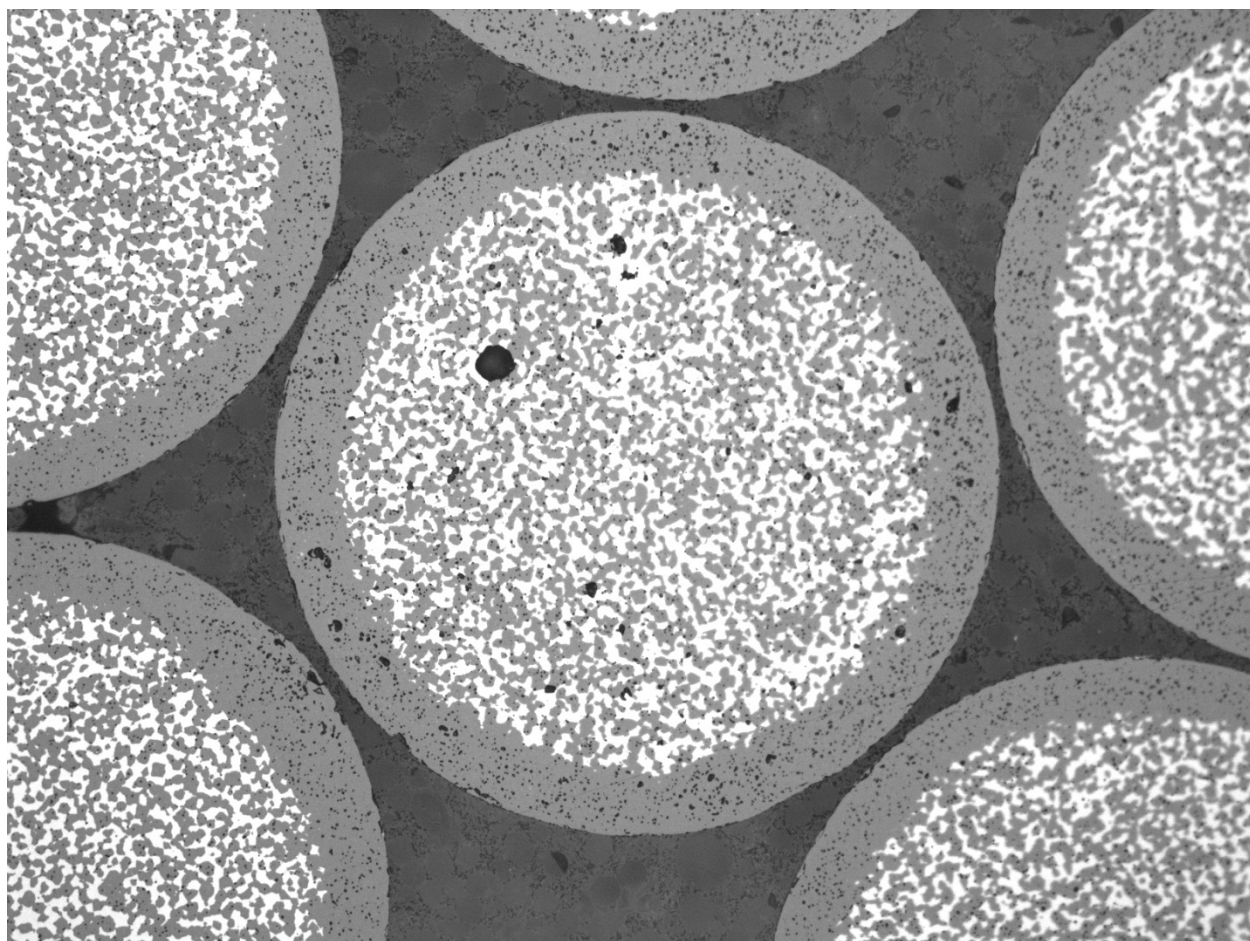
P17030905N052 segmented



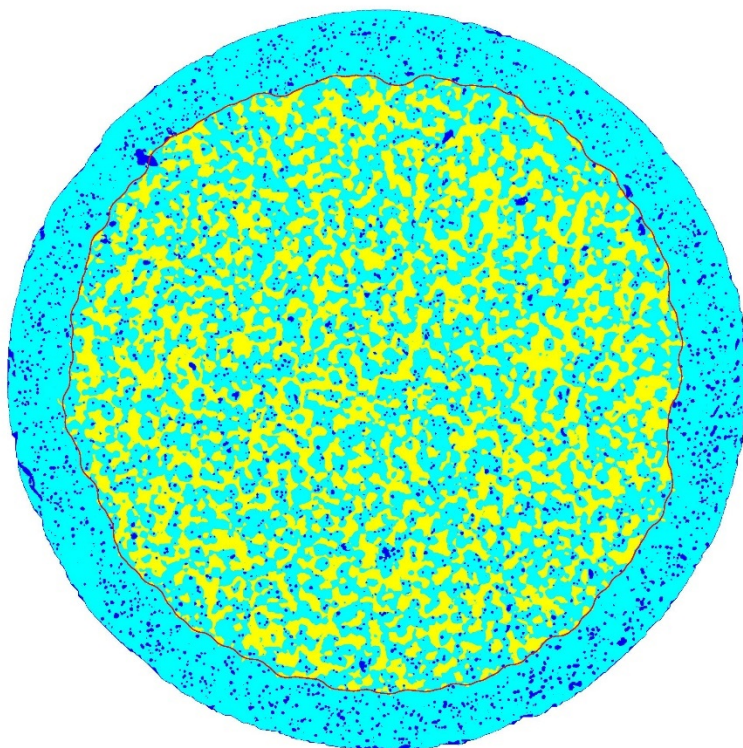
P17030905N052



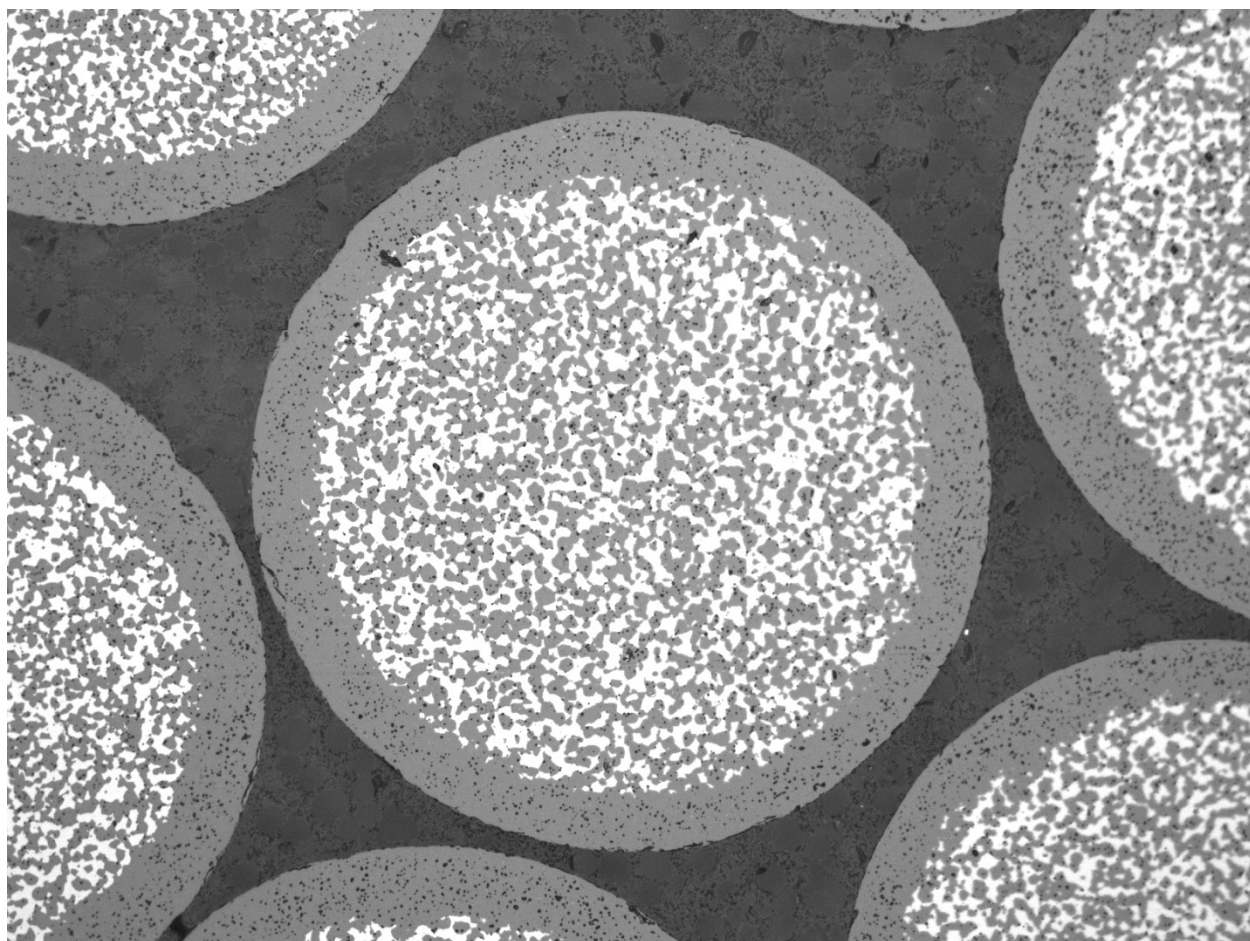
P17030905N054 segmented



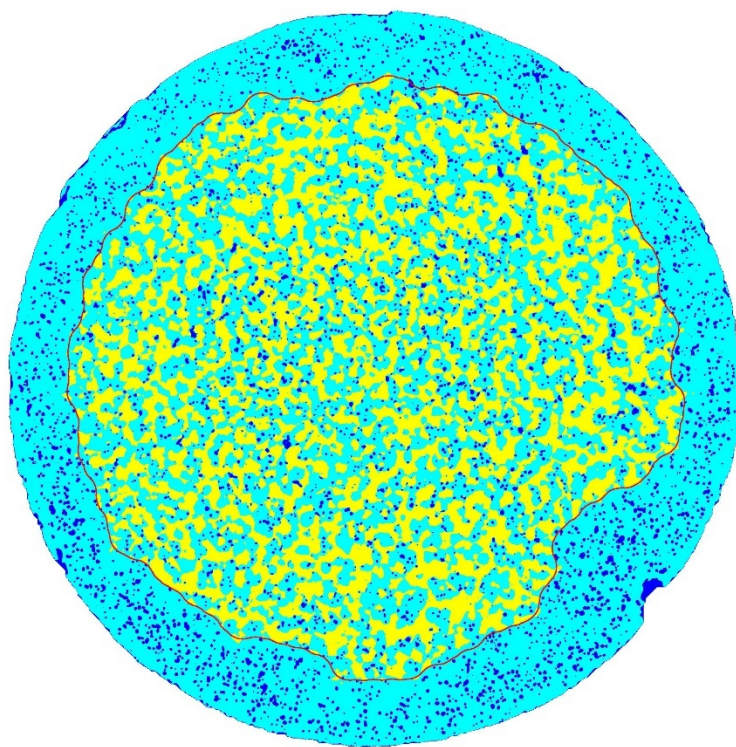
P17030905N054



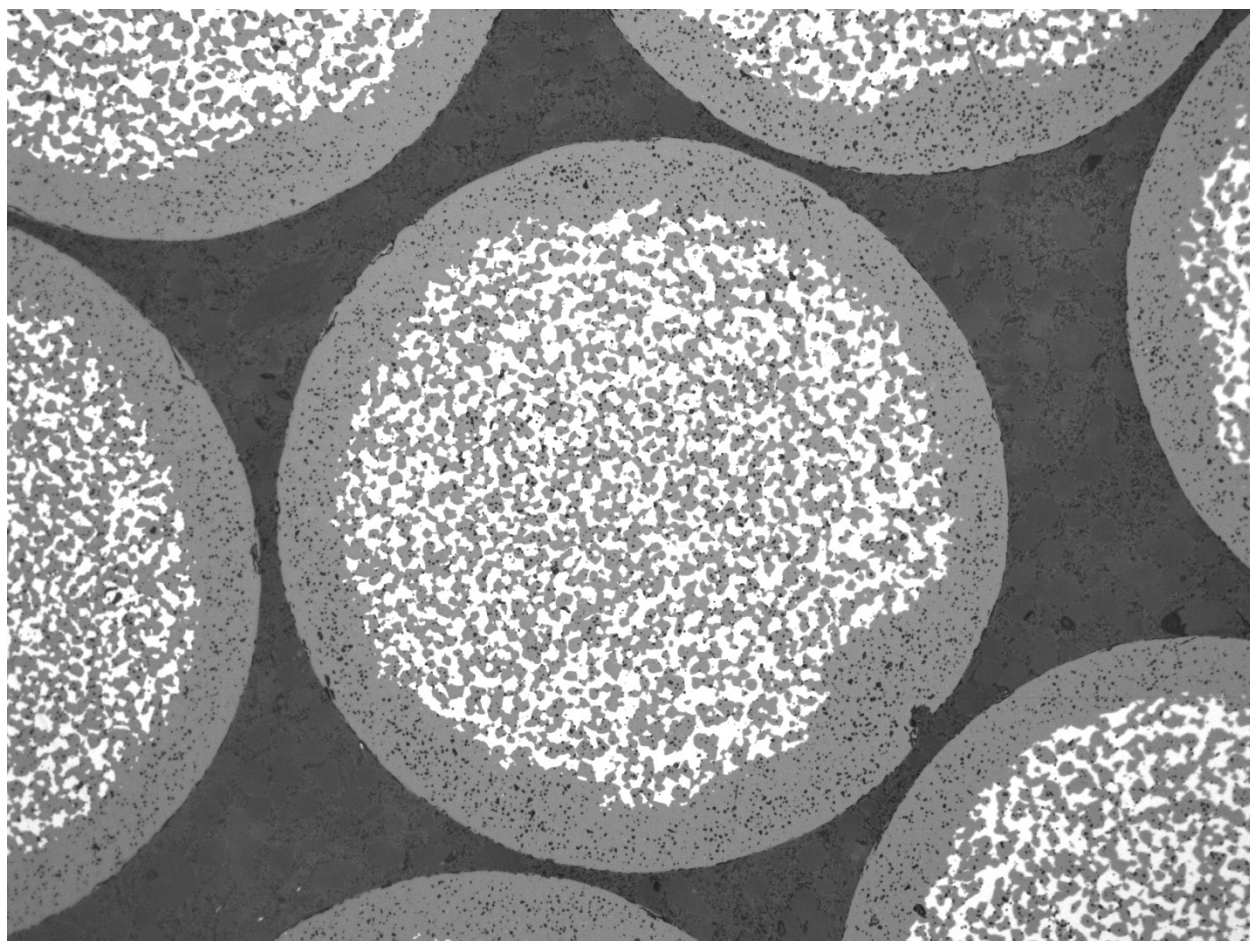
P17030905N055 segmented



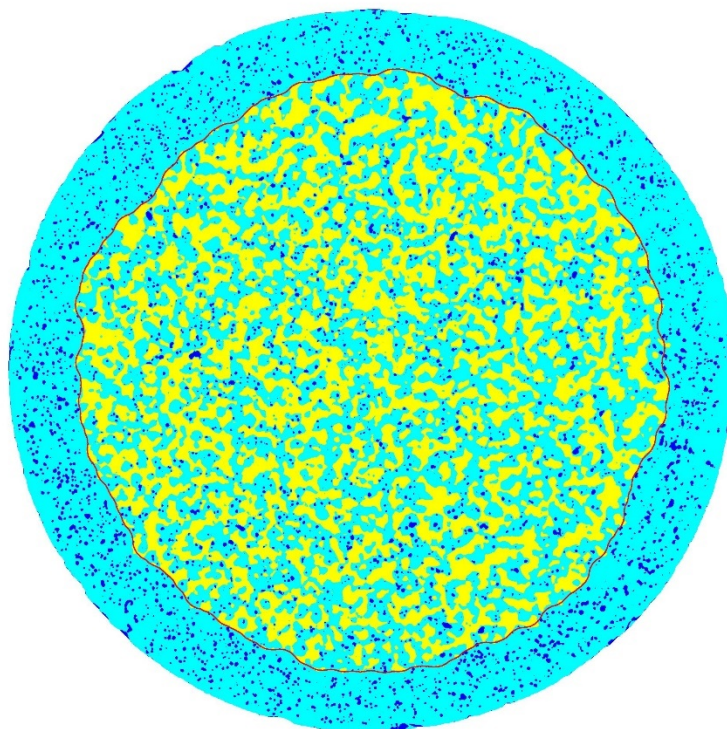
P17030905N055



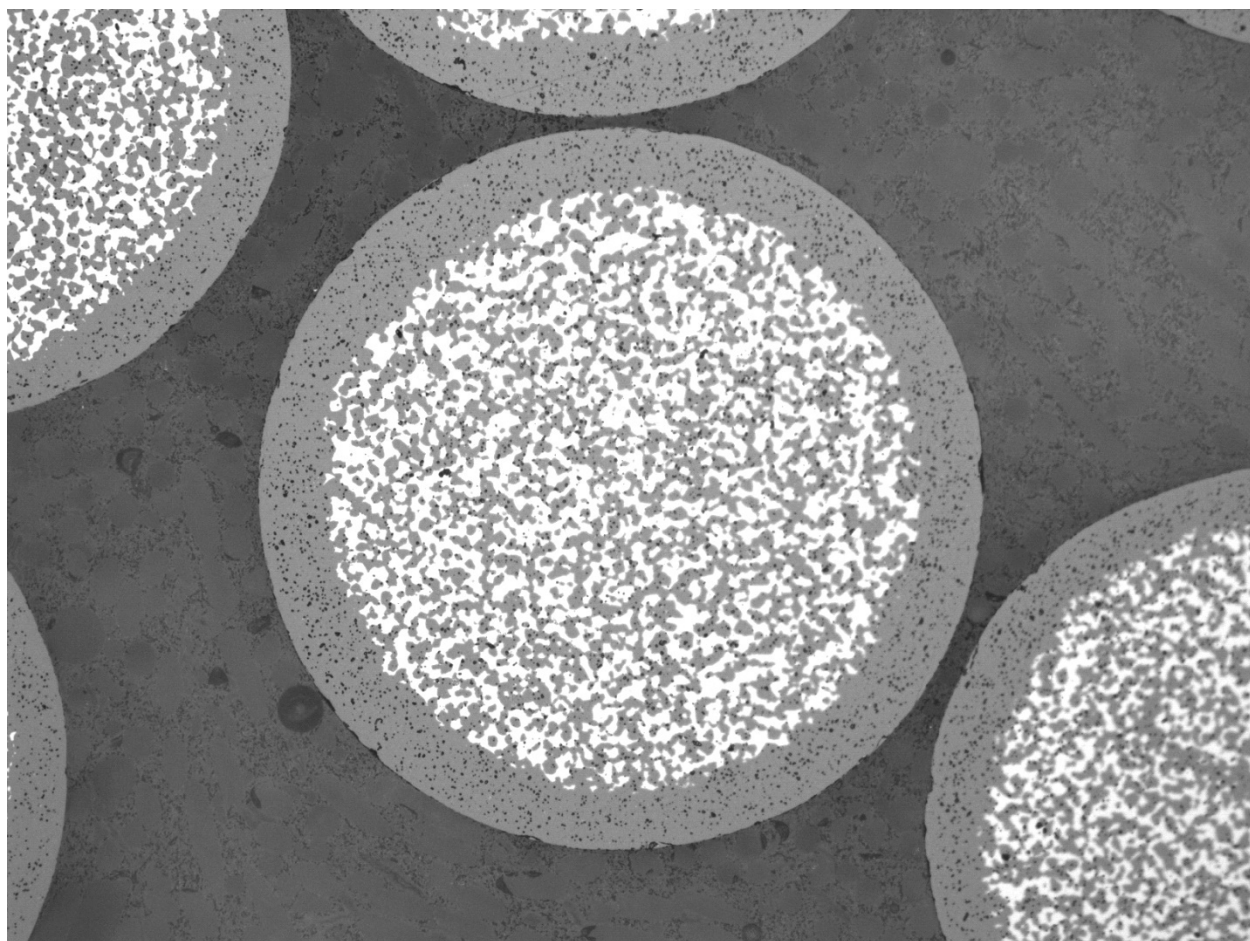
P17030905N056 segmented



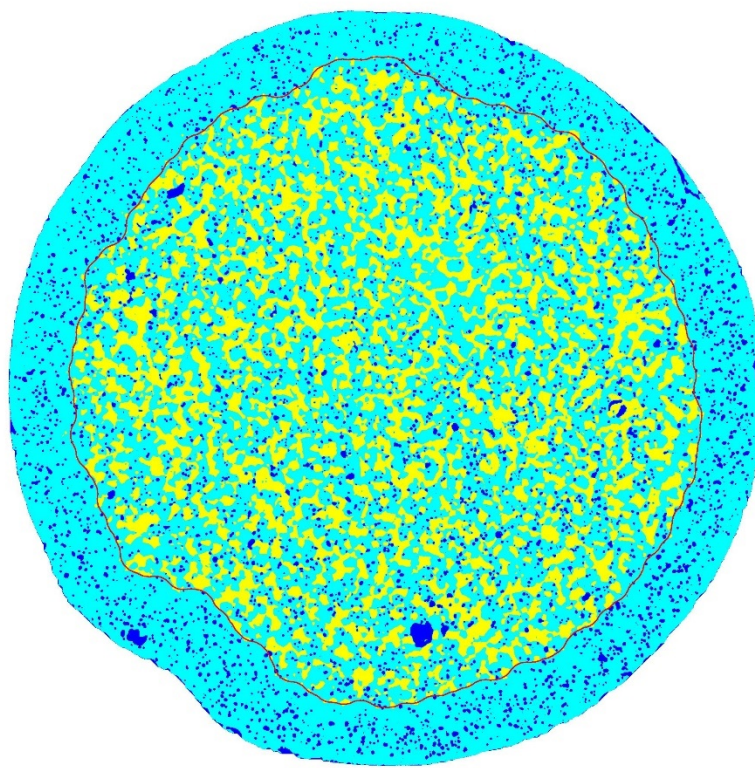
P17030905N056



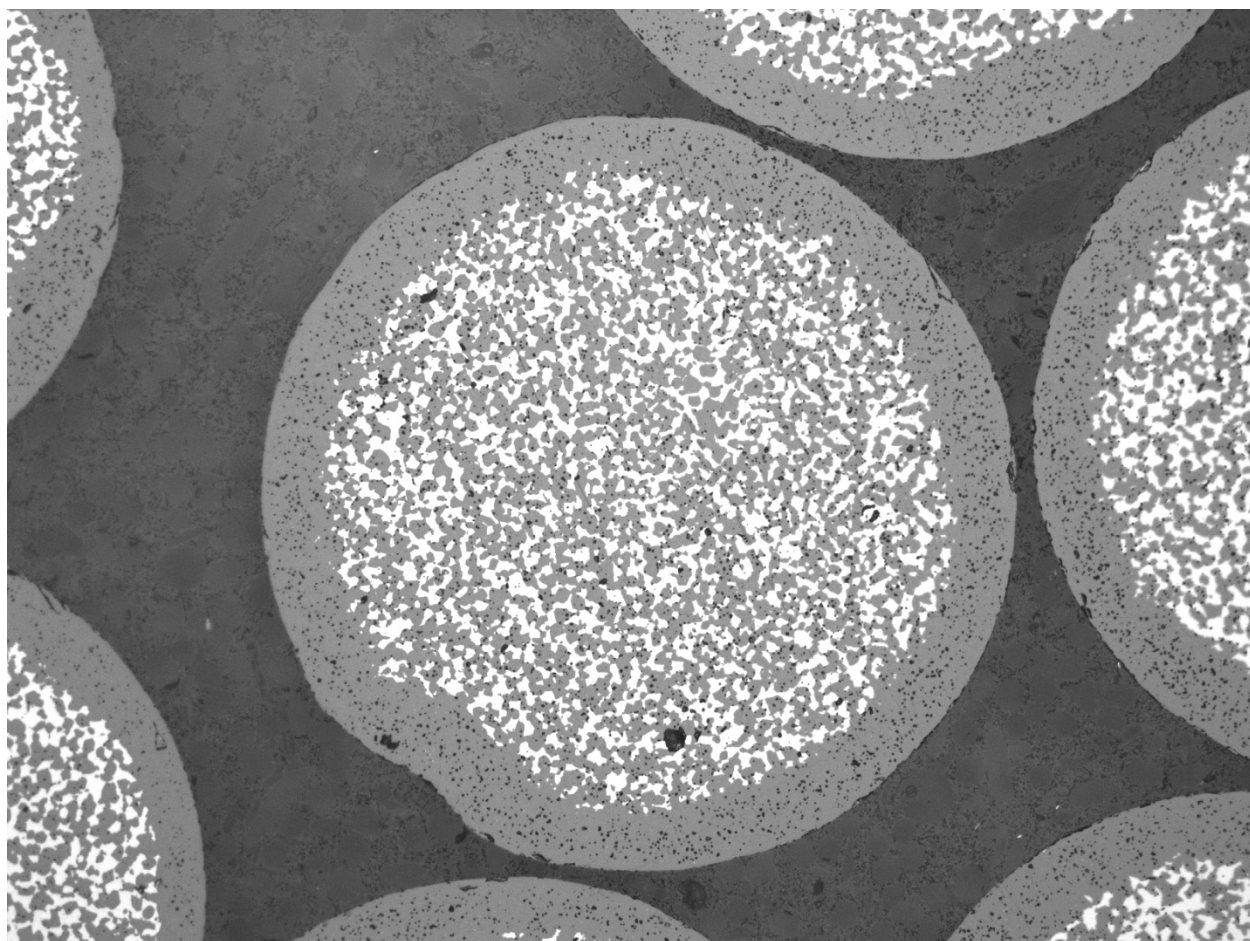
P17030905N058 segmented



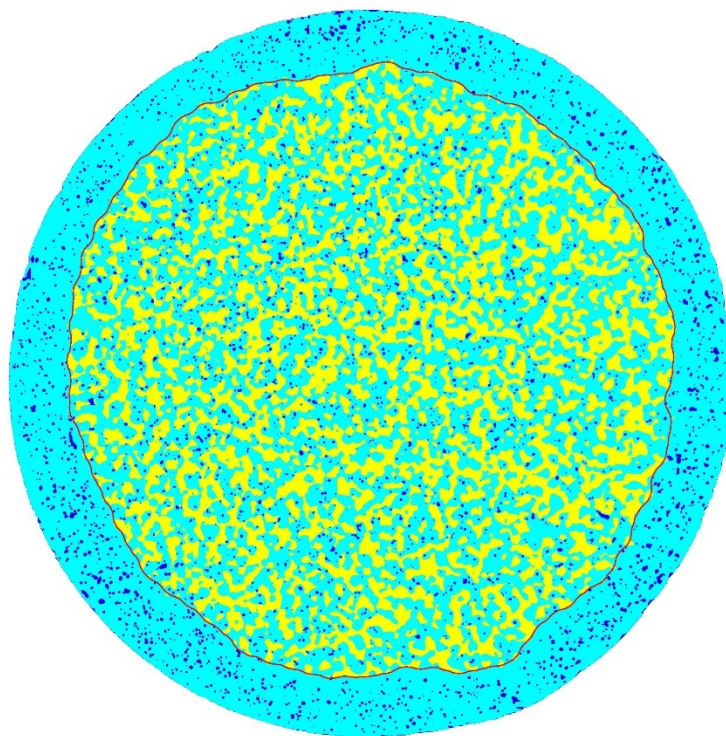
P17030905N058



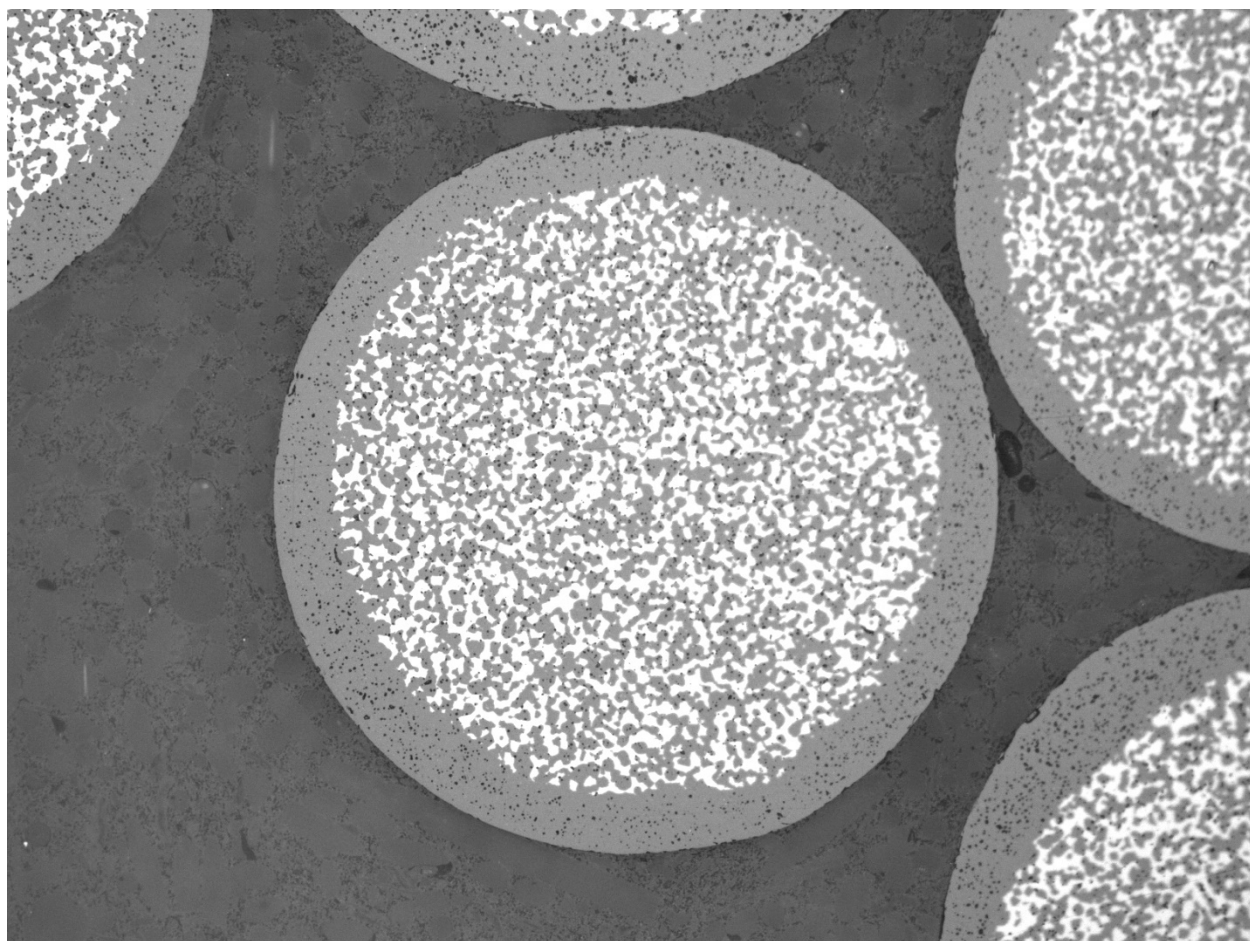
P17030905N059 segmented



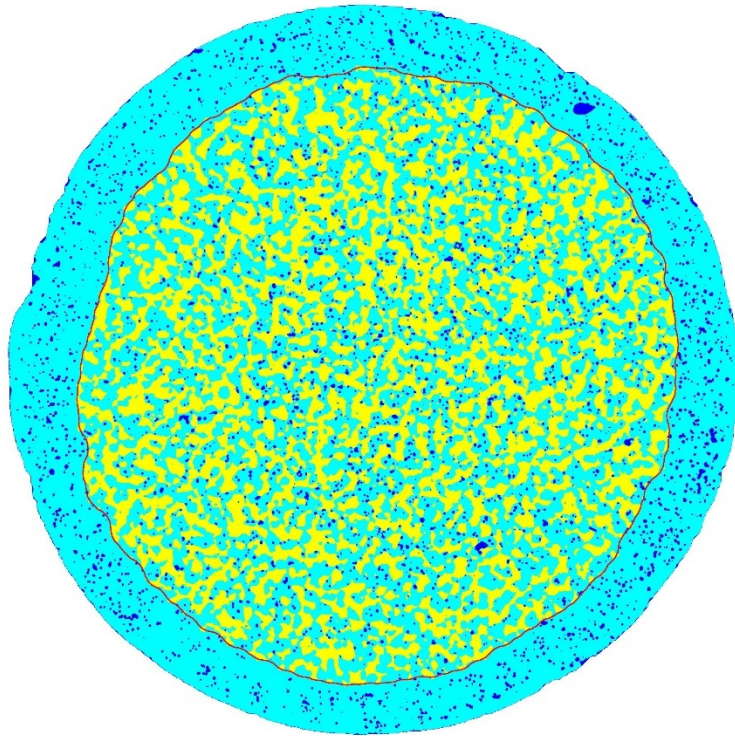
P17030905N059



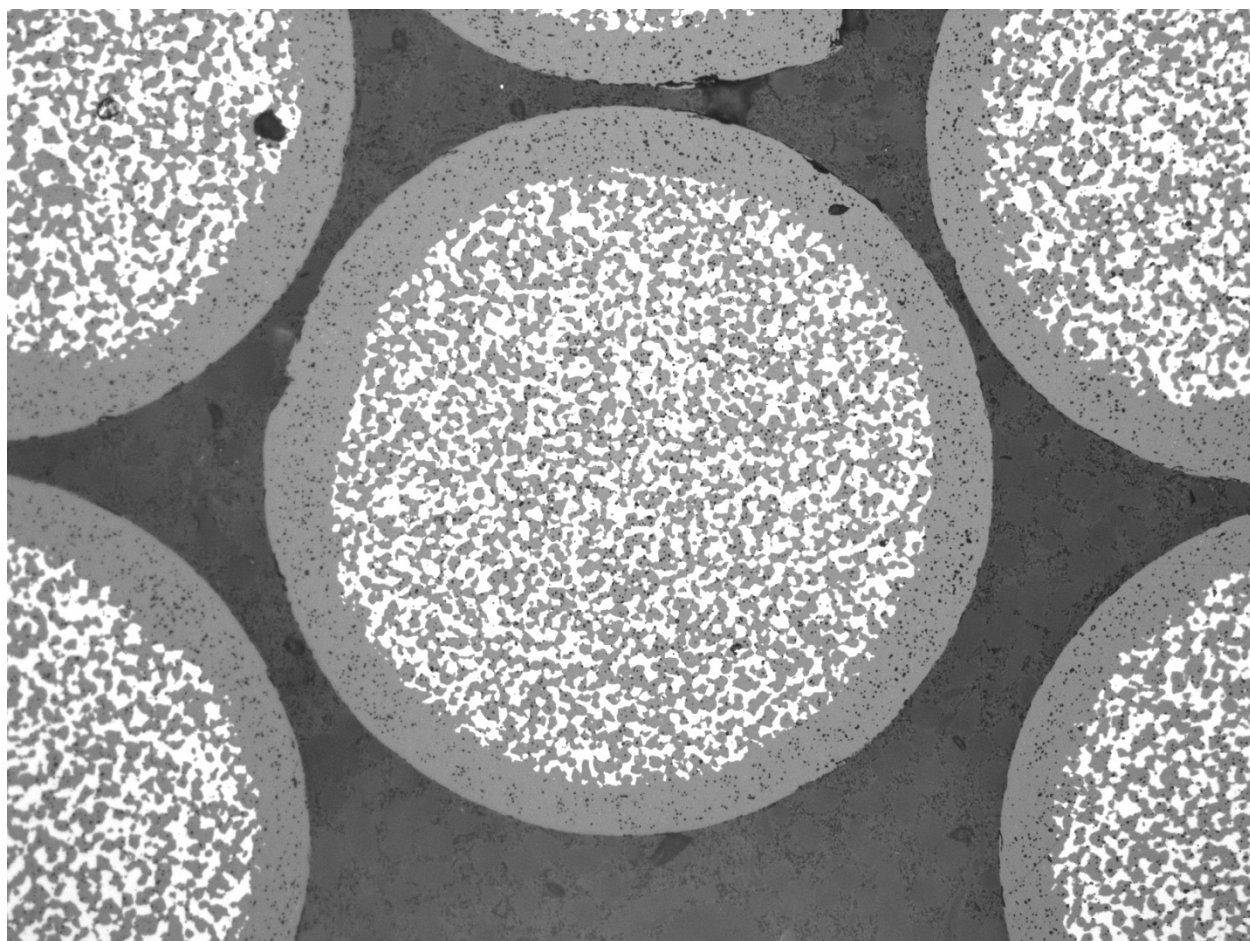
P17030905N060 segmented



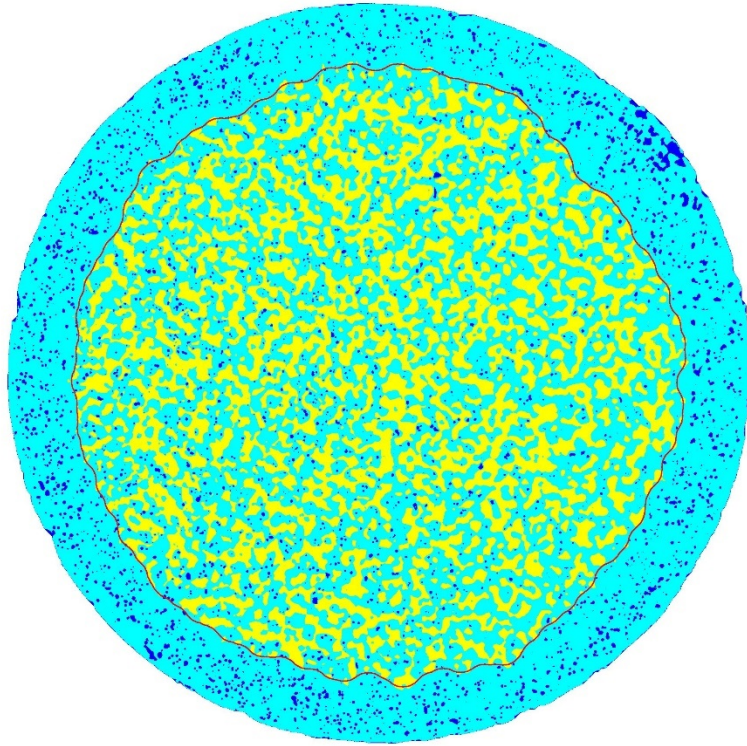
P17030905N060



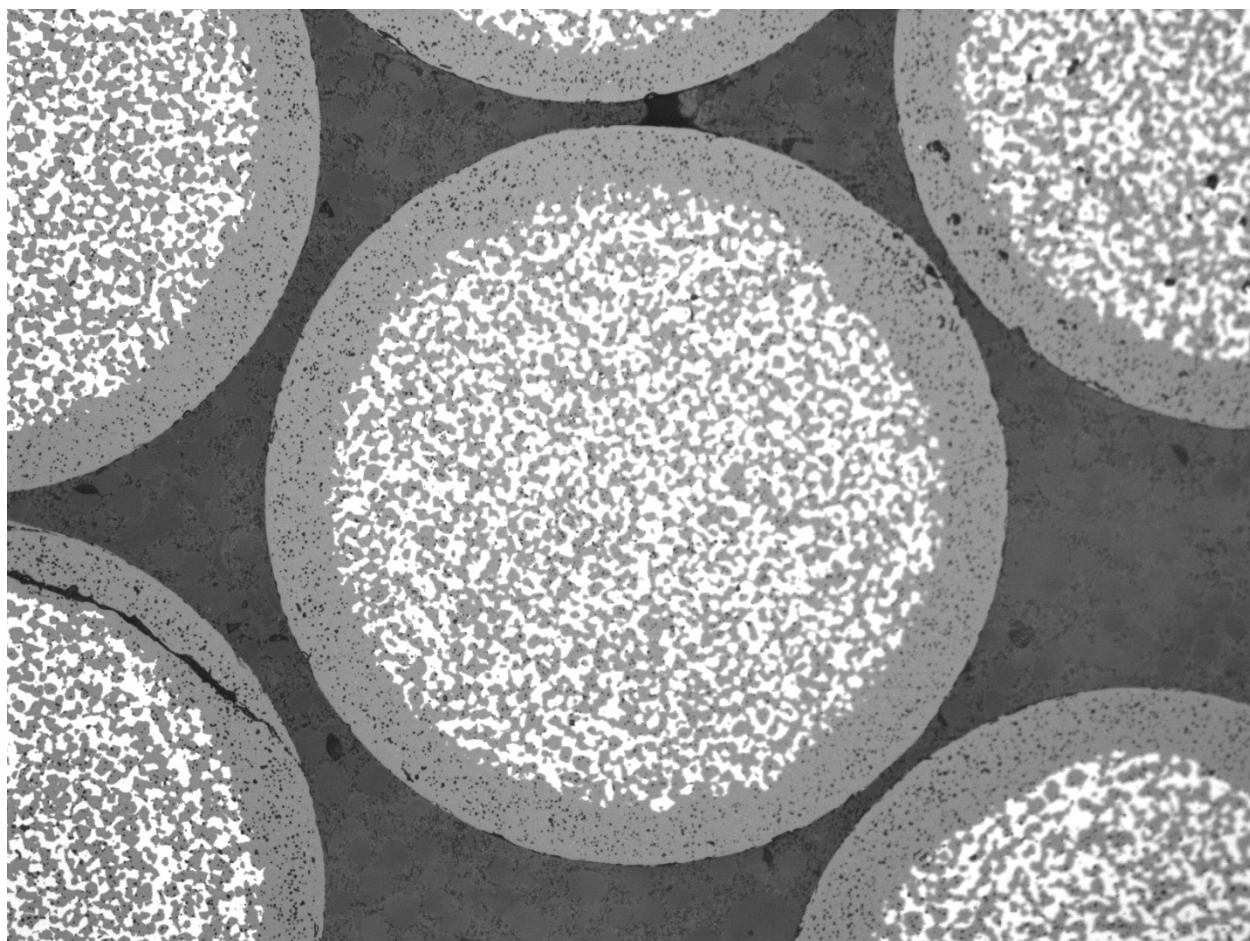
P17030905N061 segmented



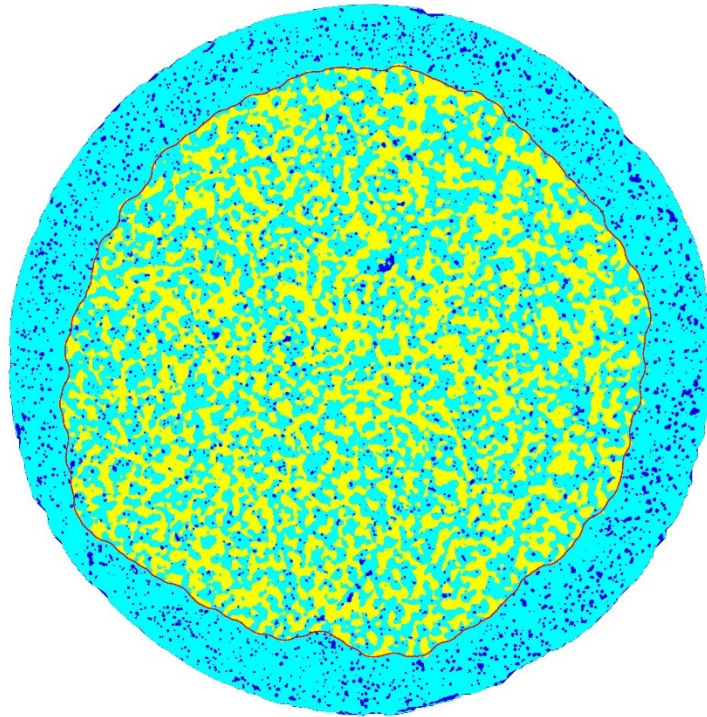
P17030905N061



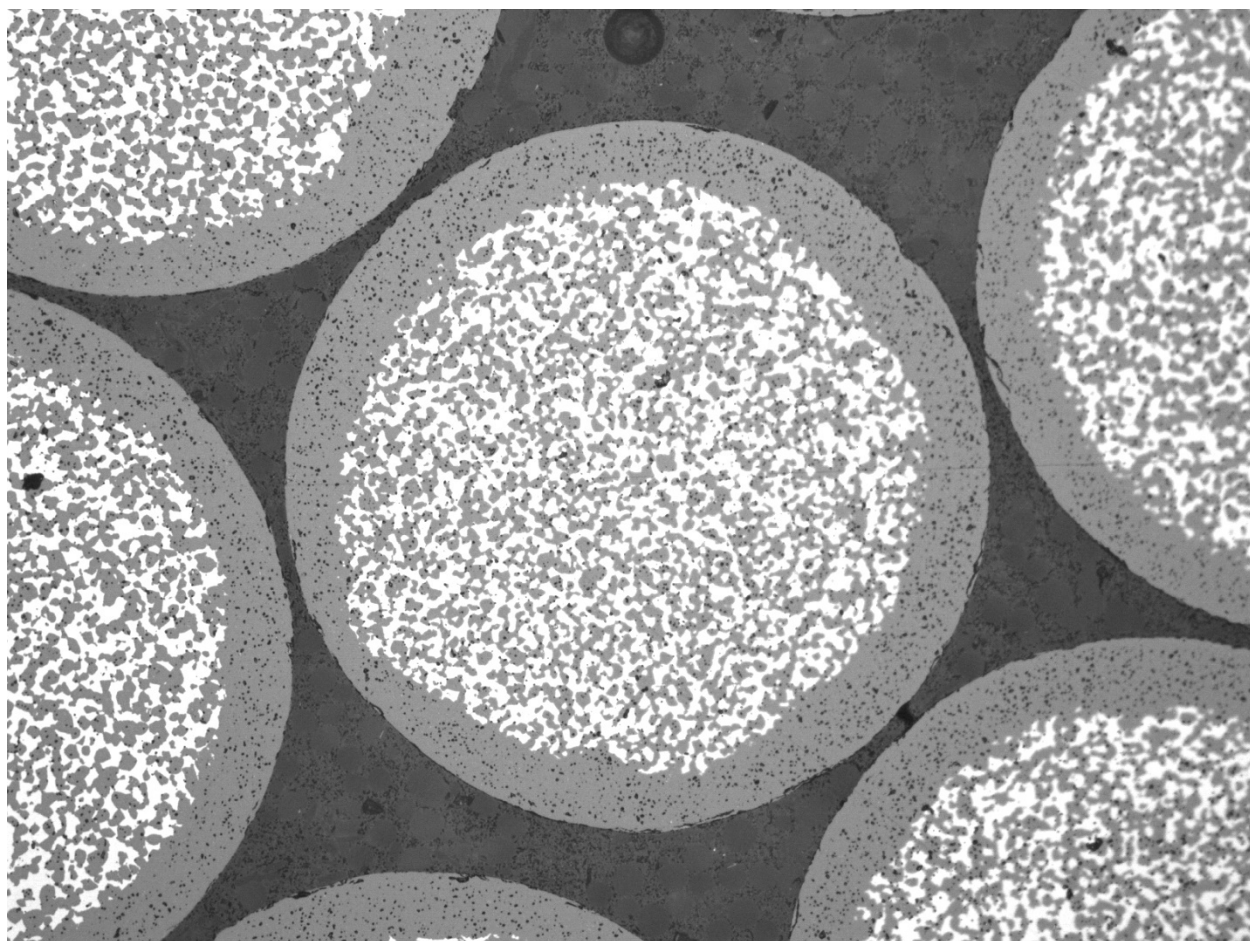
P17030905N062 segmented



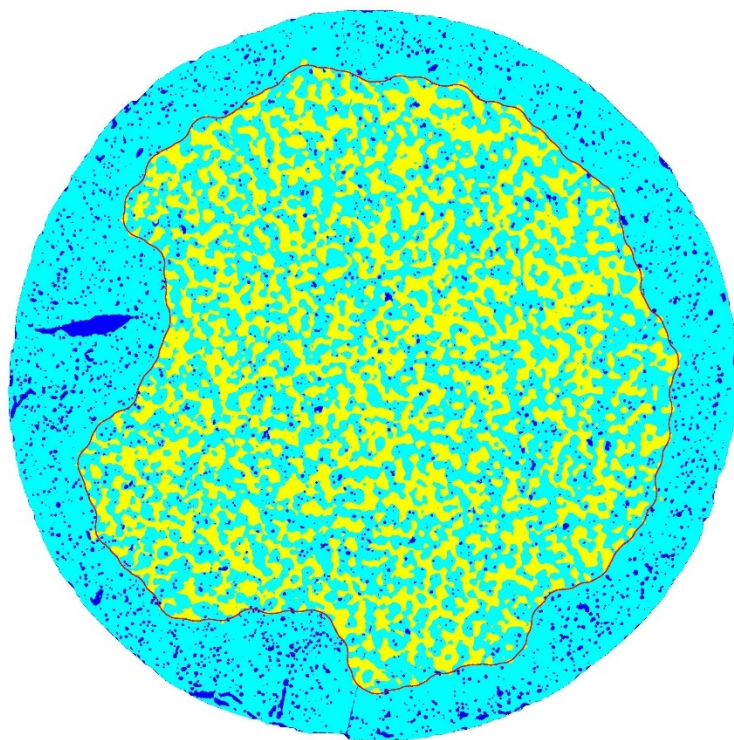
P17030905N062



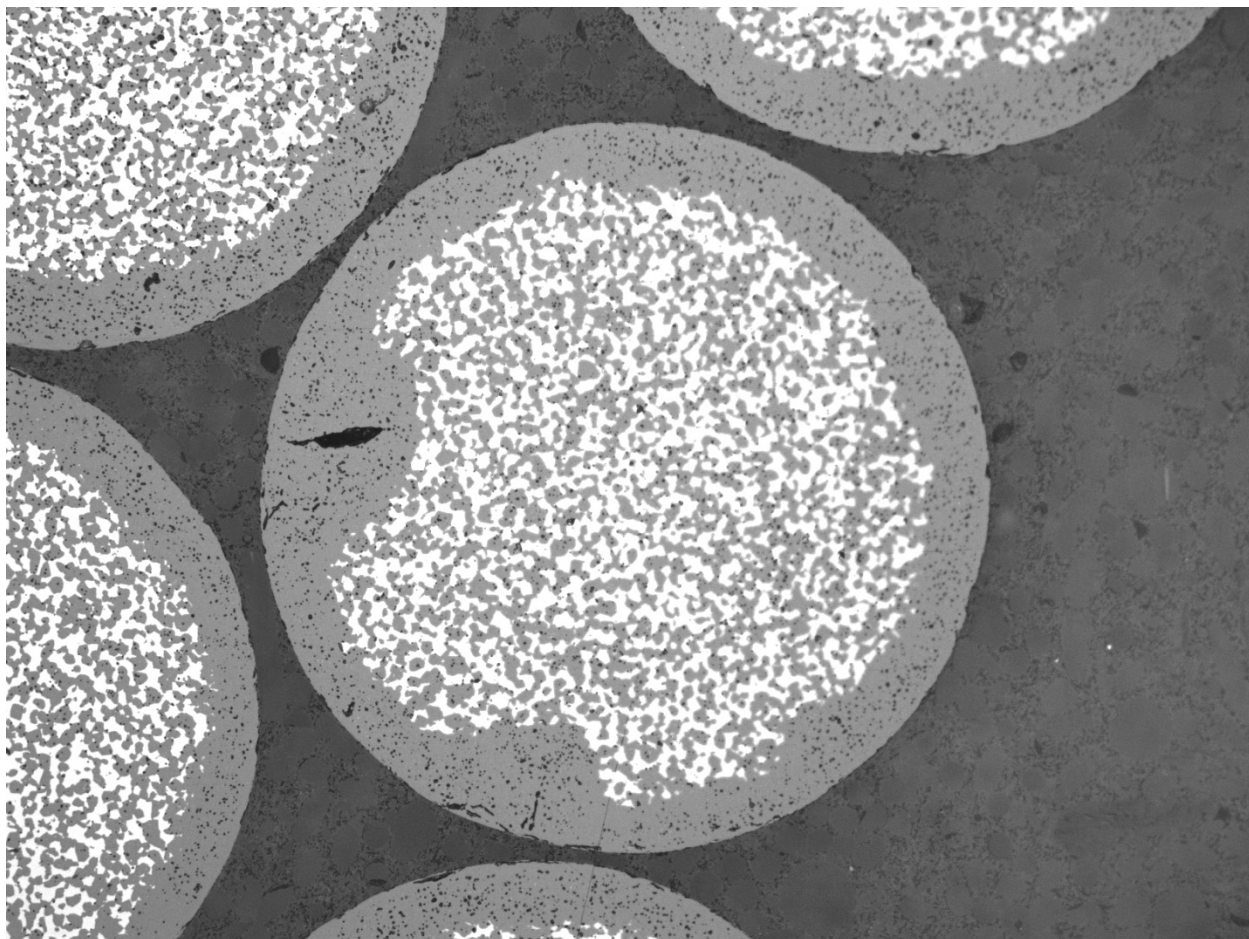
P17030905N063 segmented



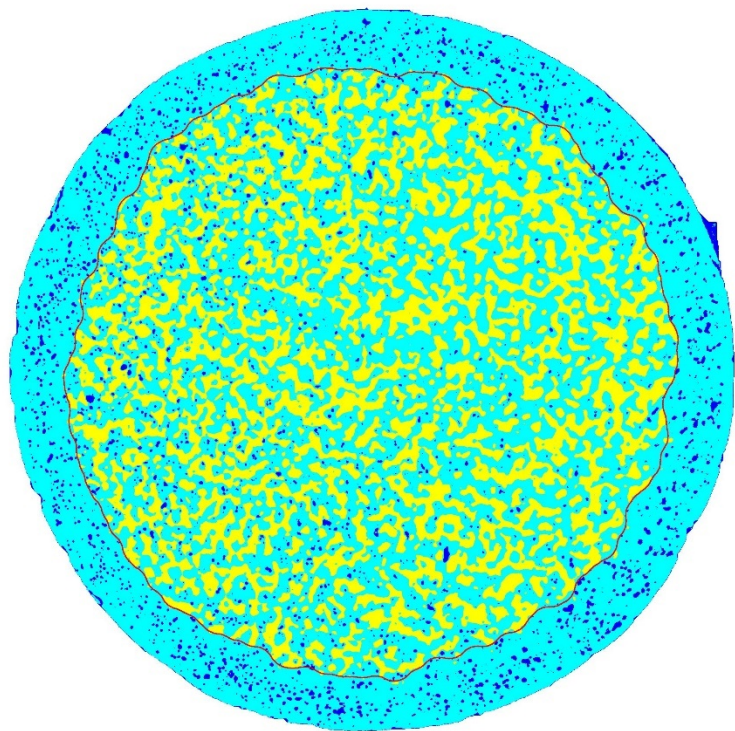
P17030905N063



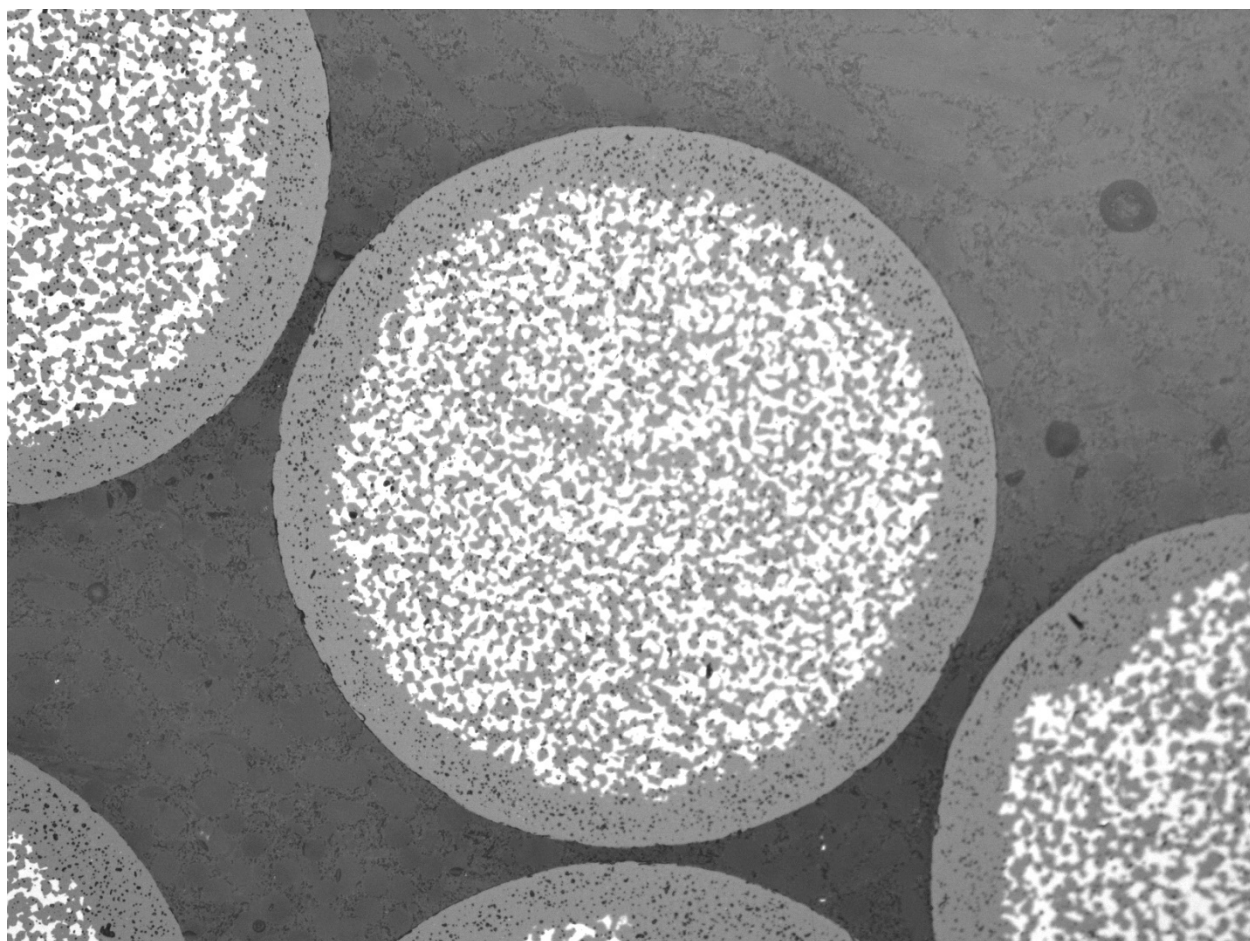
P17030905N064 segmented



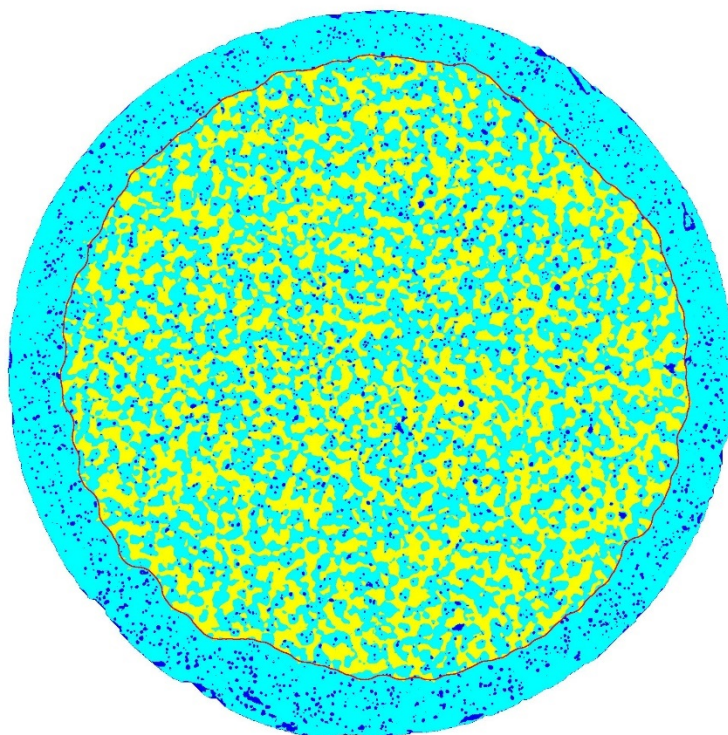
P17030905N064



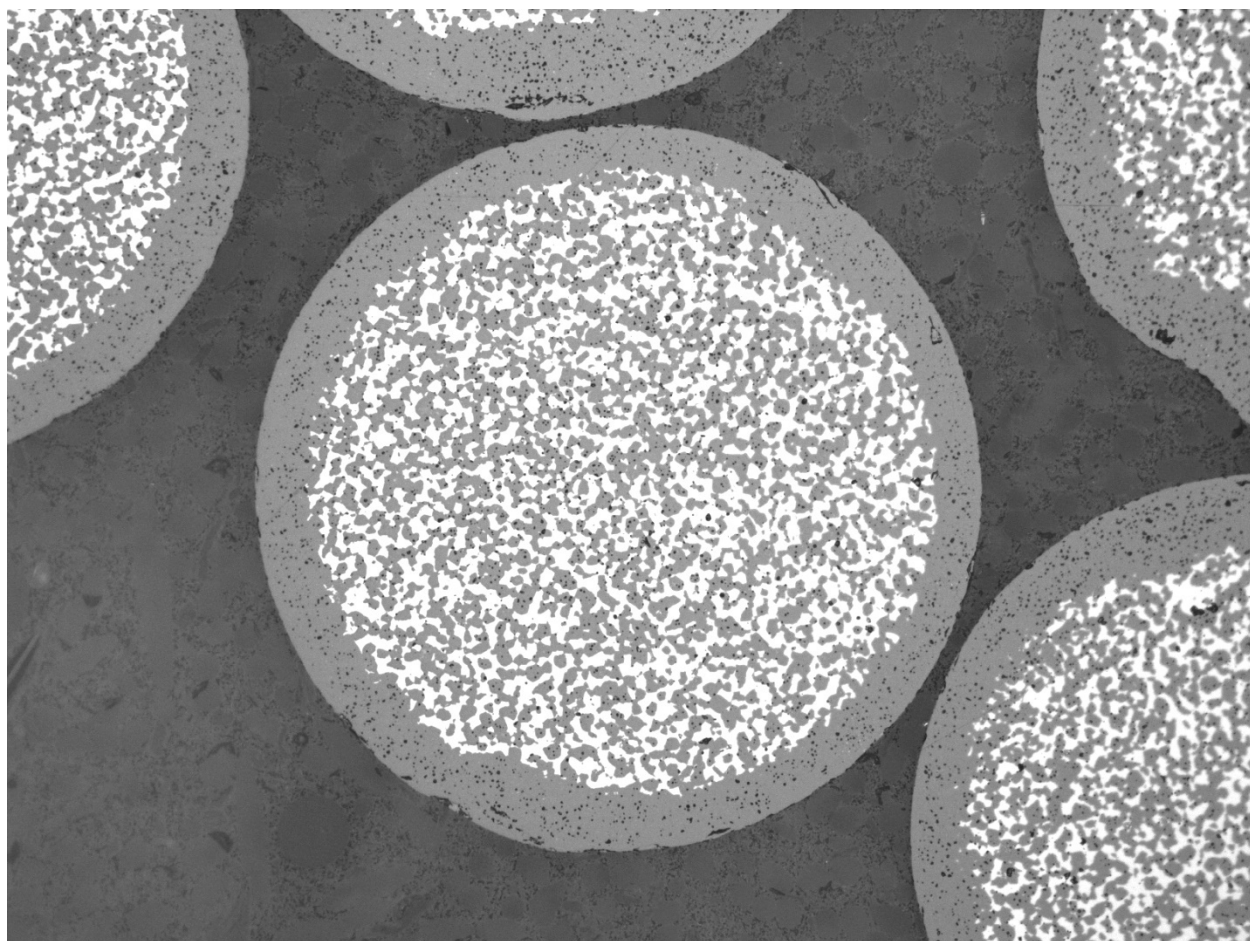
P17030905N066 segmented



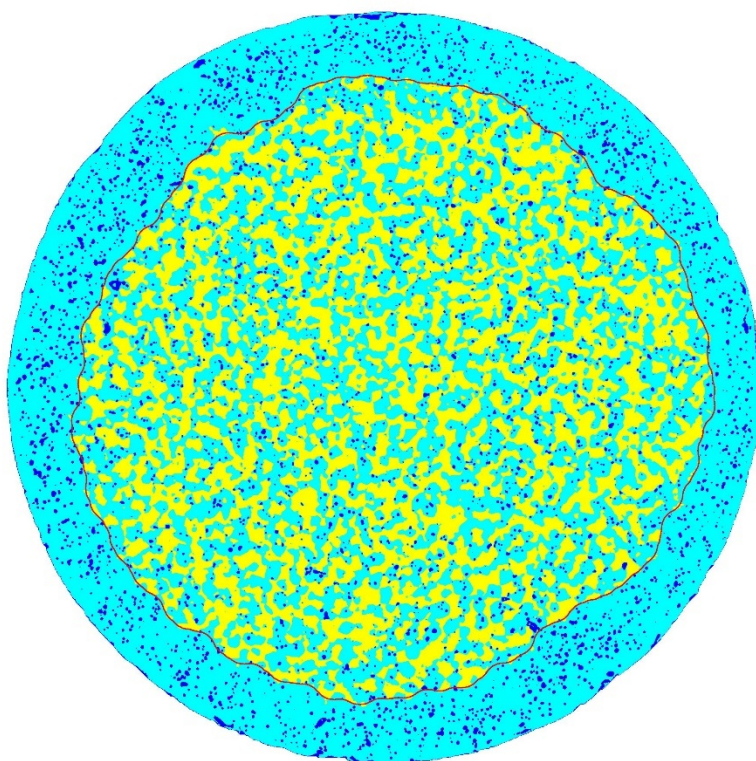
P17030905N066



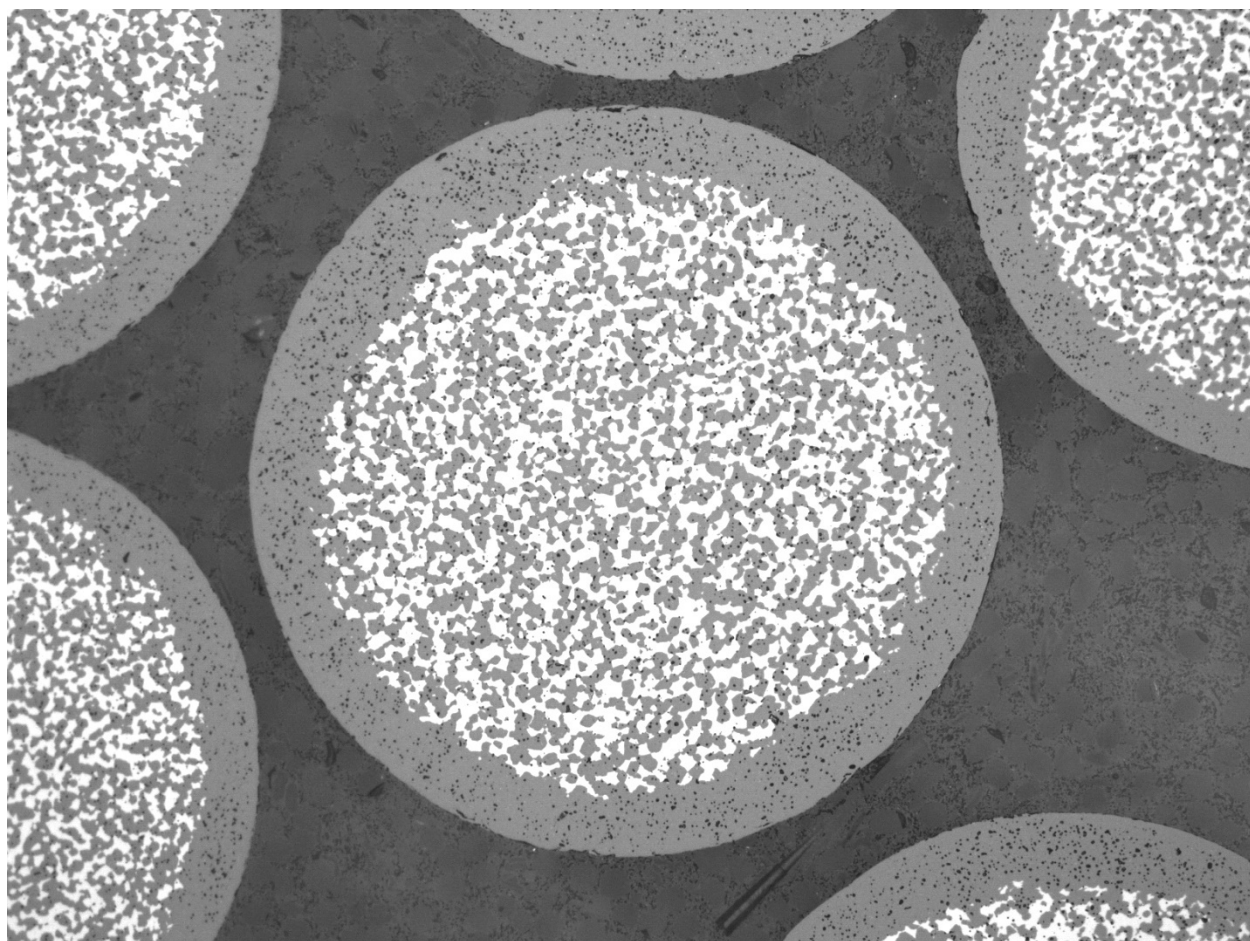
P17030905N068 segmented



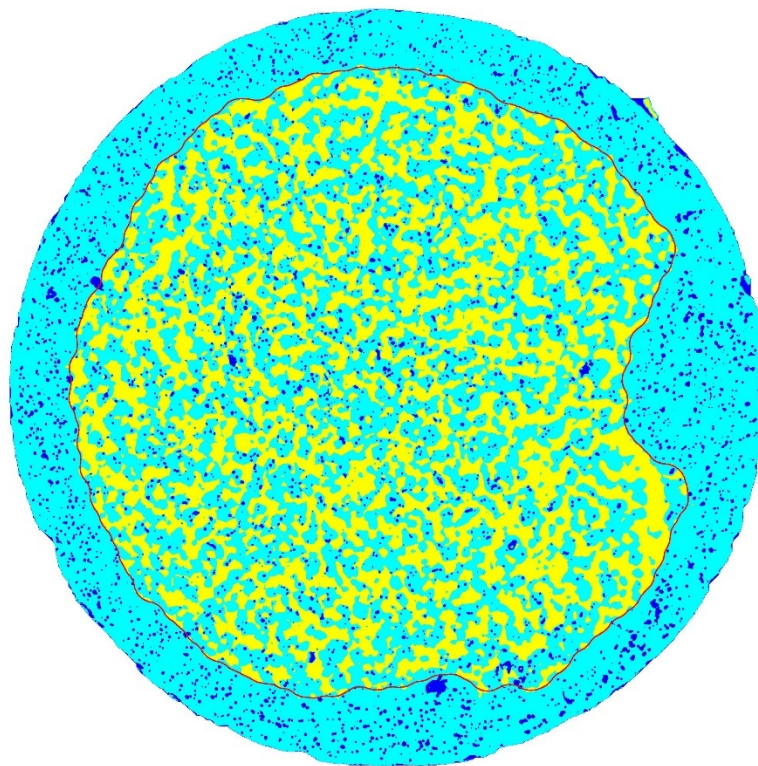
P17030905N068



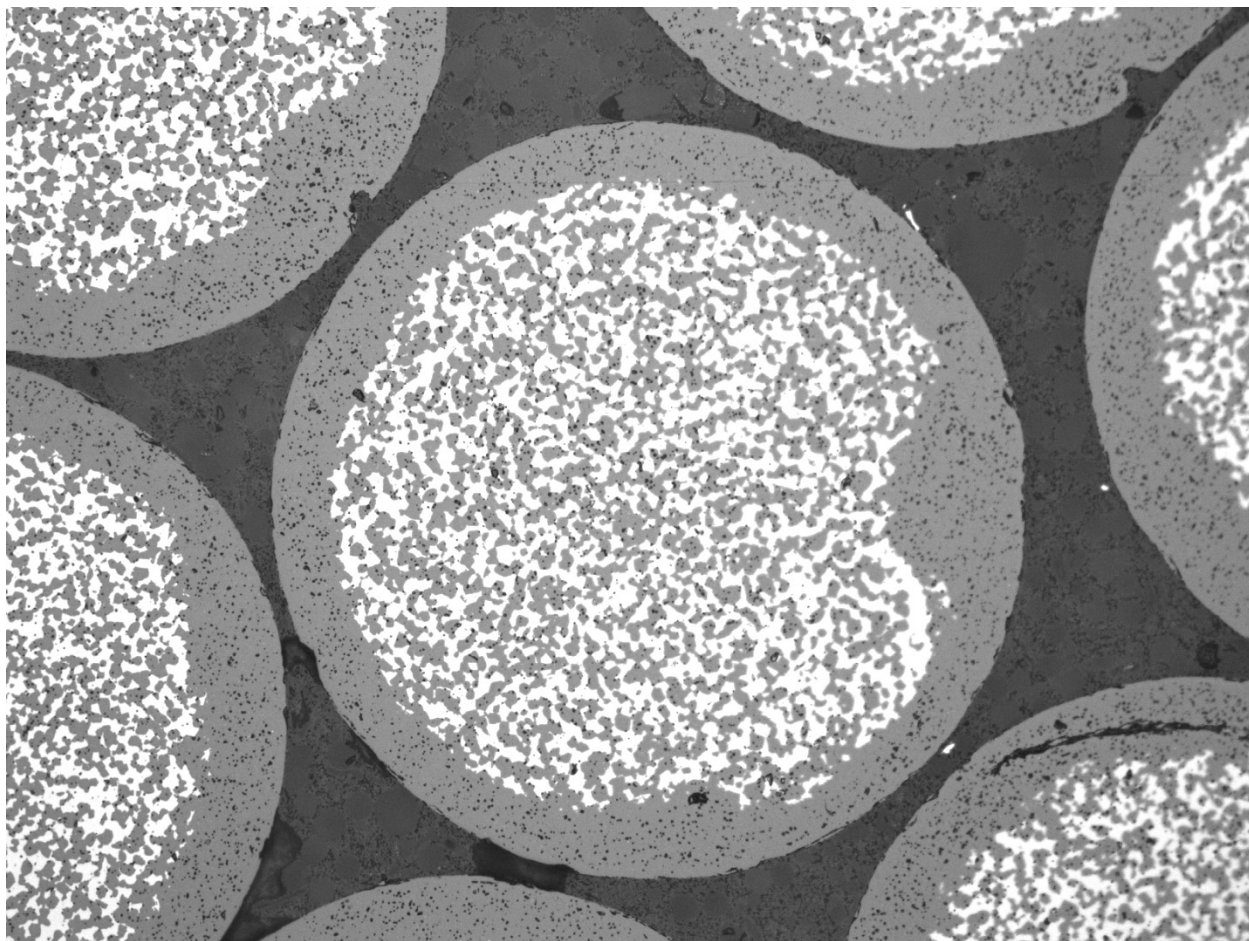
P17030905N069 segmented



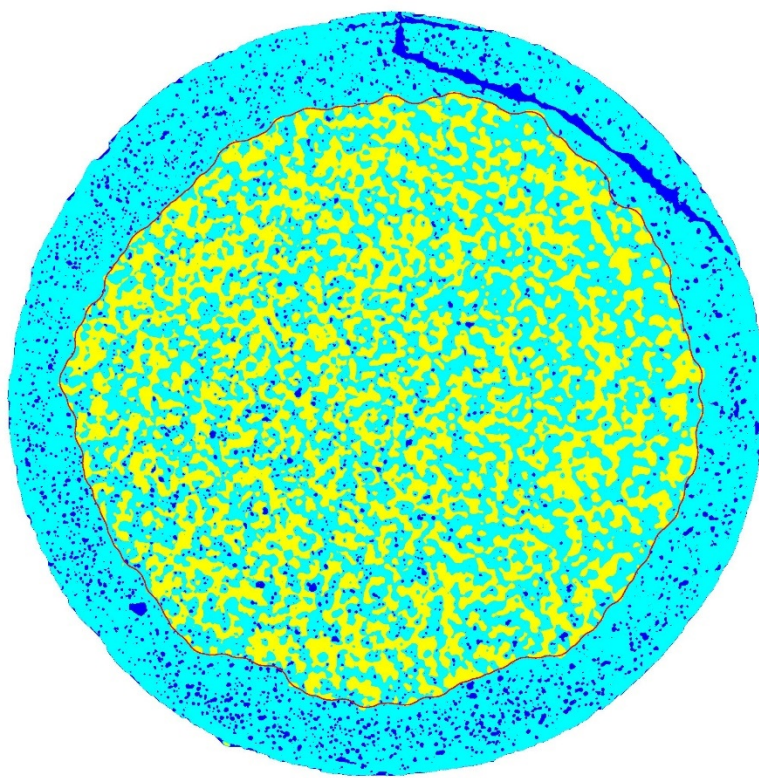
P17030905N069



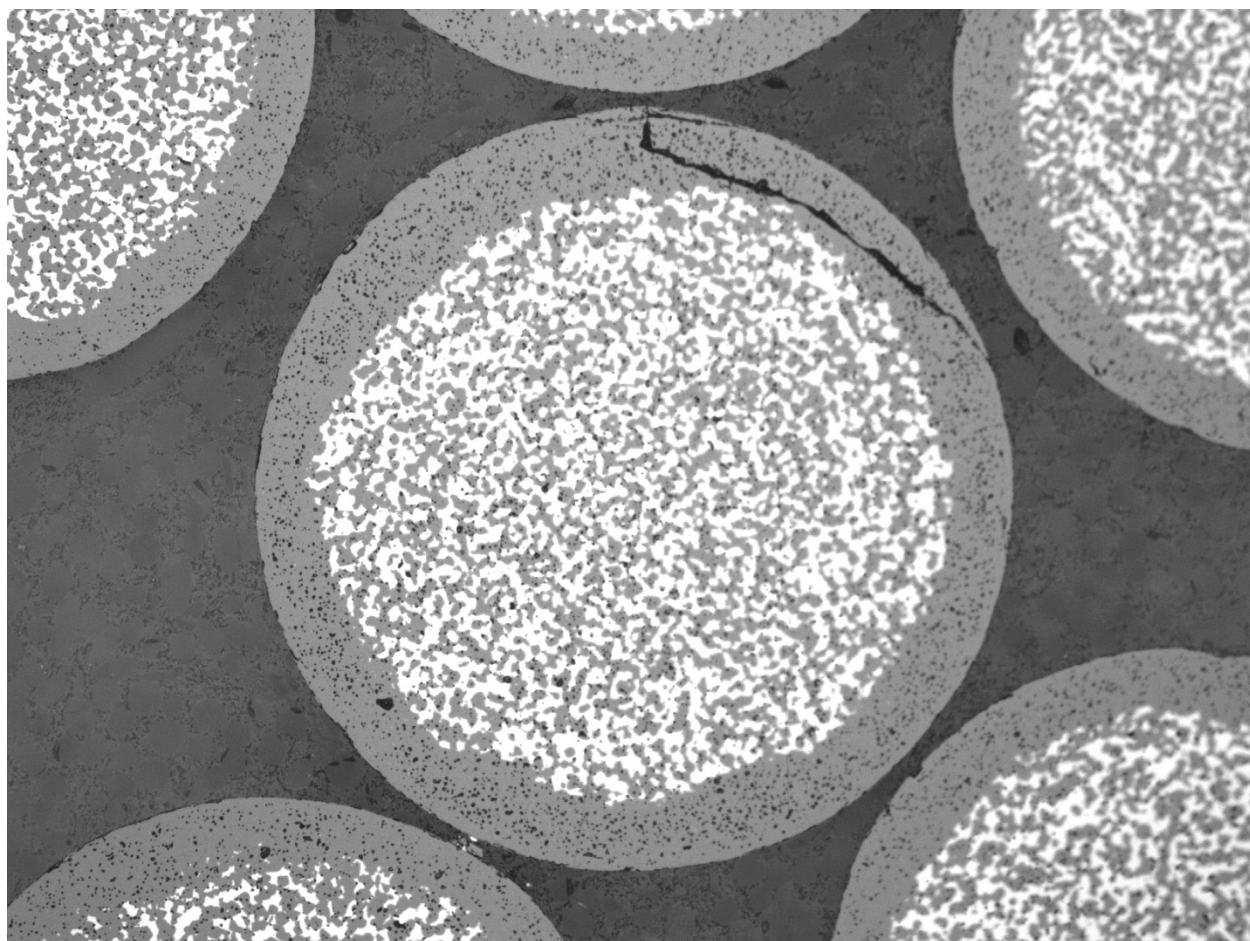
P17030905N070 segmented



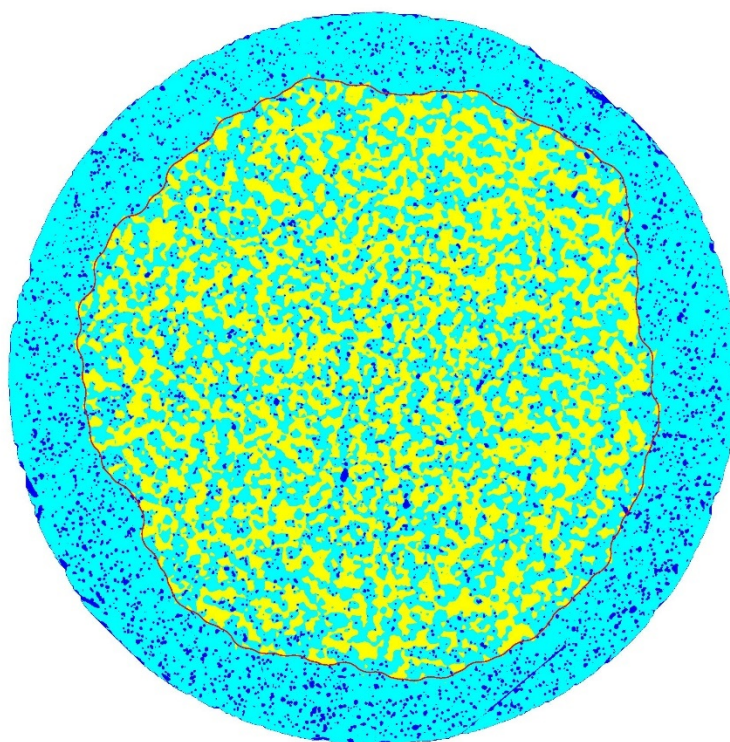
P17030905N070



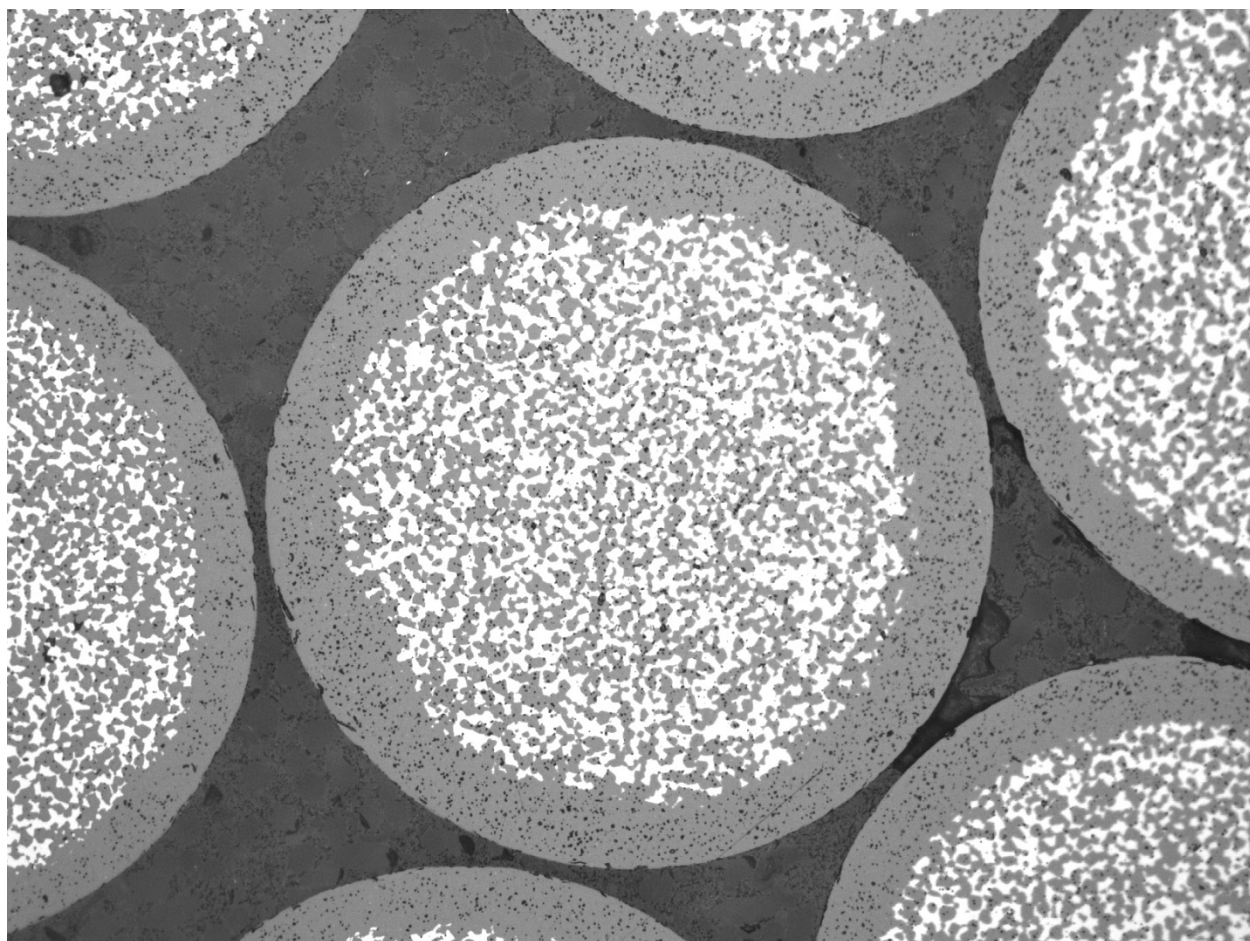
P17030905N072 segmented



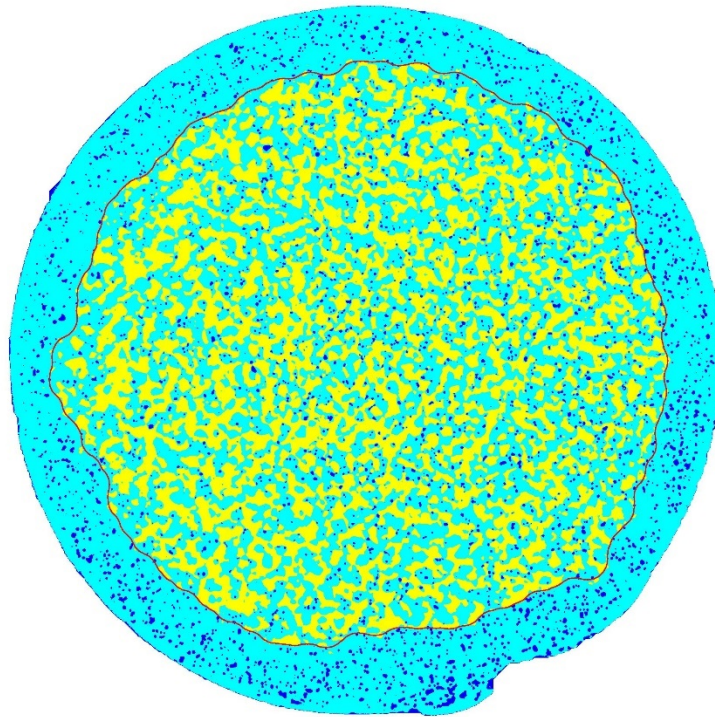
P17030905N072



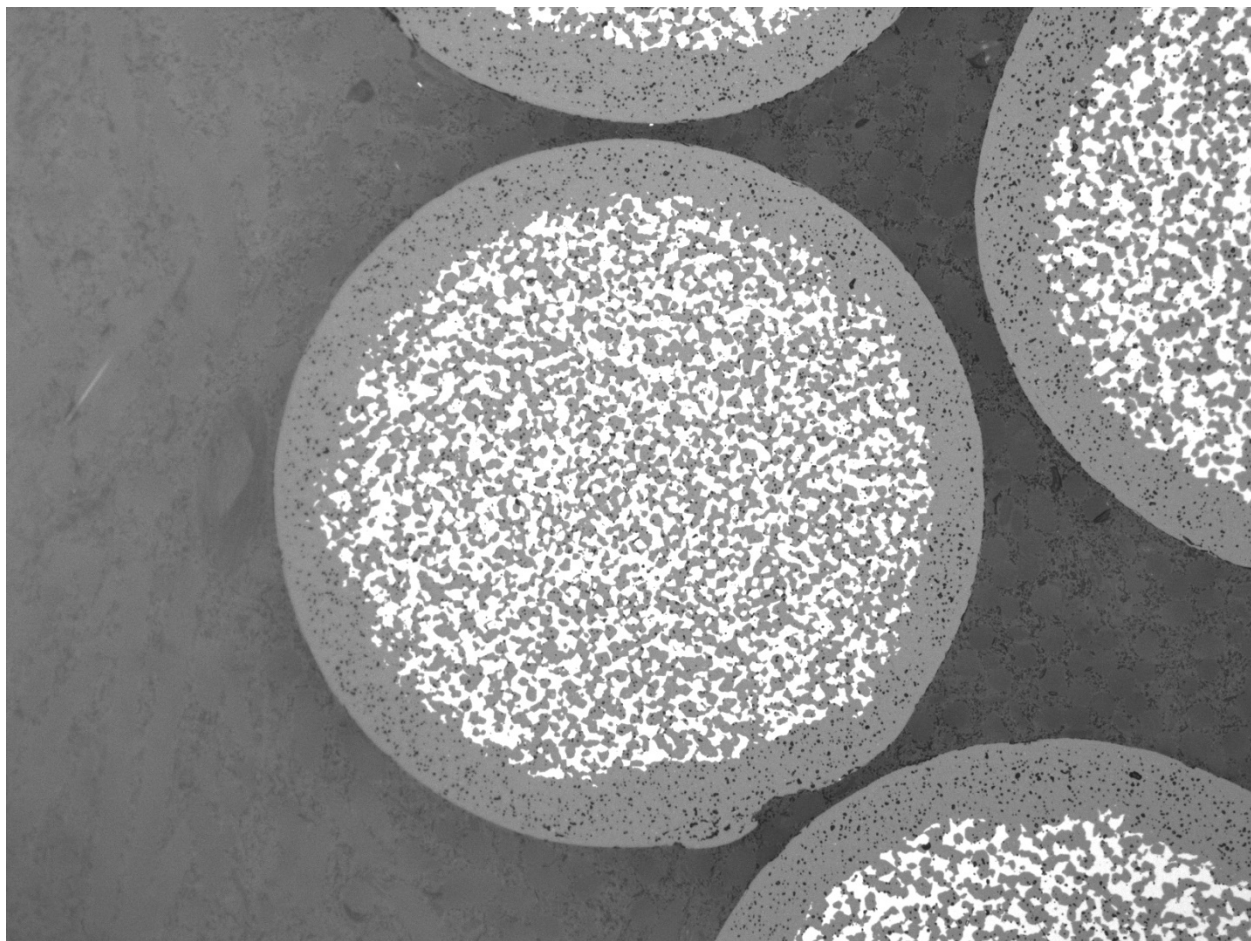
P17030905N073 segmented



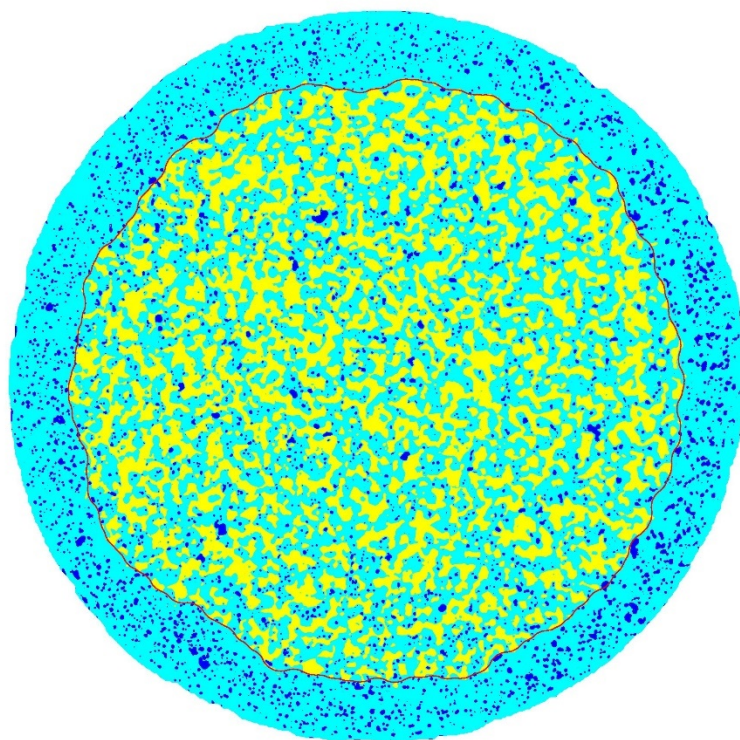
P17030905N073



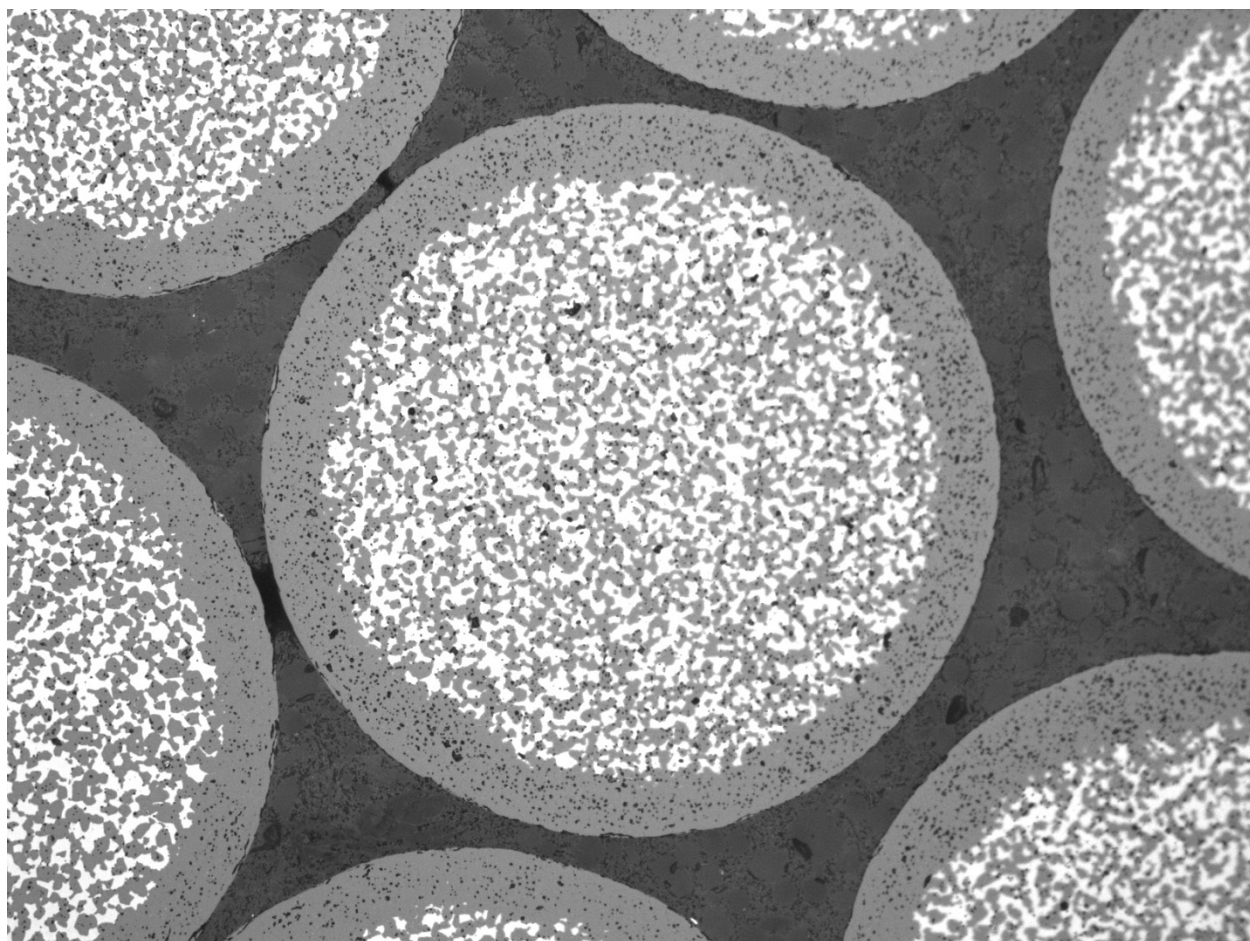
P17030905N075 segmented



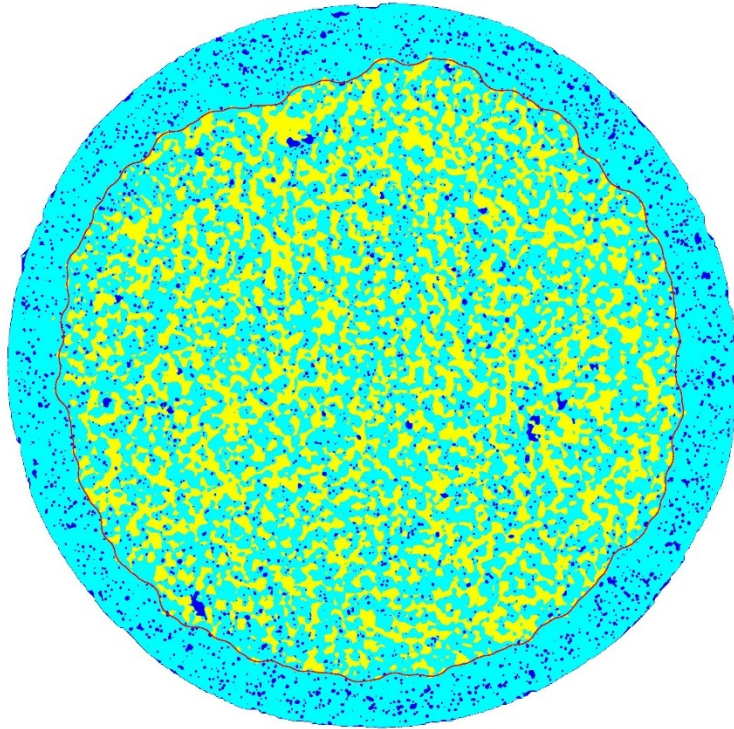
P17030905N075



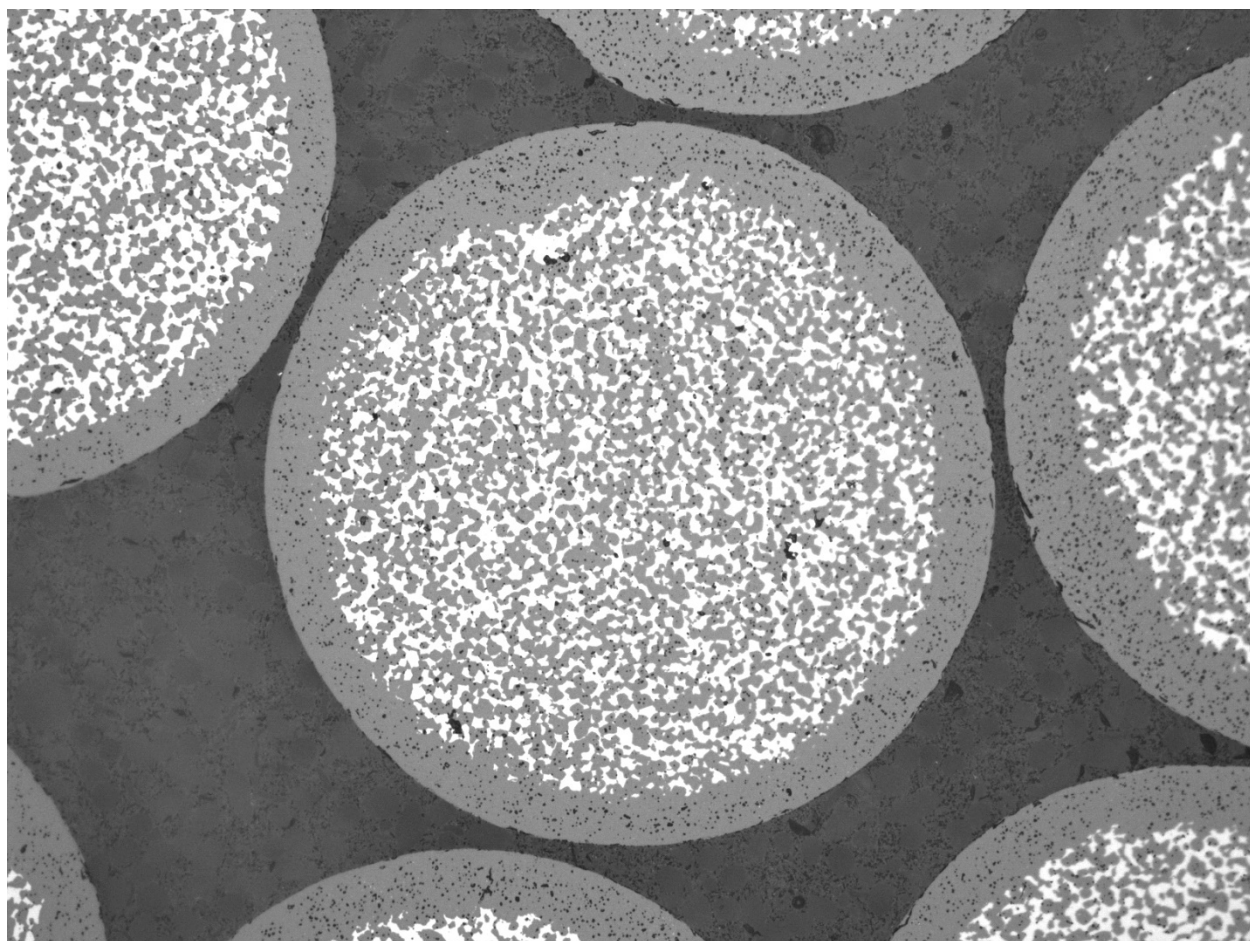
P17030905N076 segmented



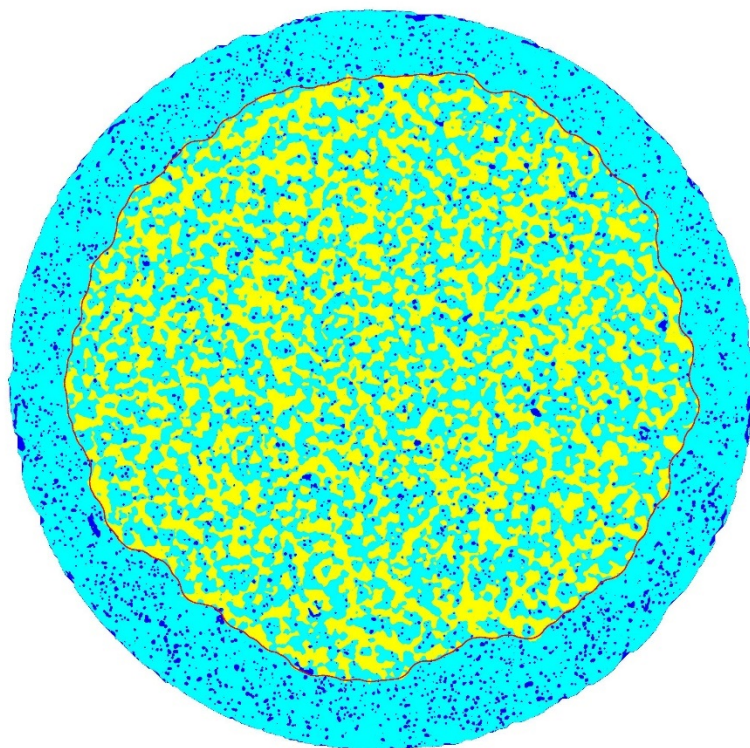
P17030905N076



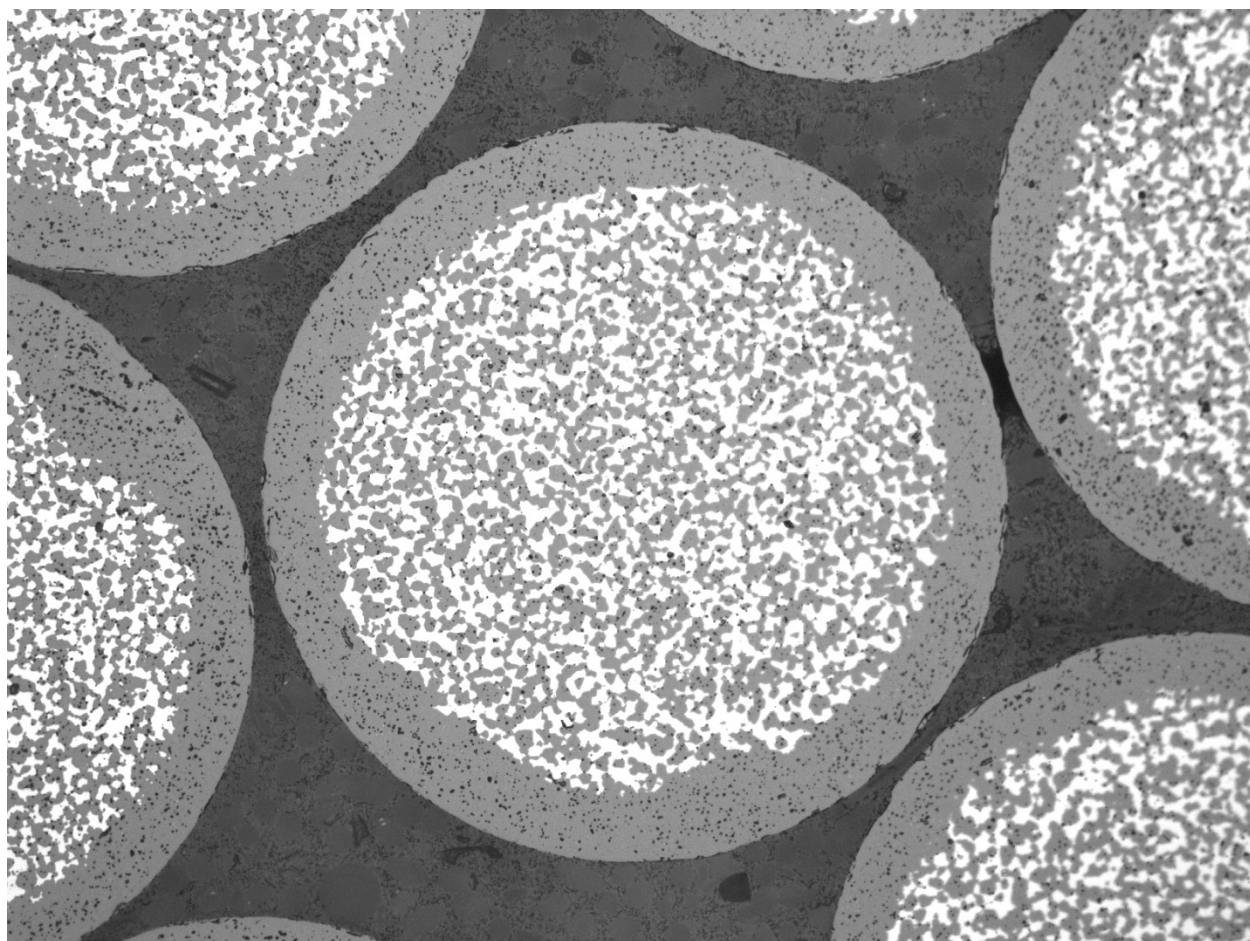
P17030905N078 segmented



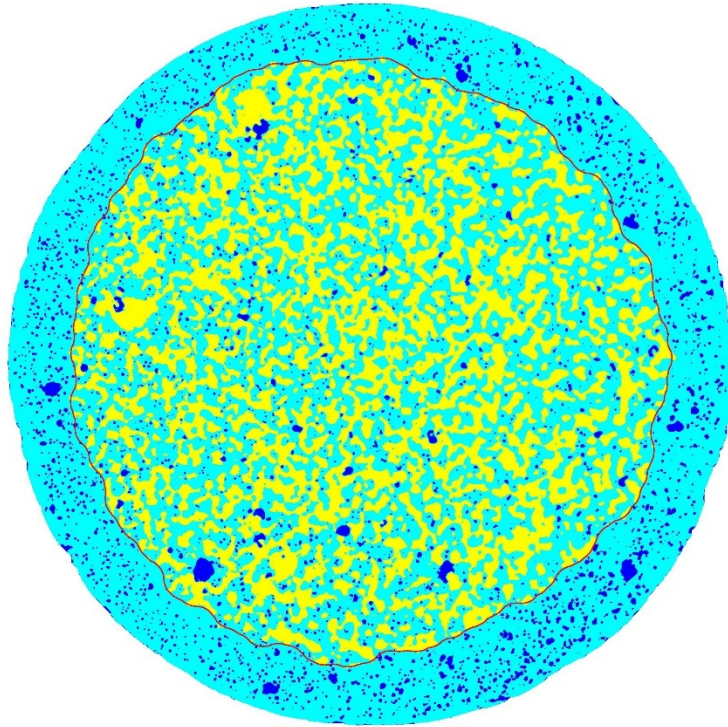
P17030905N078



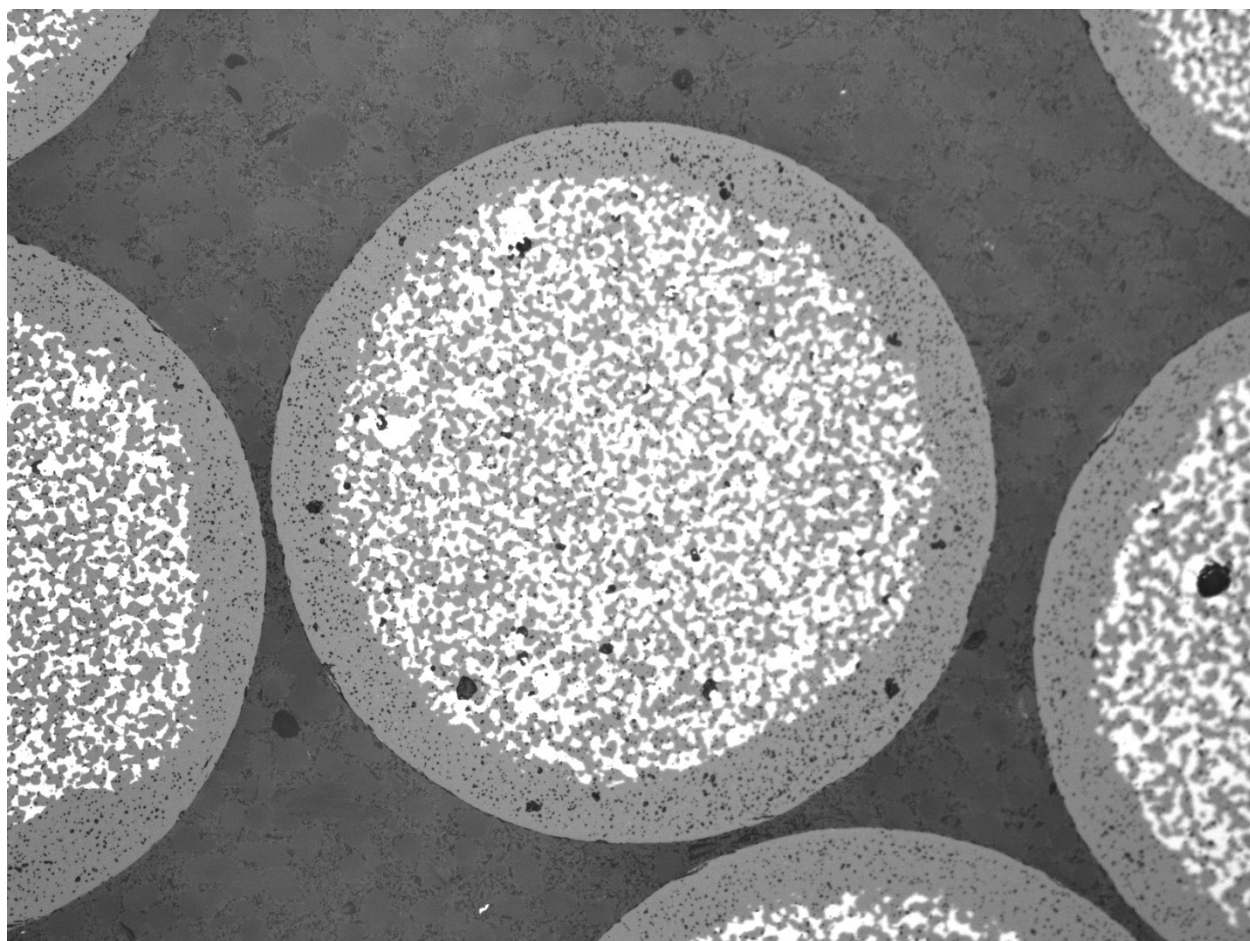
P17030905N079 segmented



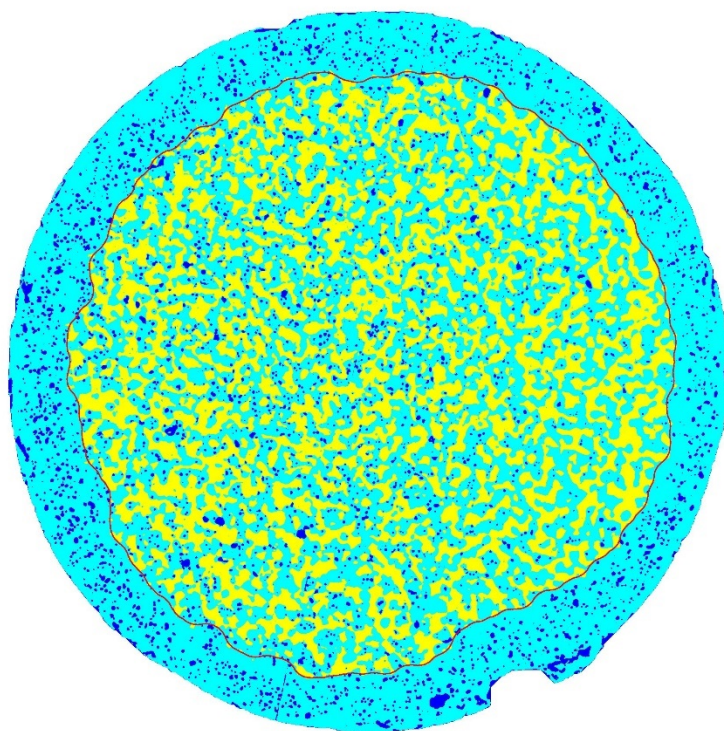
P17030905N079



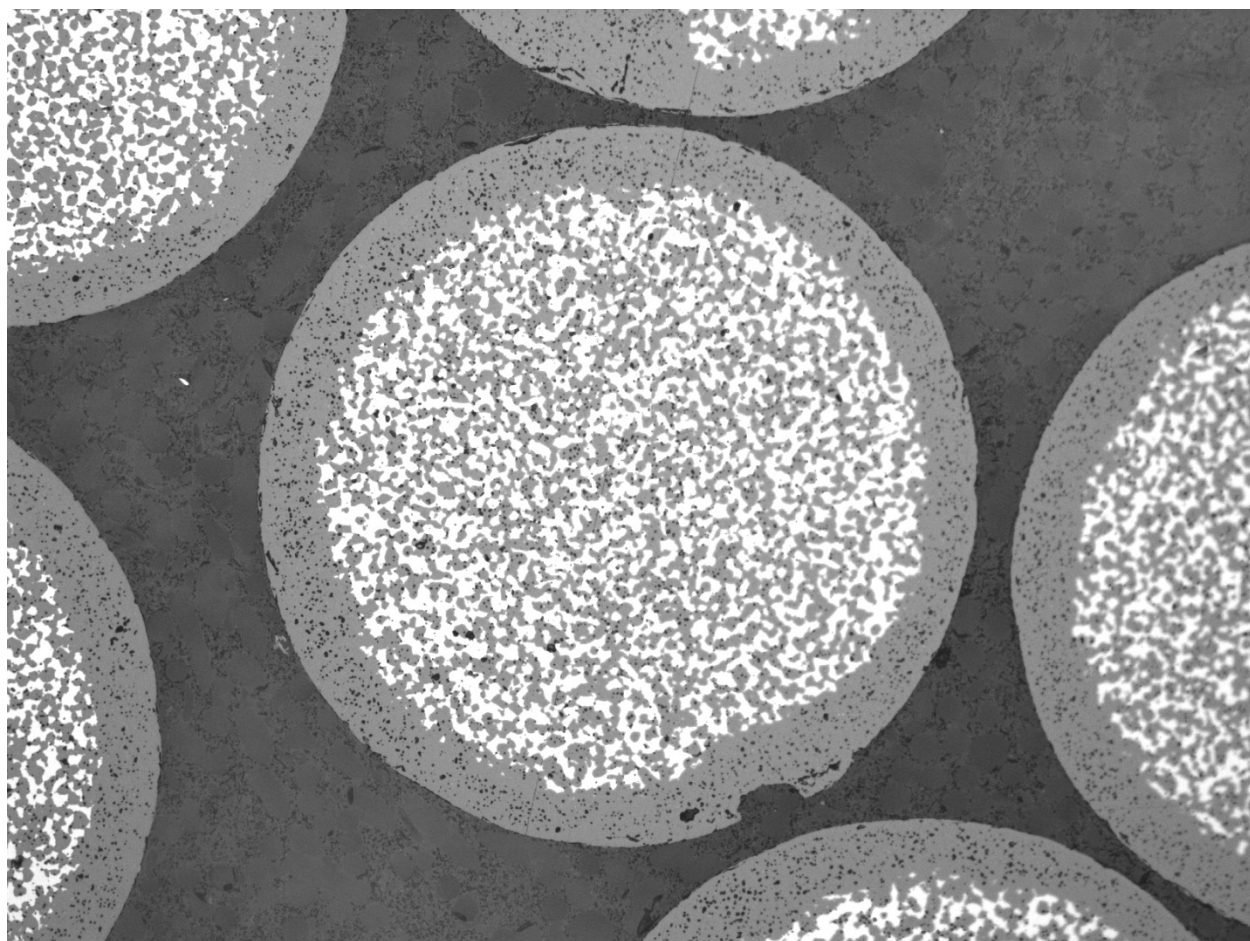
P17030905N080 segmented



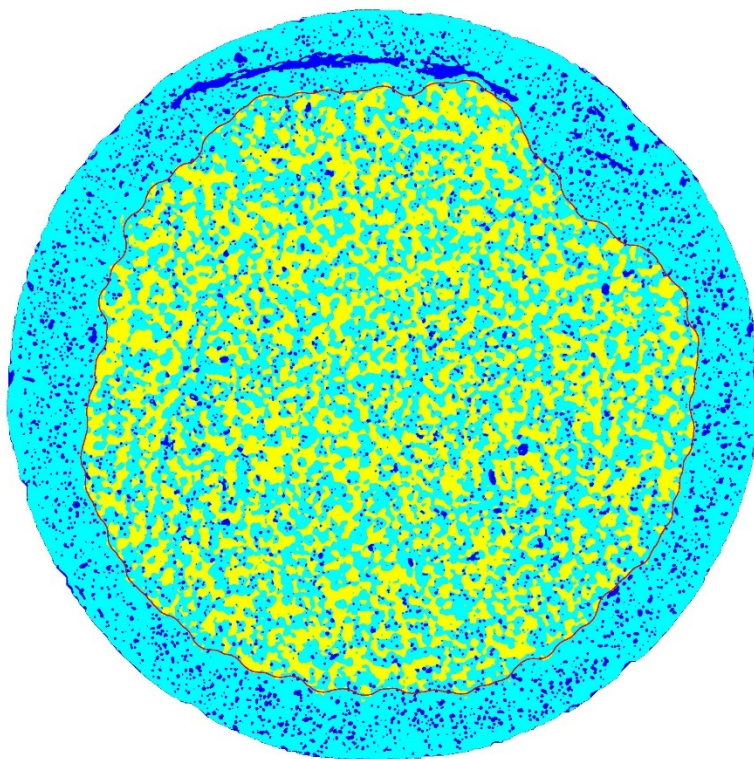
P17030905N080



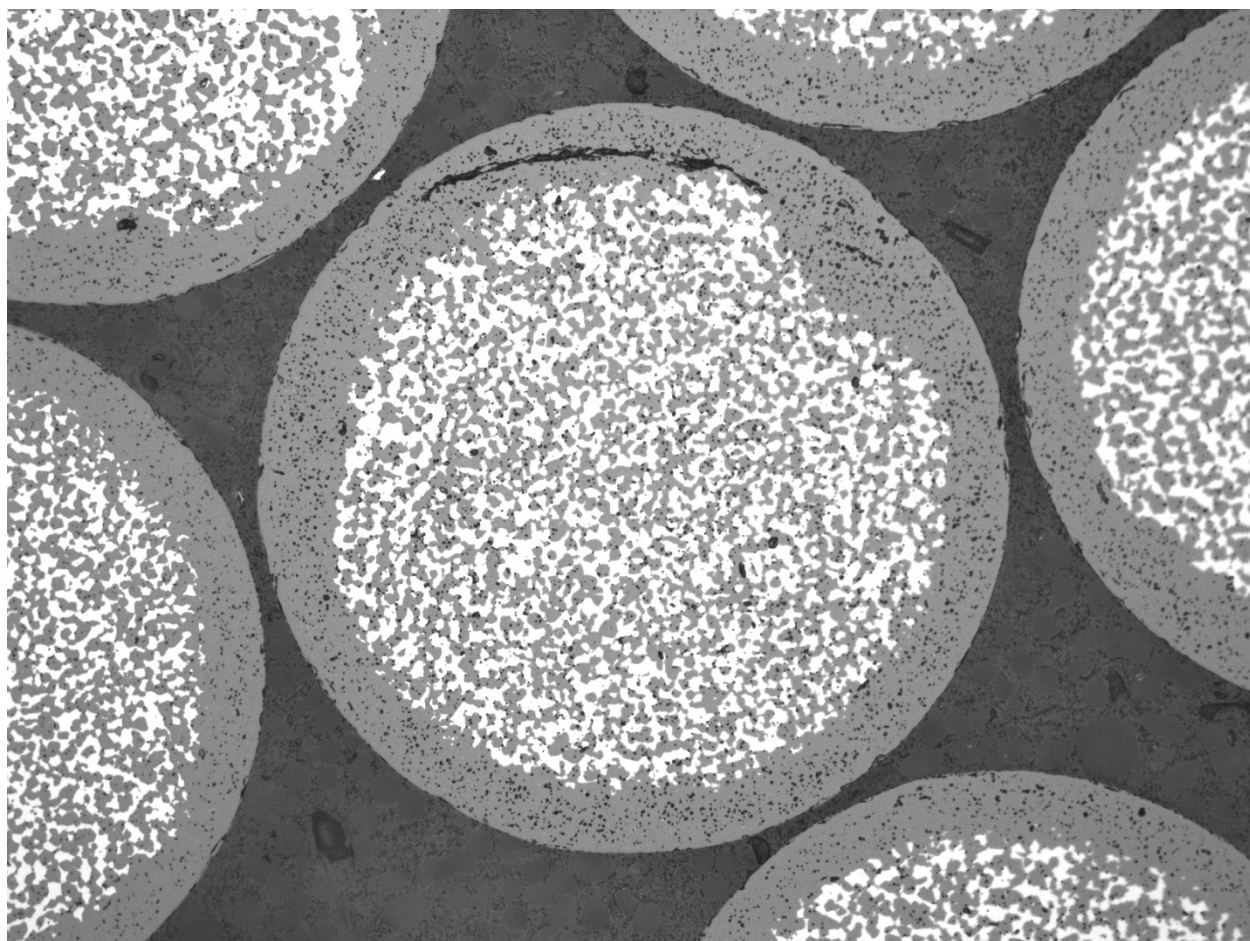
P17030905N081 segmented



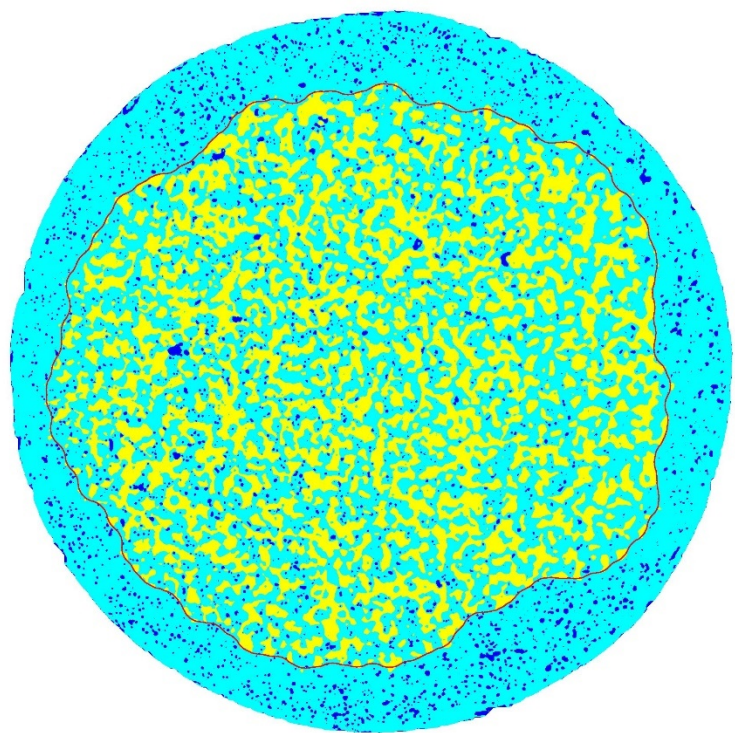
P17030905N081



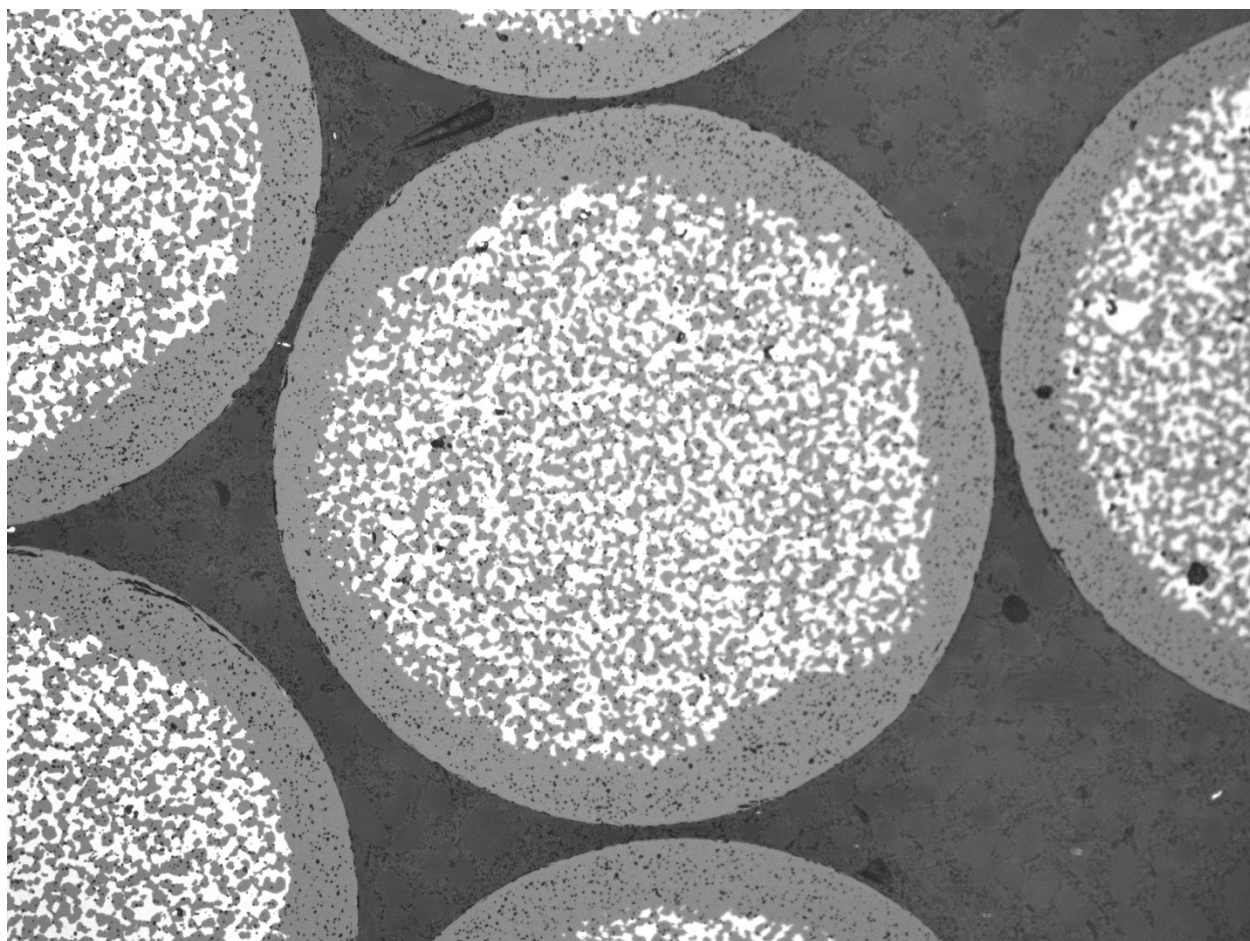
P17030905N082 segmented



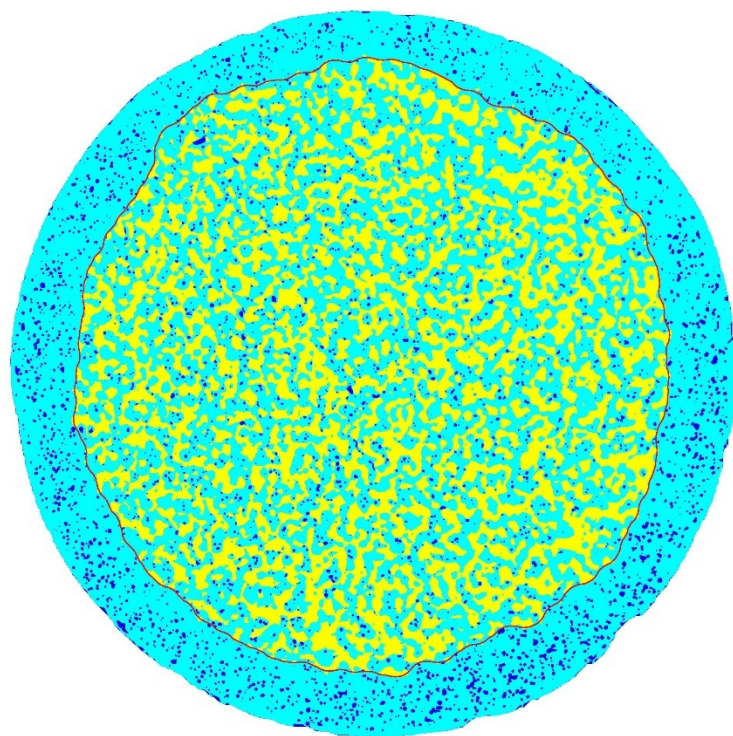
P17030905N082



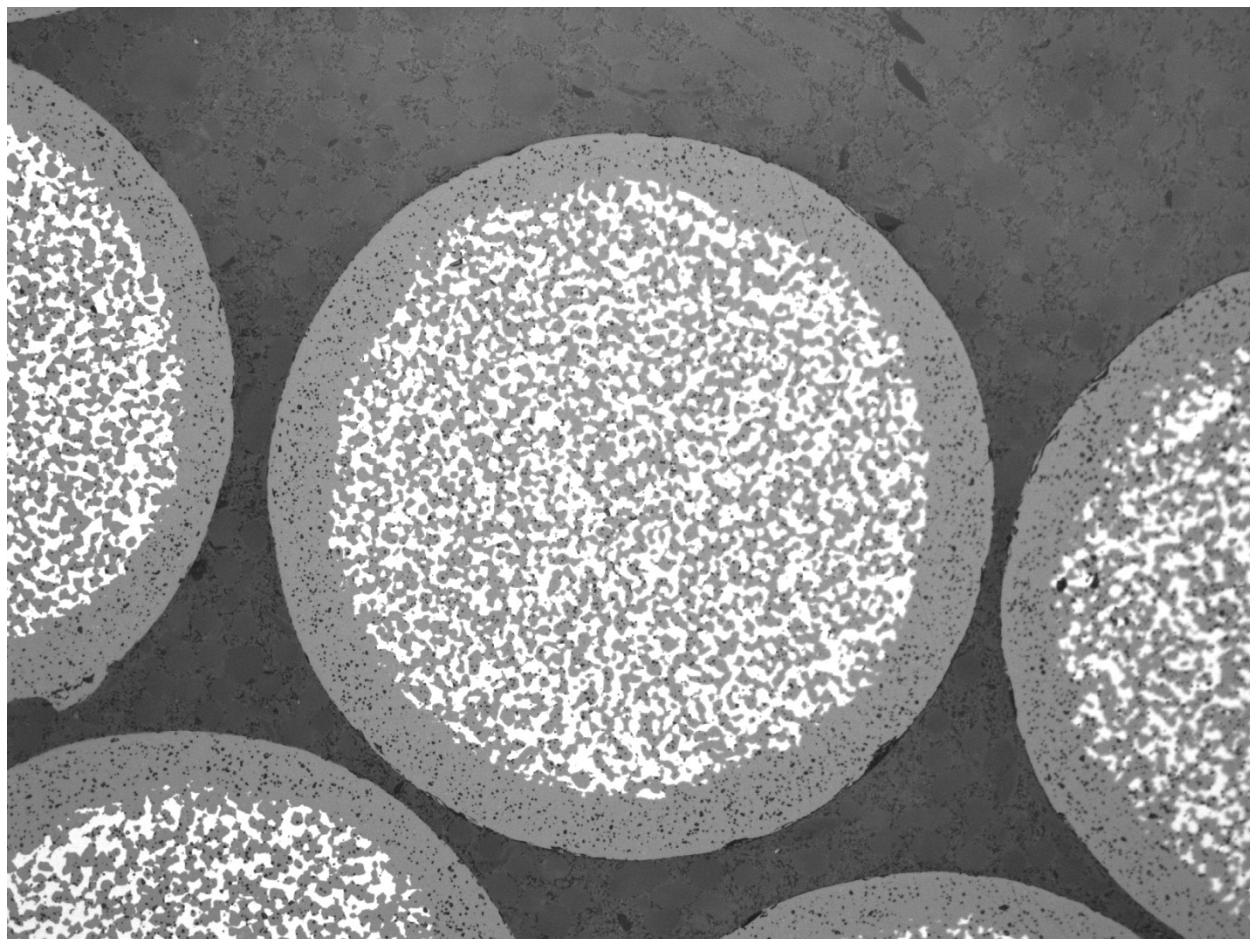
P17030905N083 segmented



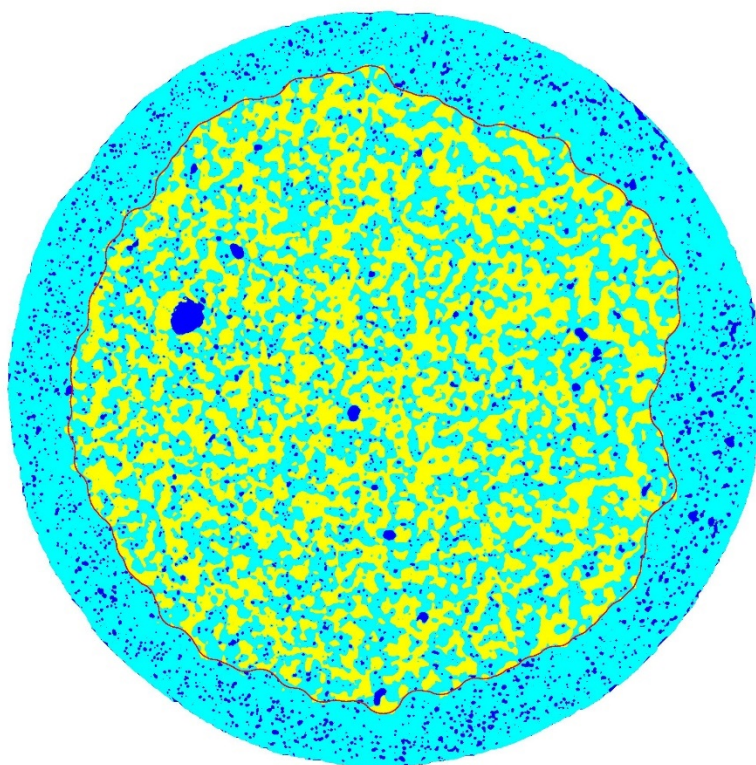
P17030905N083



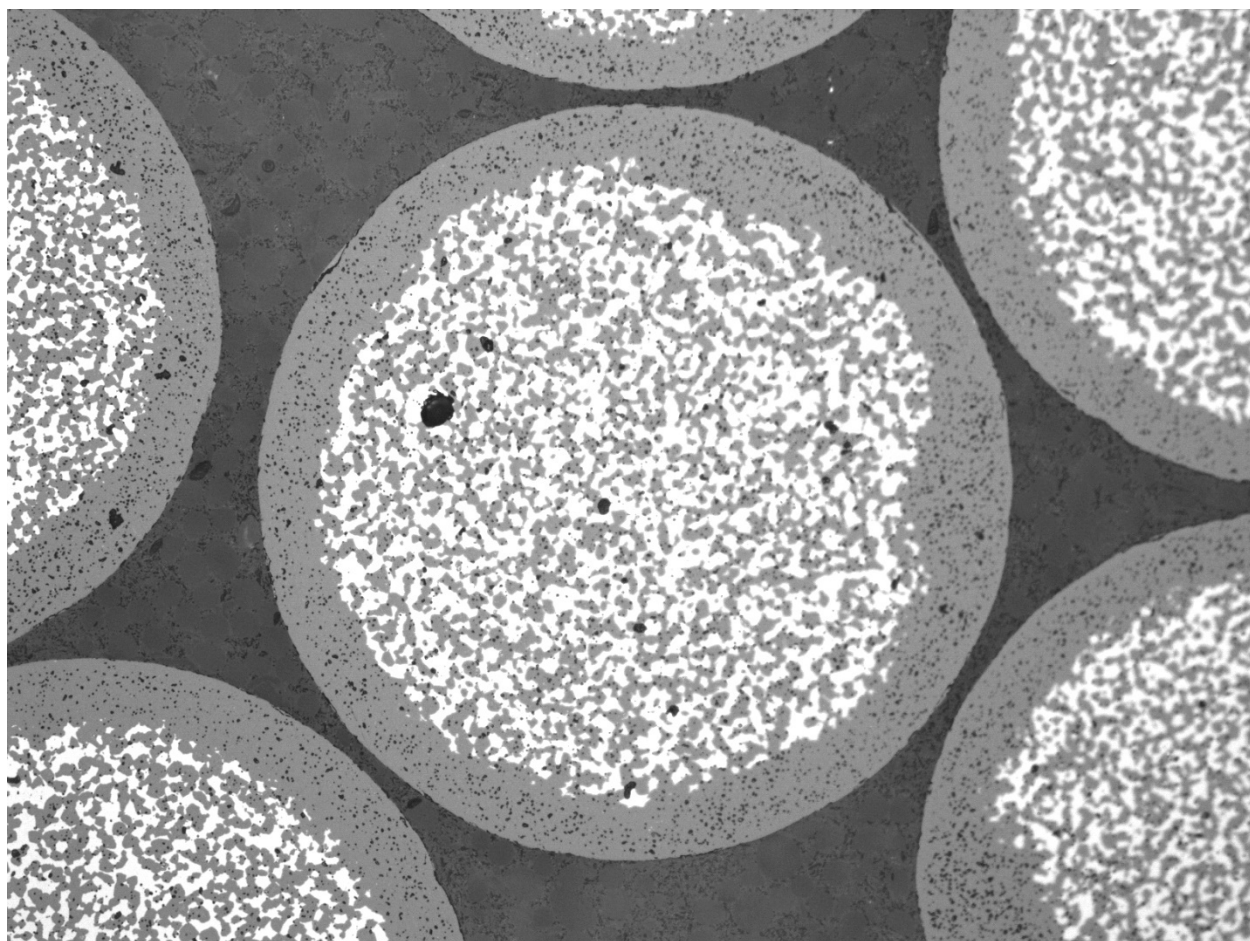
P17030905N084 segmented



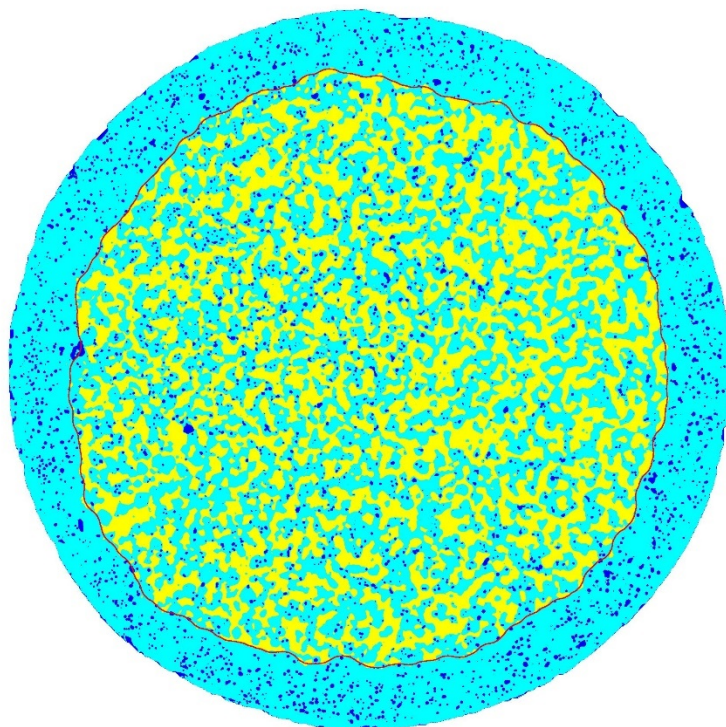
P17030905N084



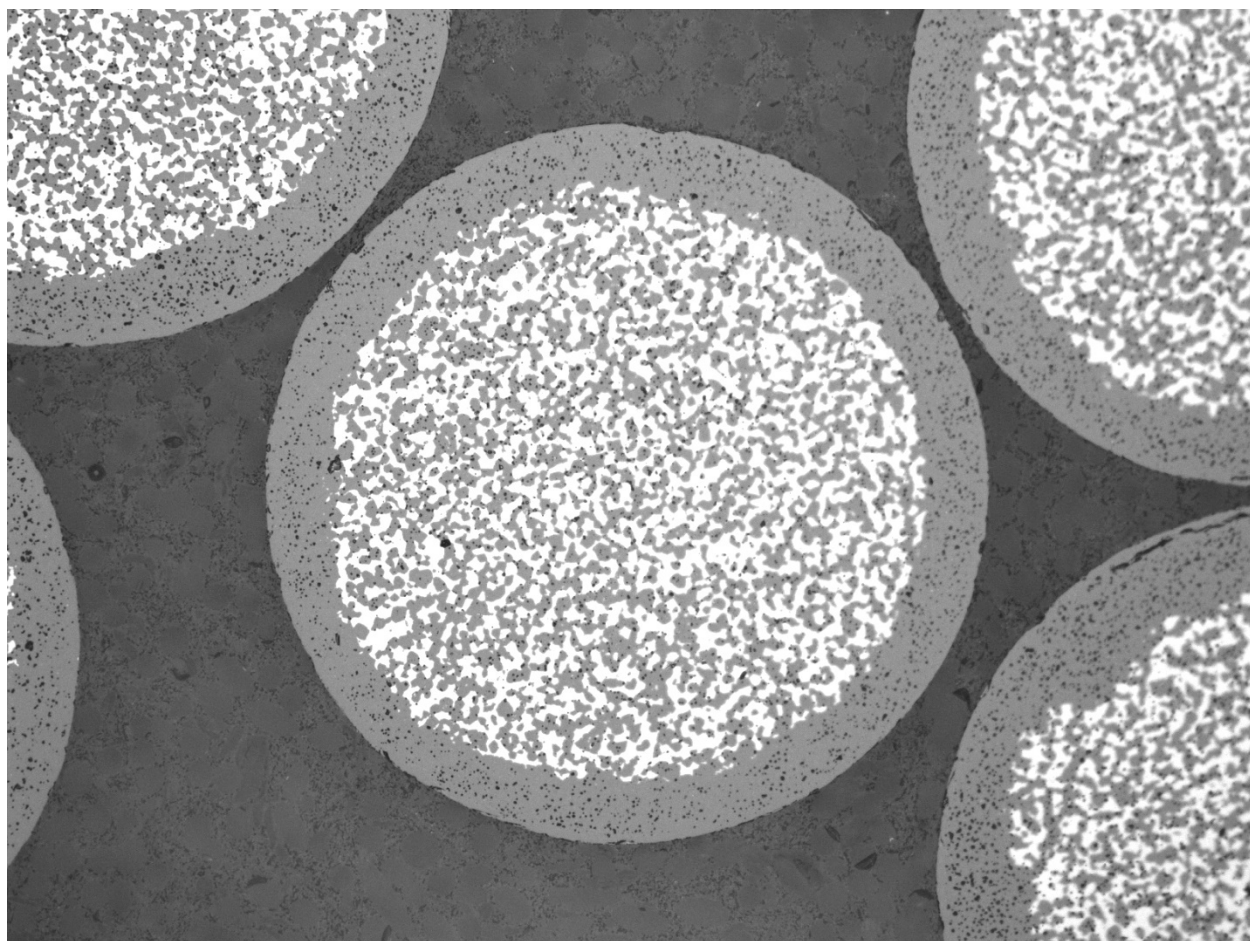
P17030905N085 segmented



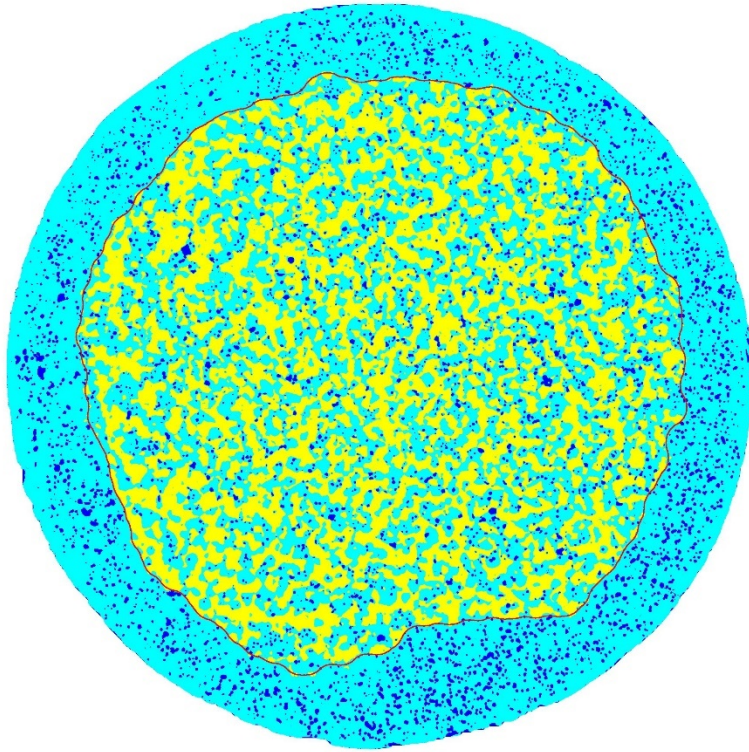
P17030905N085



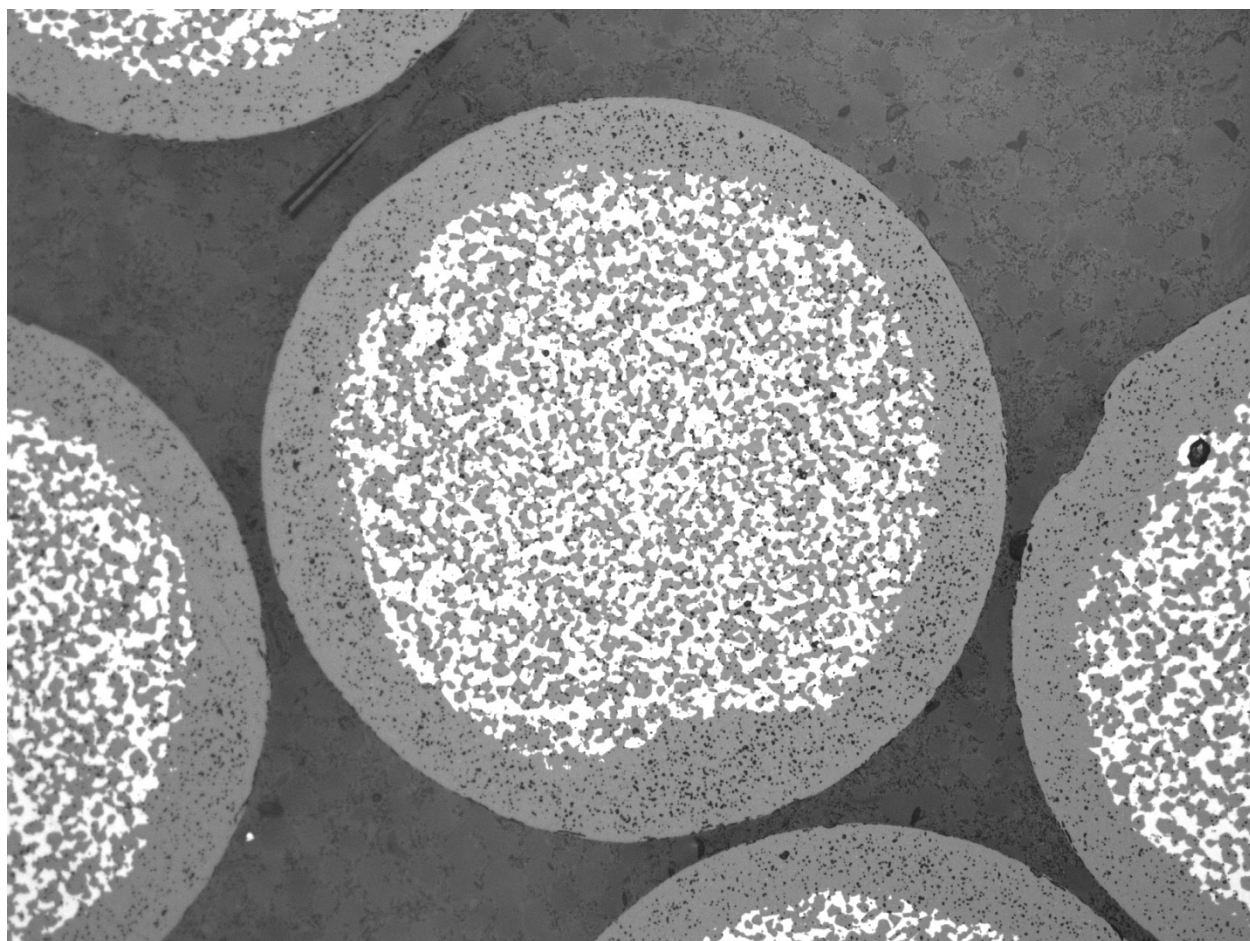
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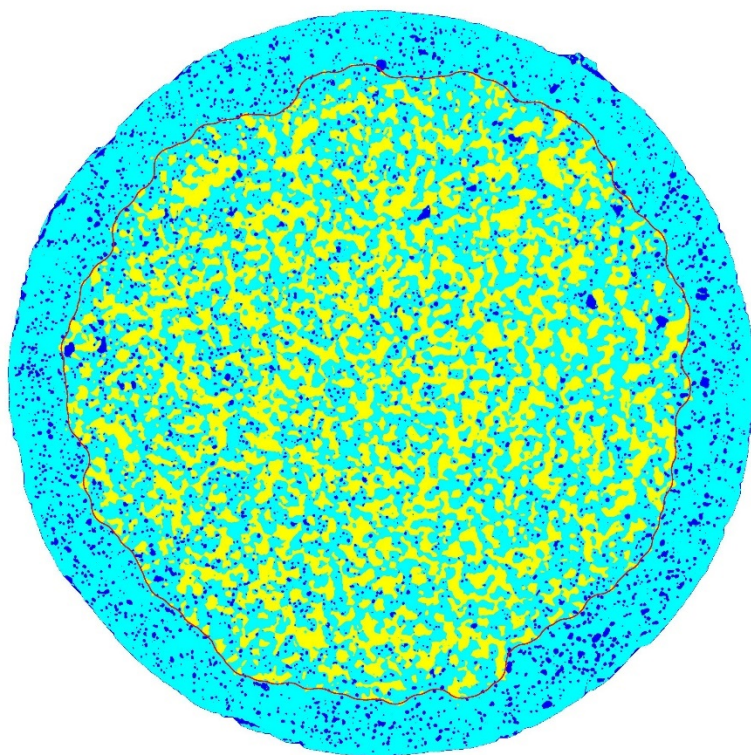
P17030905N086



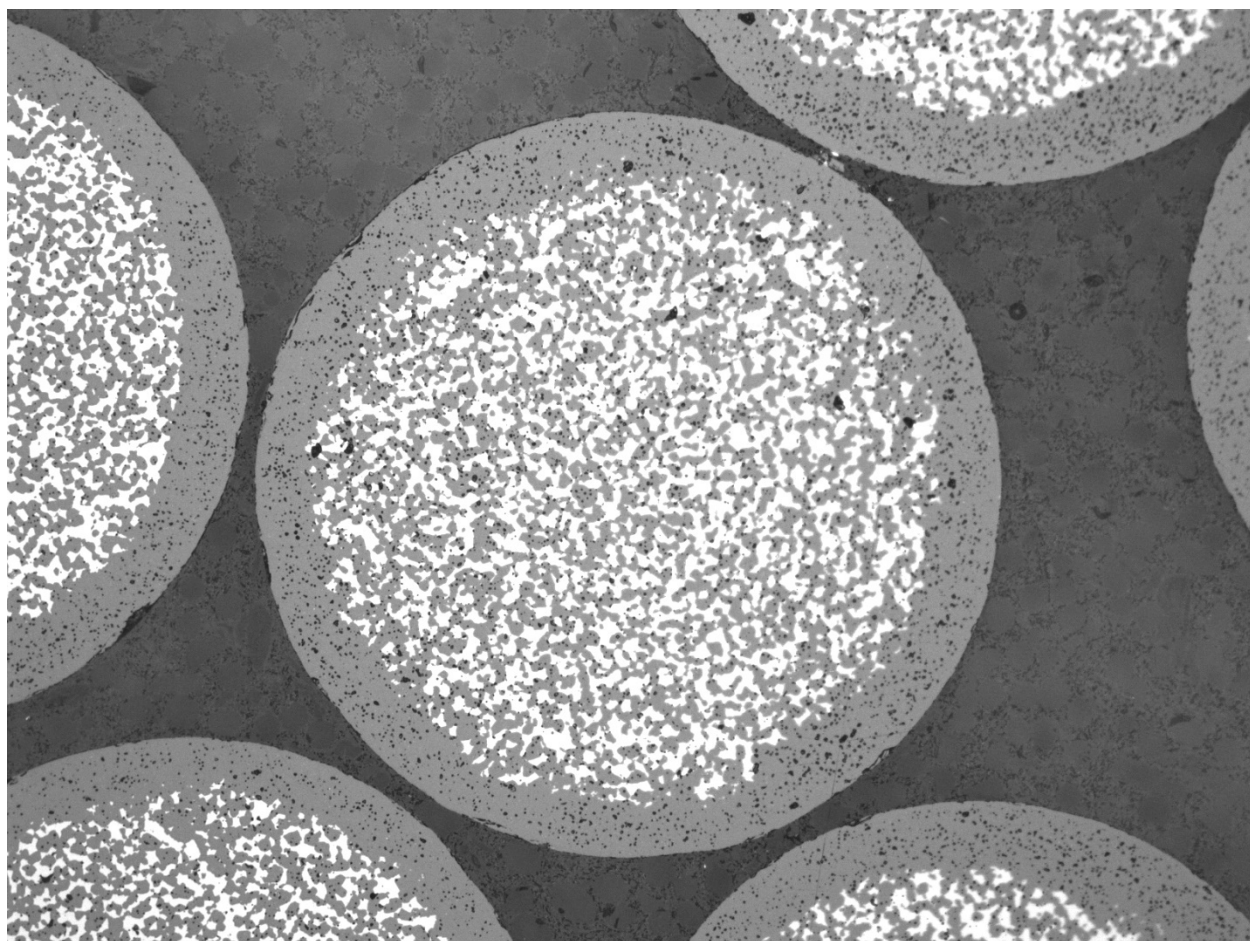
P17030905N087 segmented



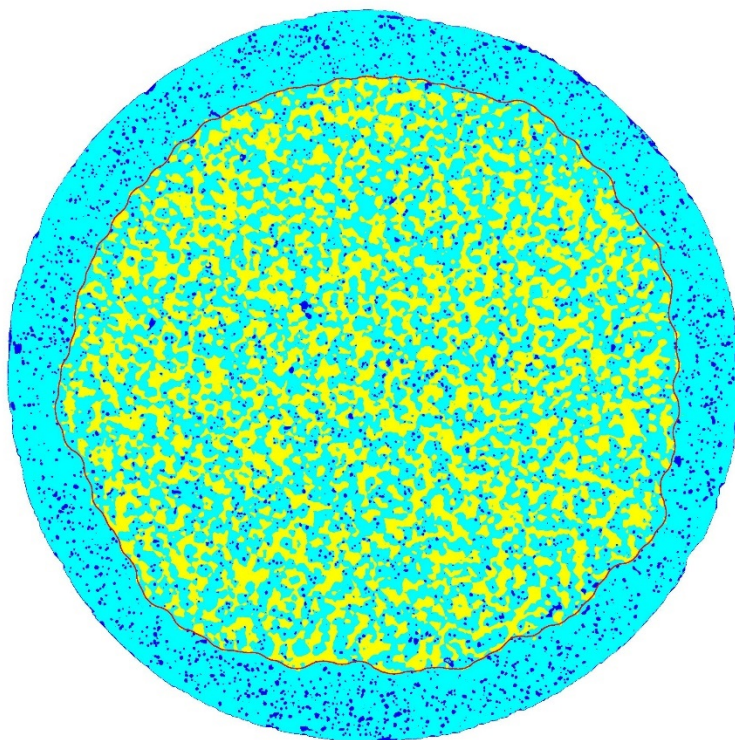
P17030905N087



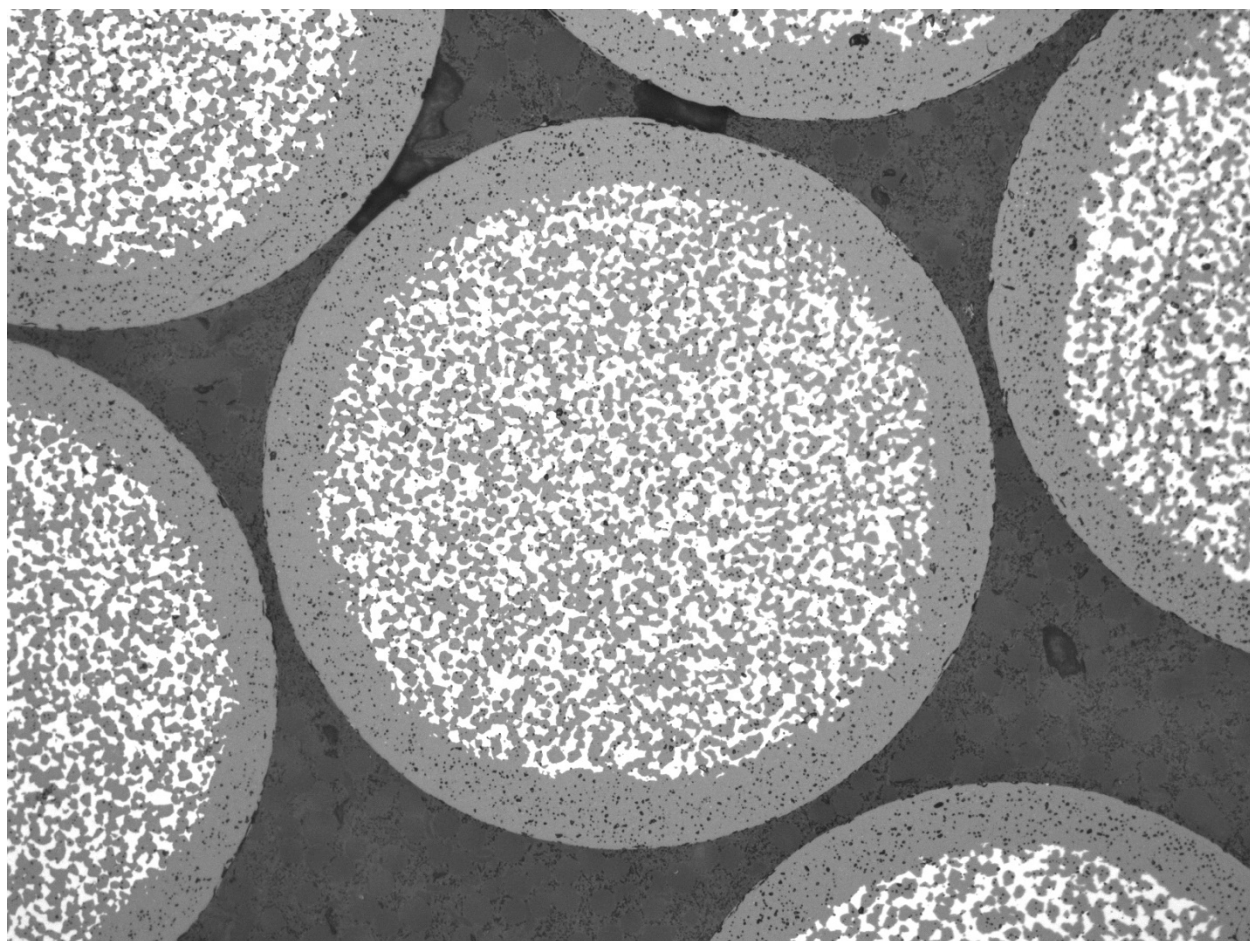
P17030905N088 segmented



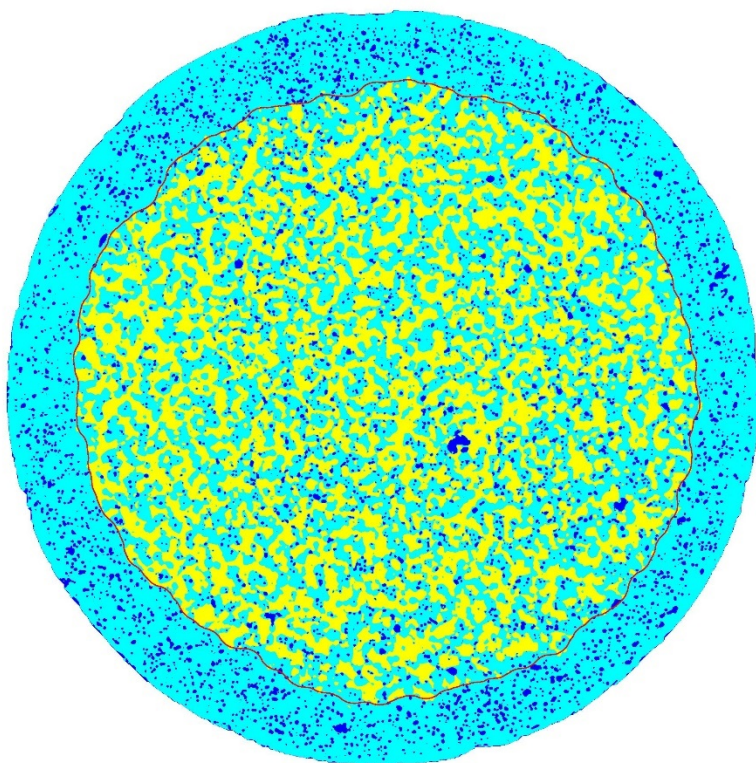
P17030905N088



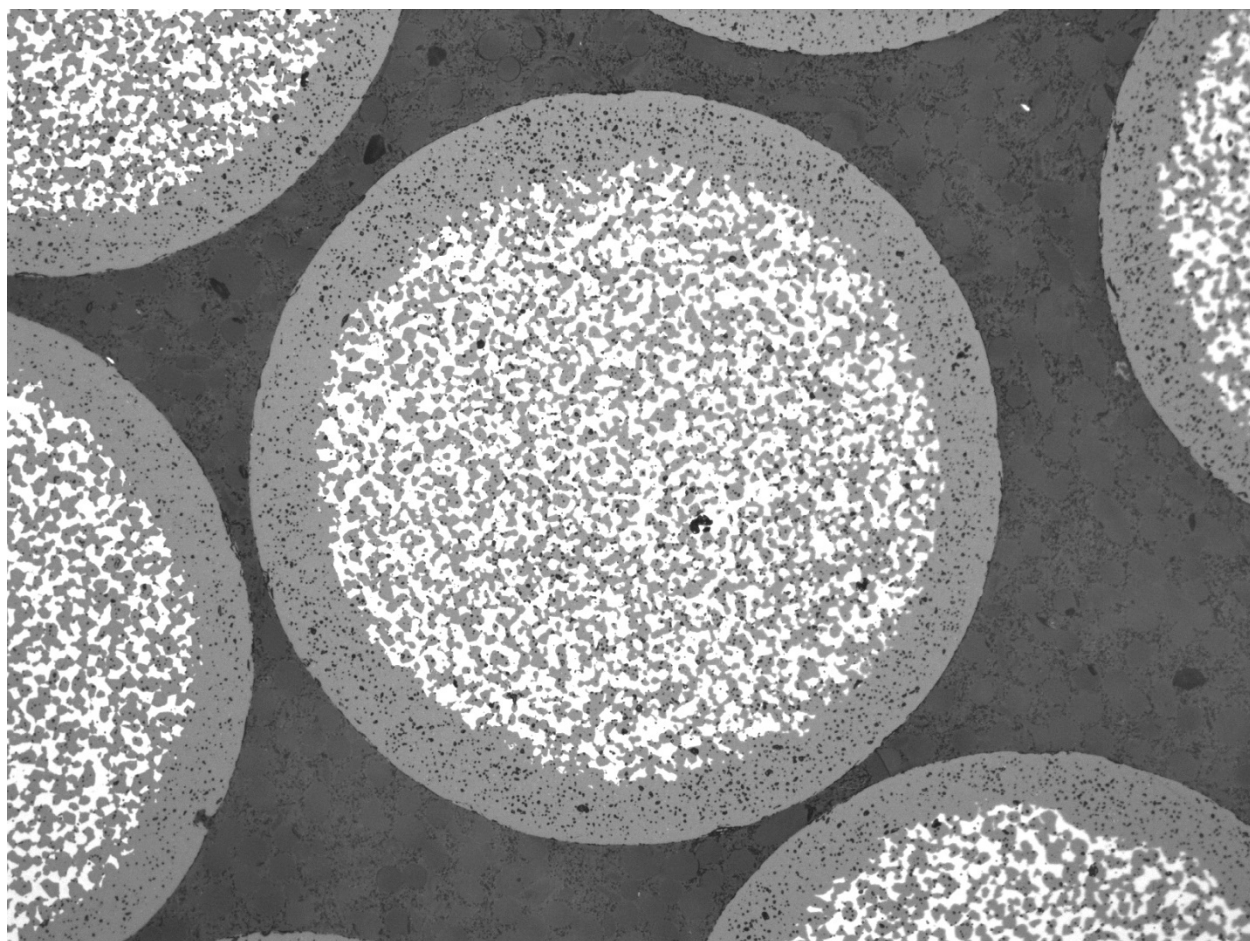
P17030905N089 segmented



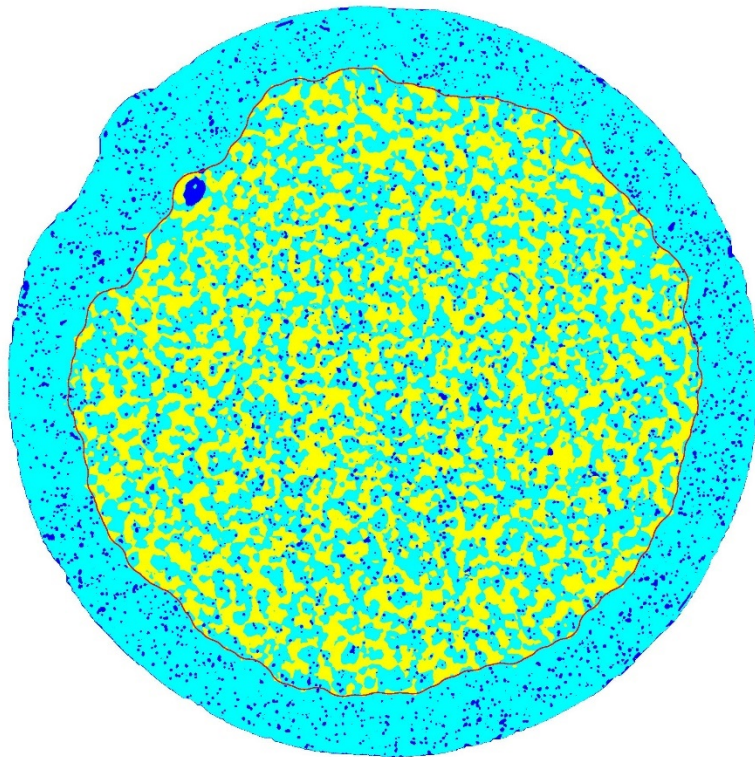
P17030905N089



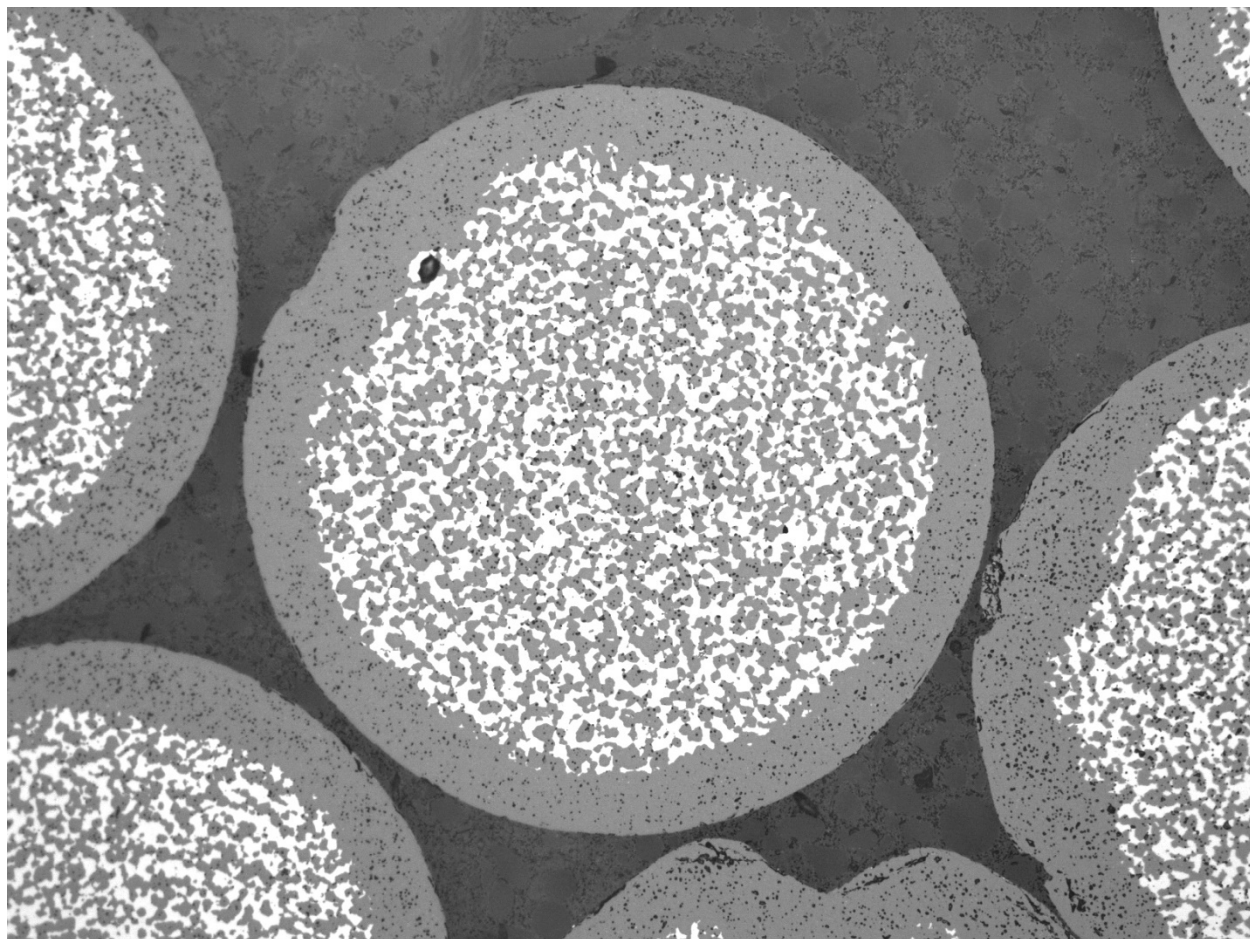
P17030905N090 segmented



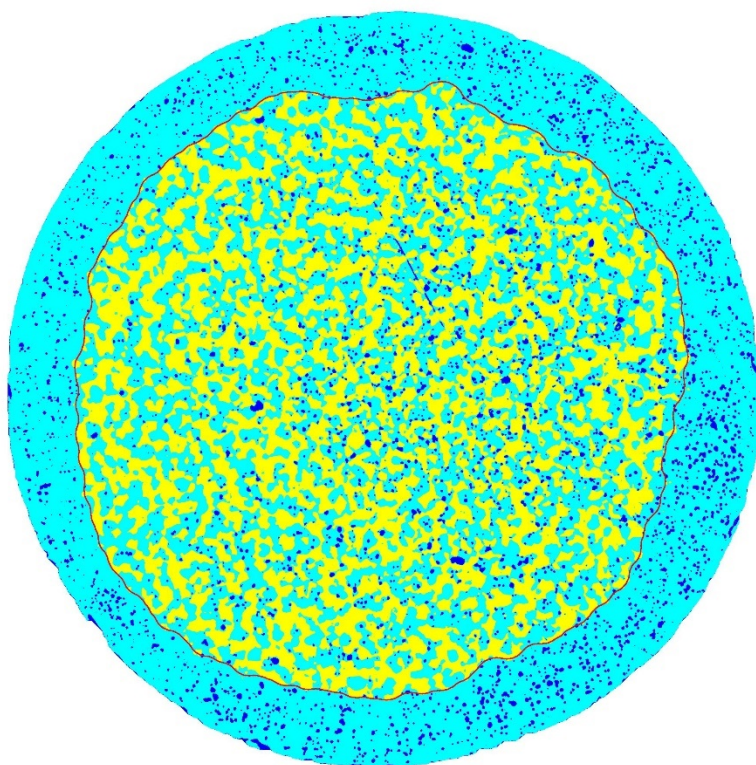
P17030905N090



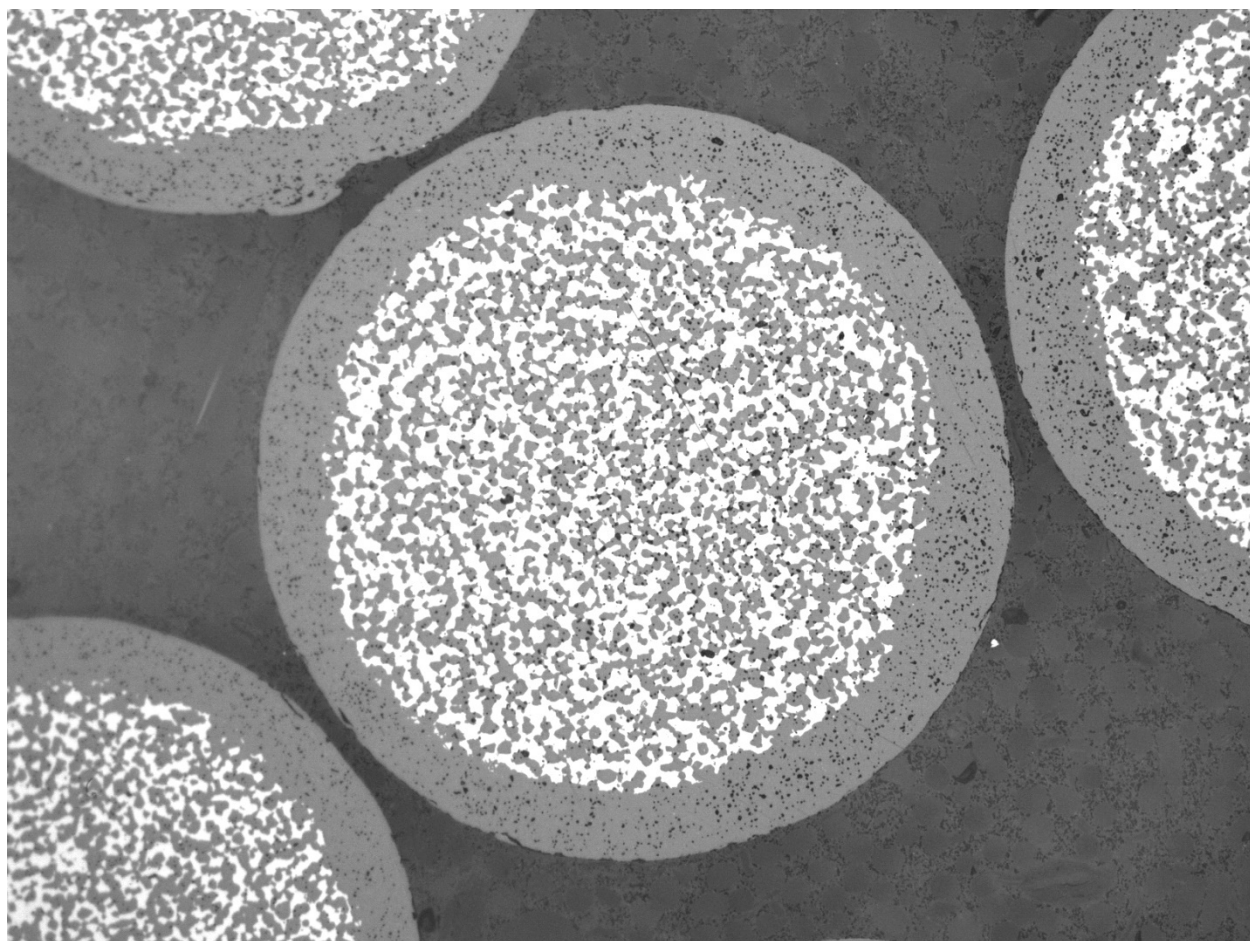
P17030905N091 segmented



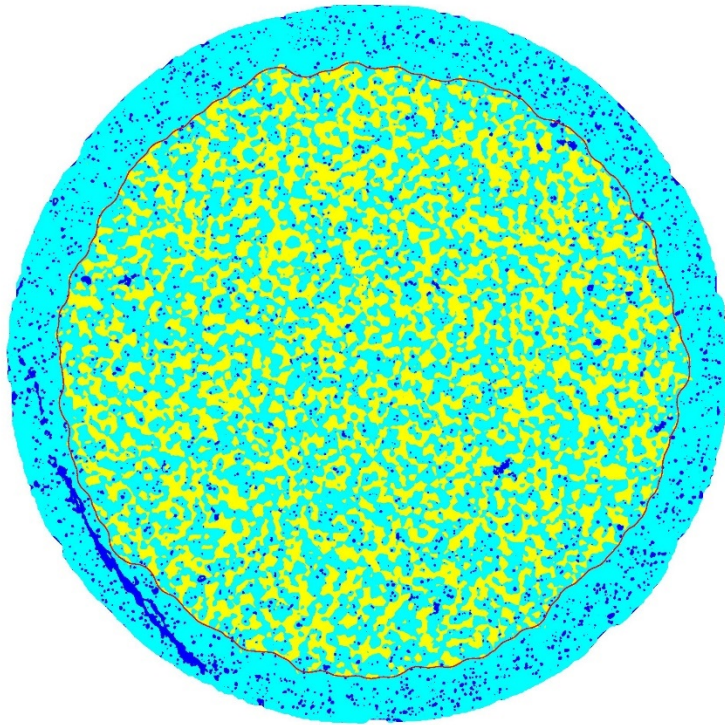
P17030905N091



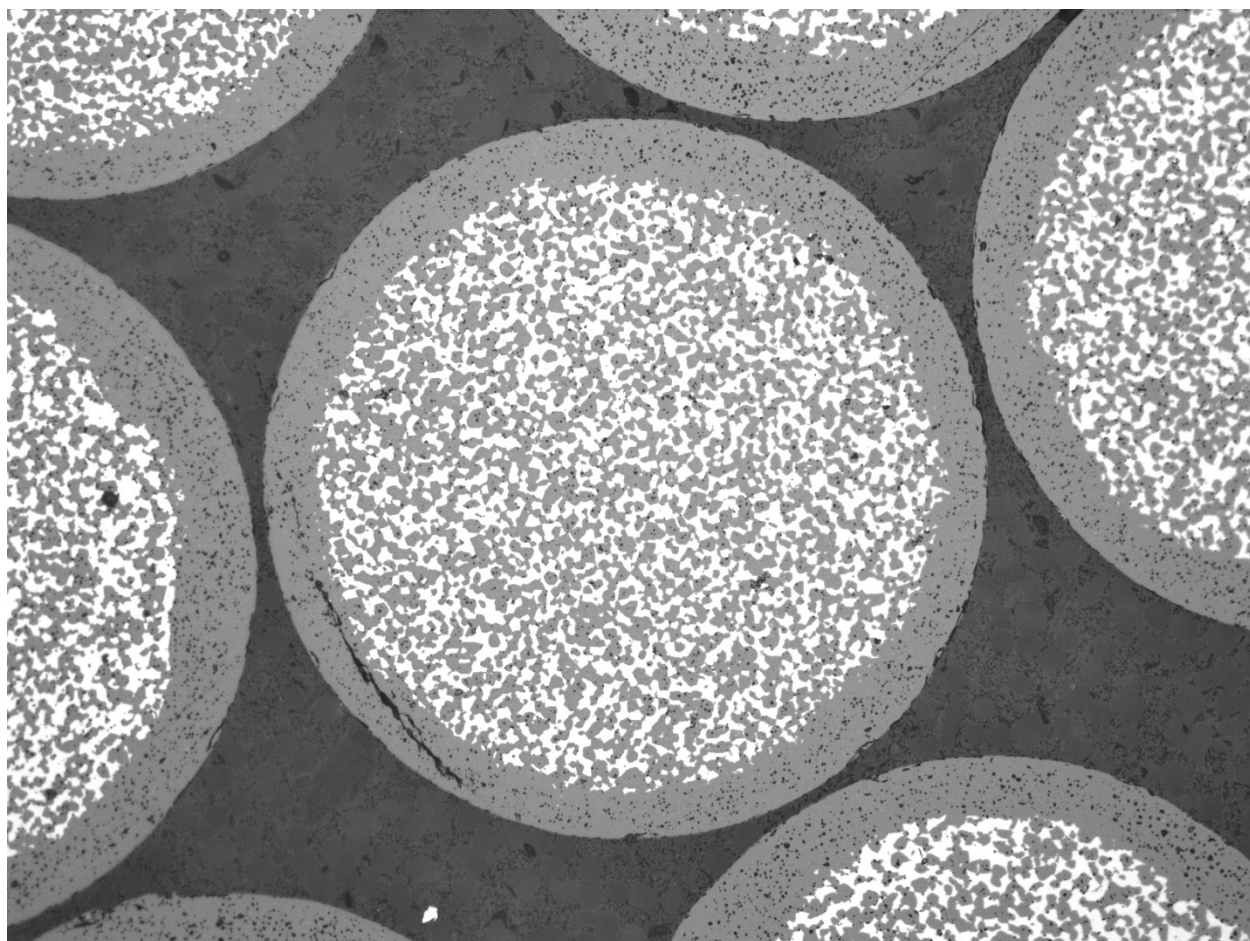
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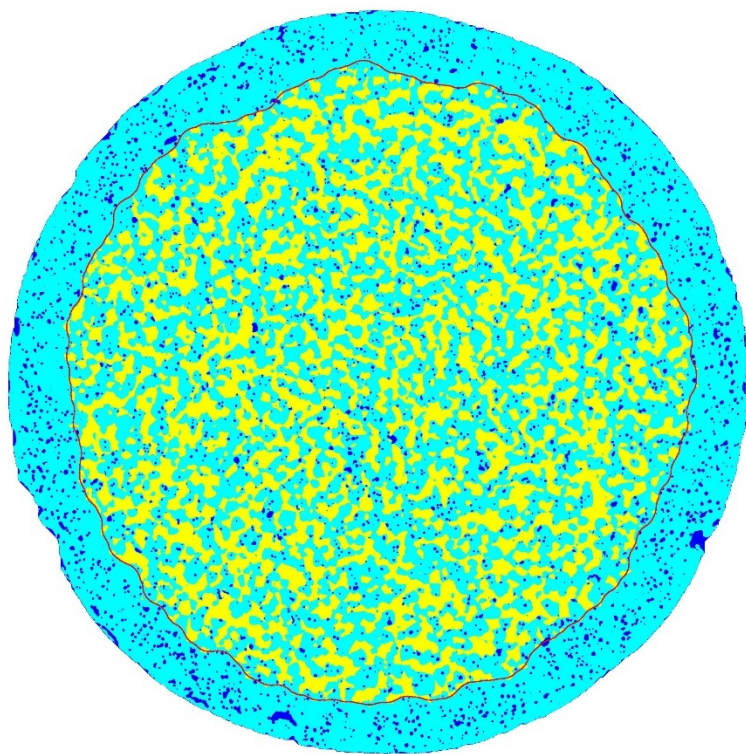
P17030905N092



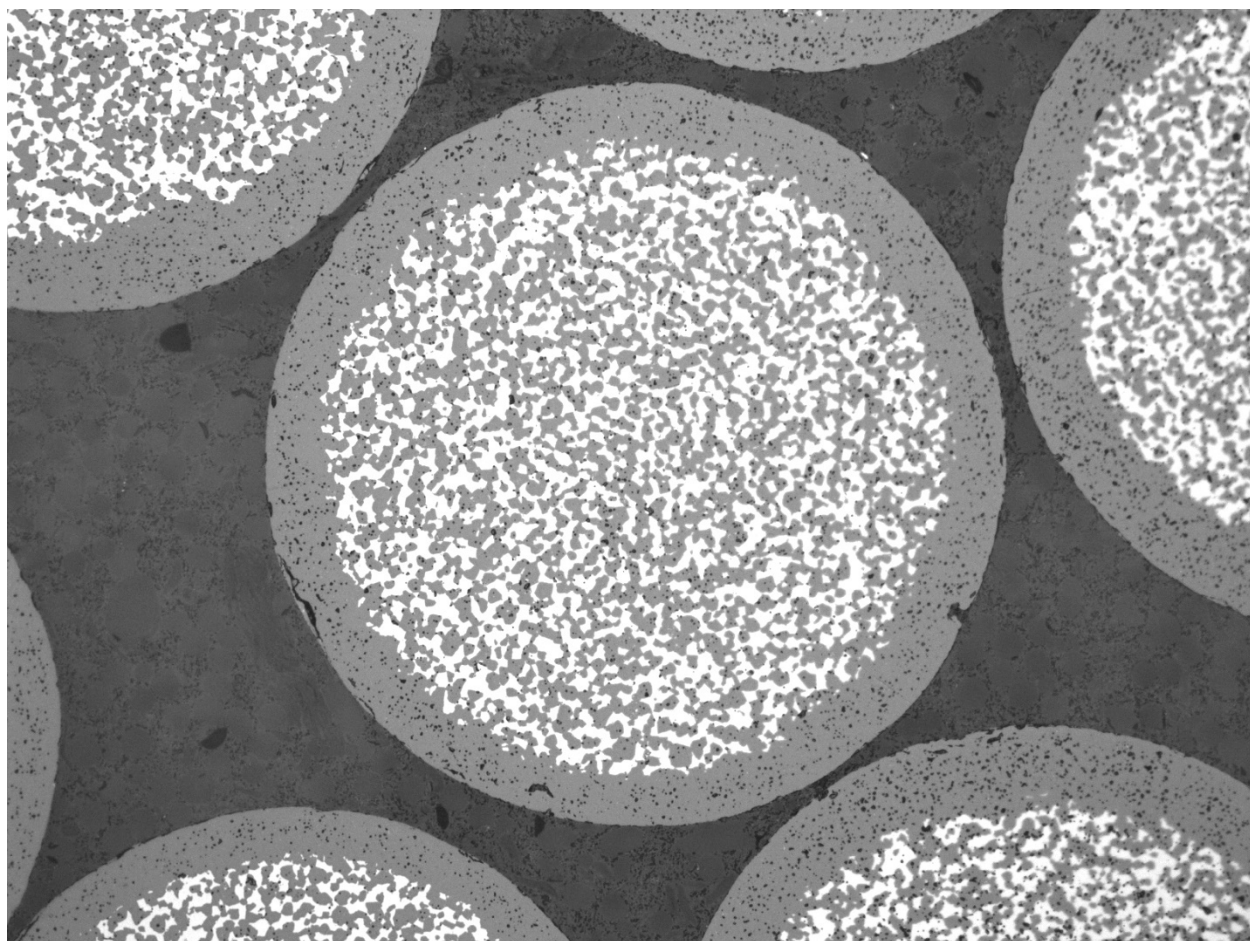
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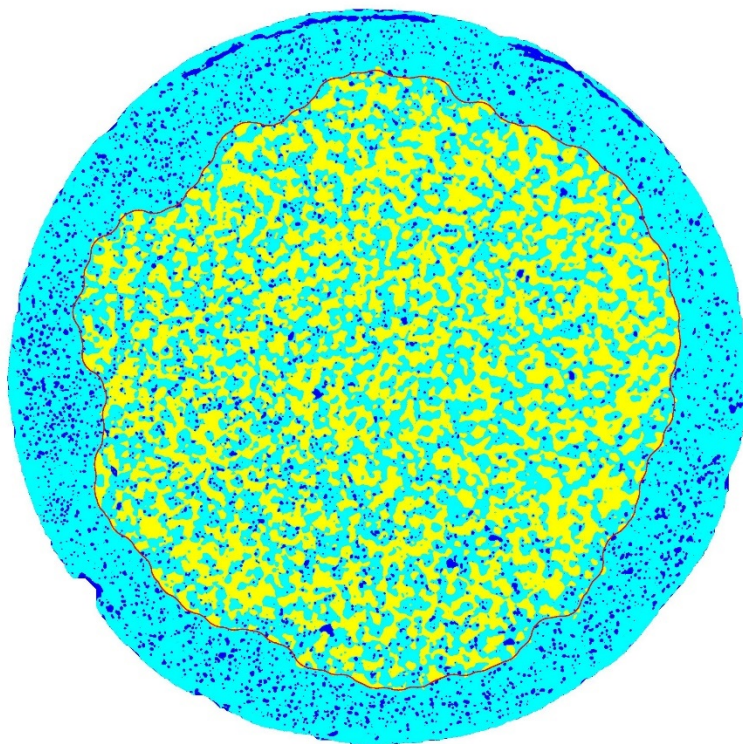
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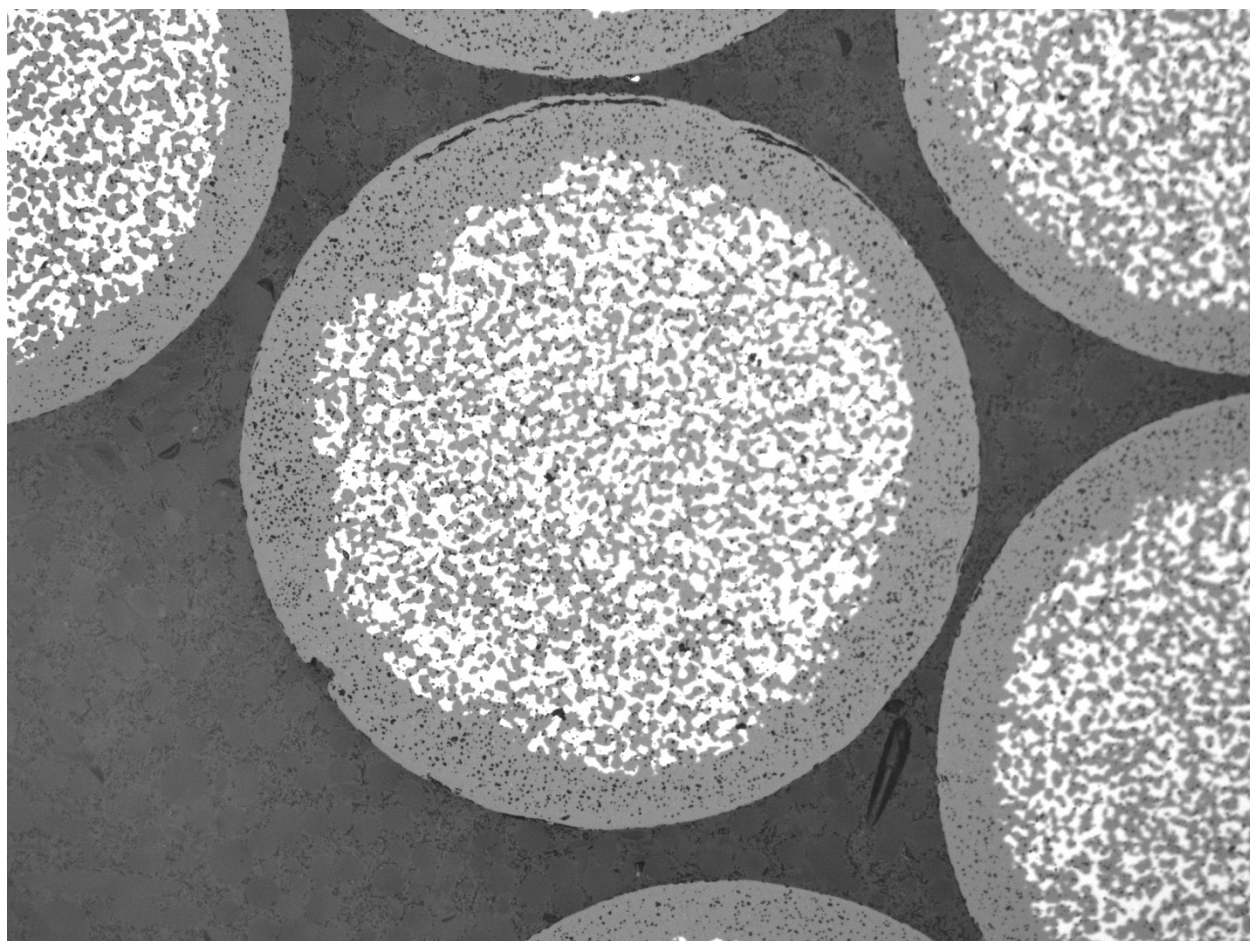
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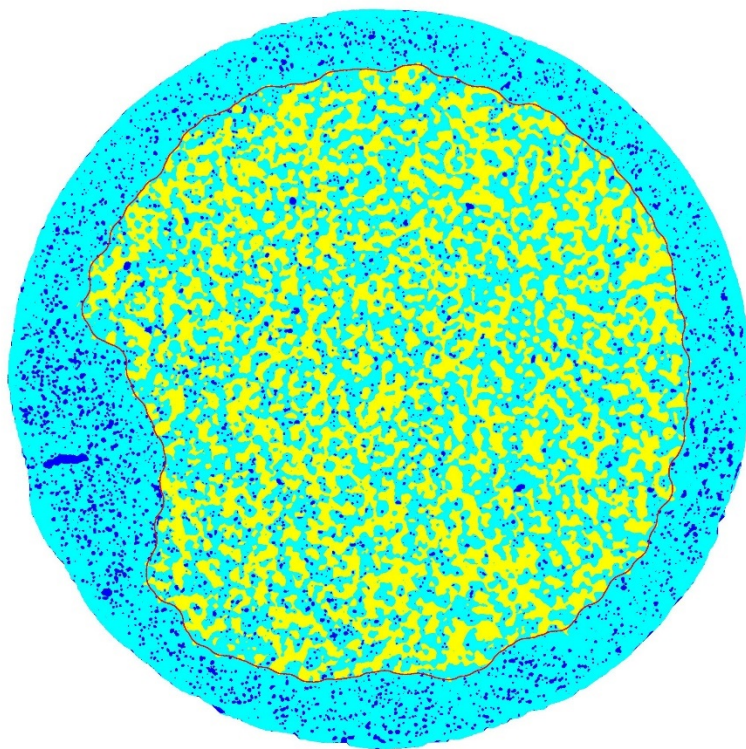
P17030905N094



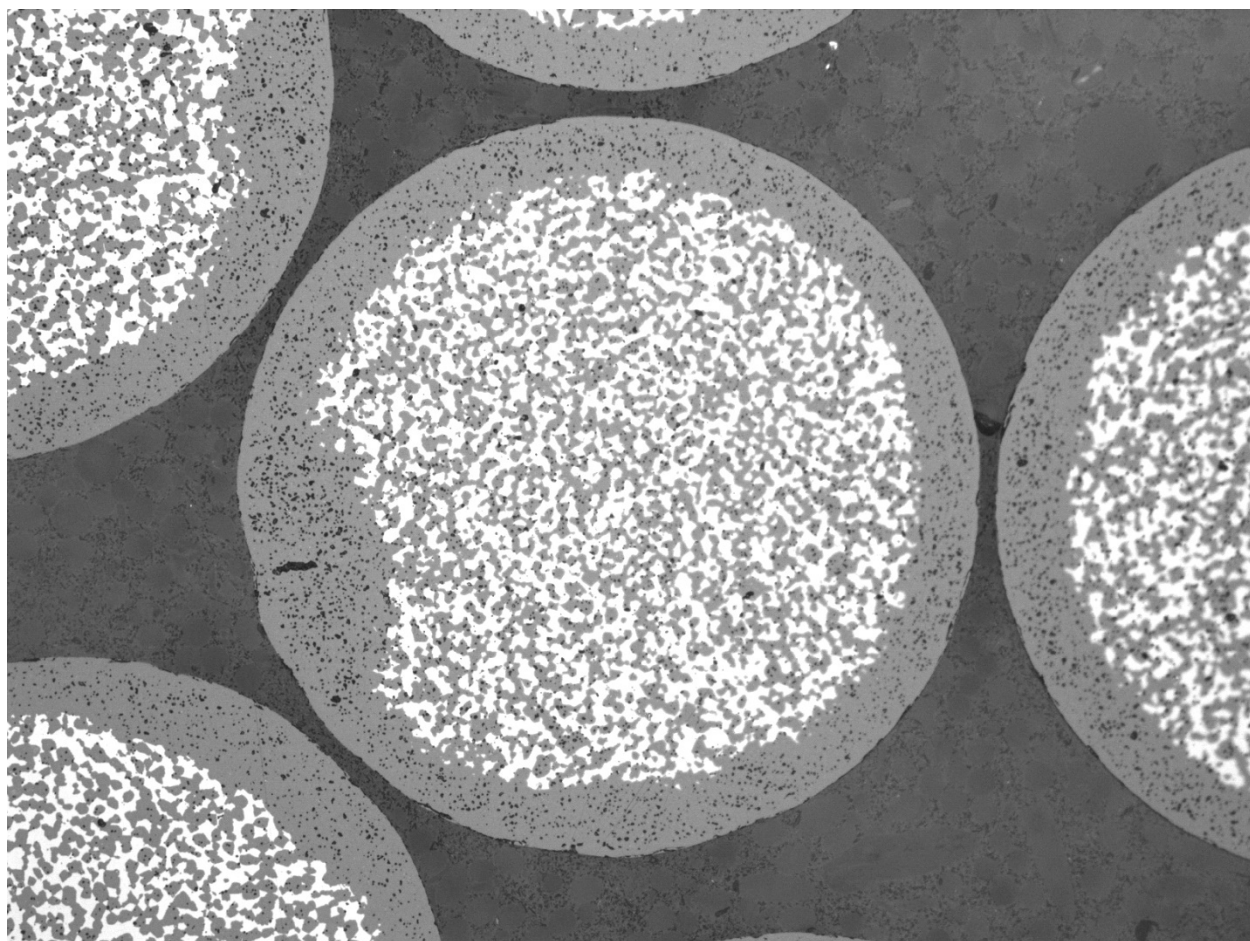
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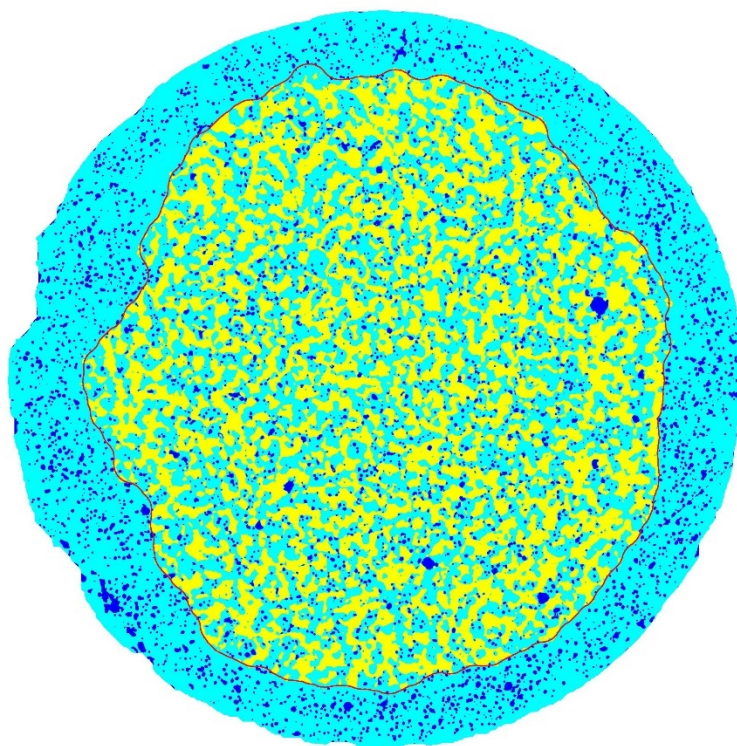
P17030905N095



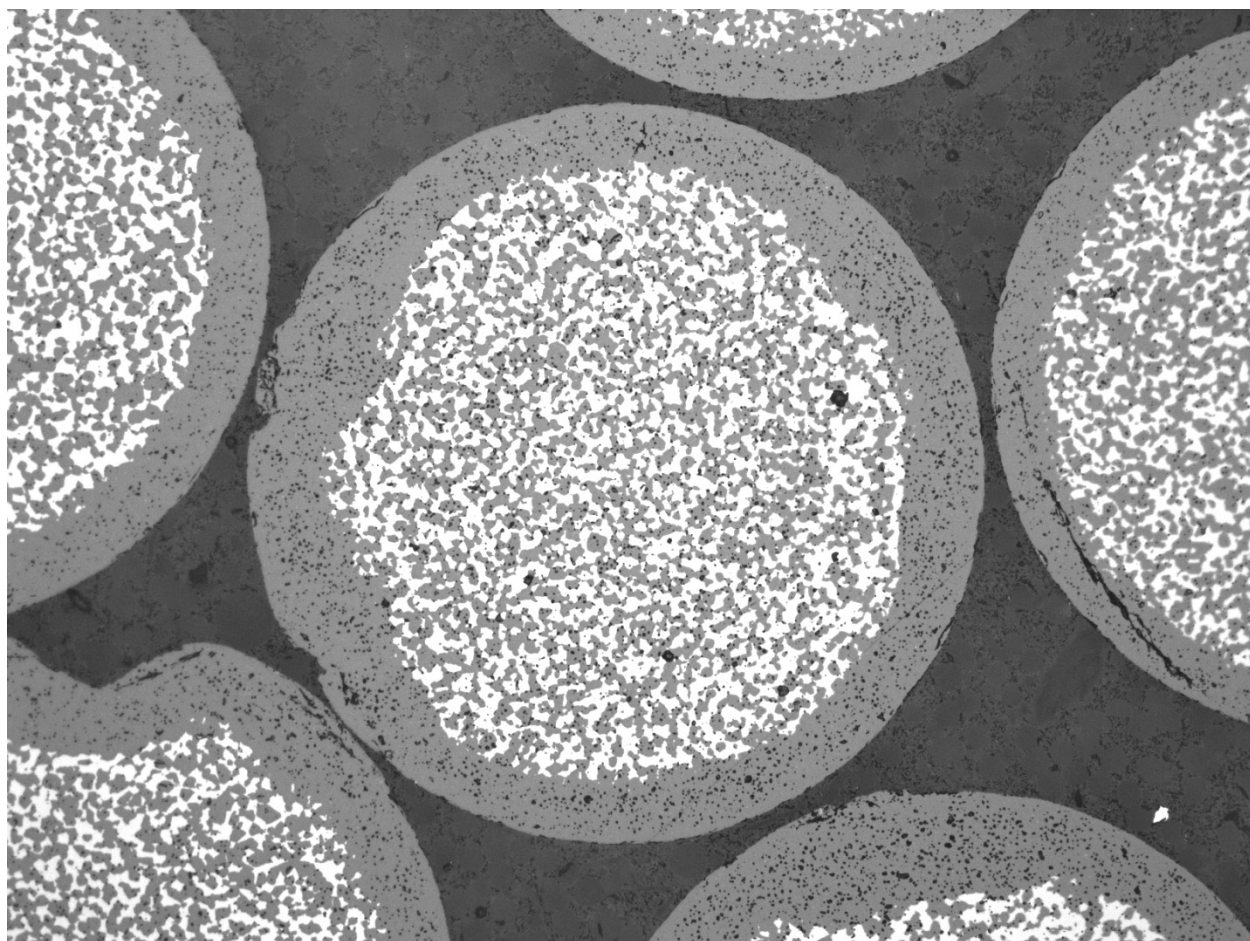
P17030905N096 segmented



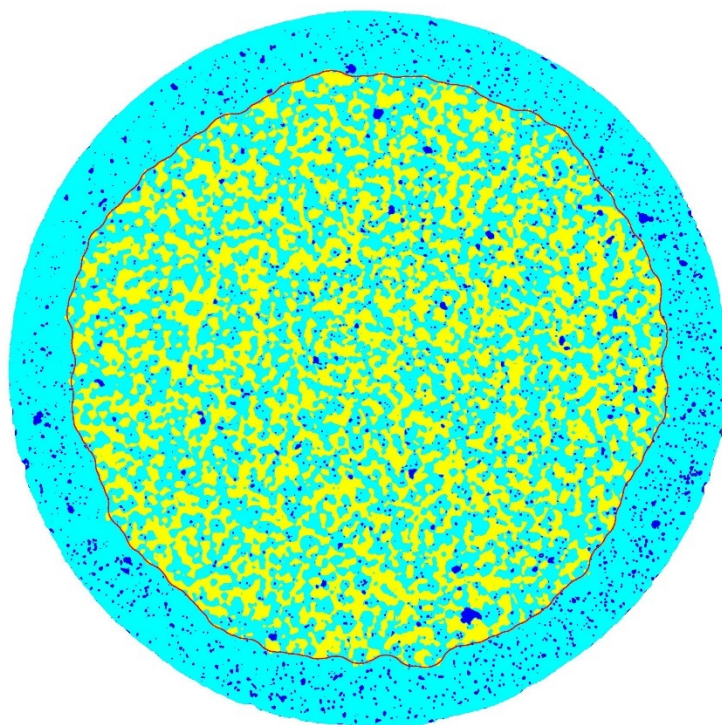
P17030905N096



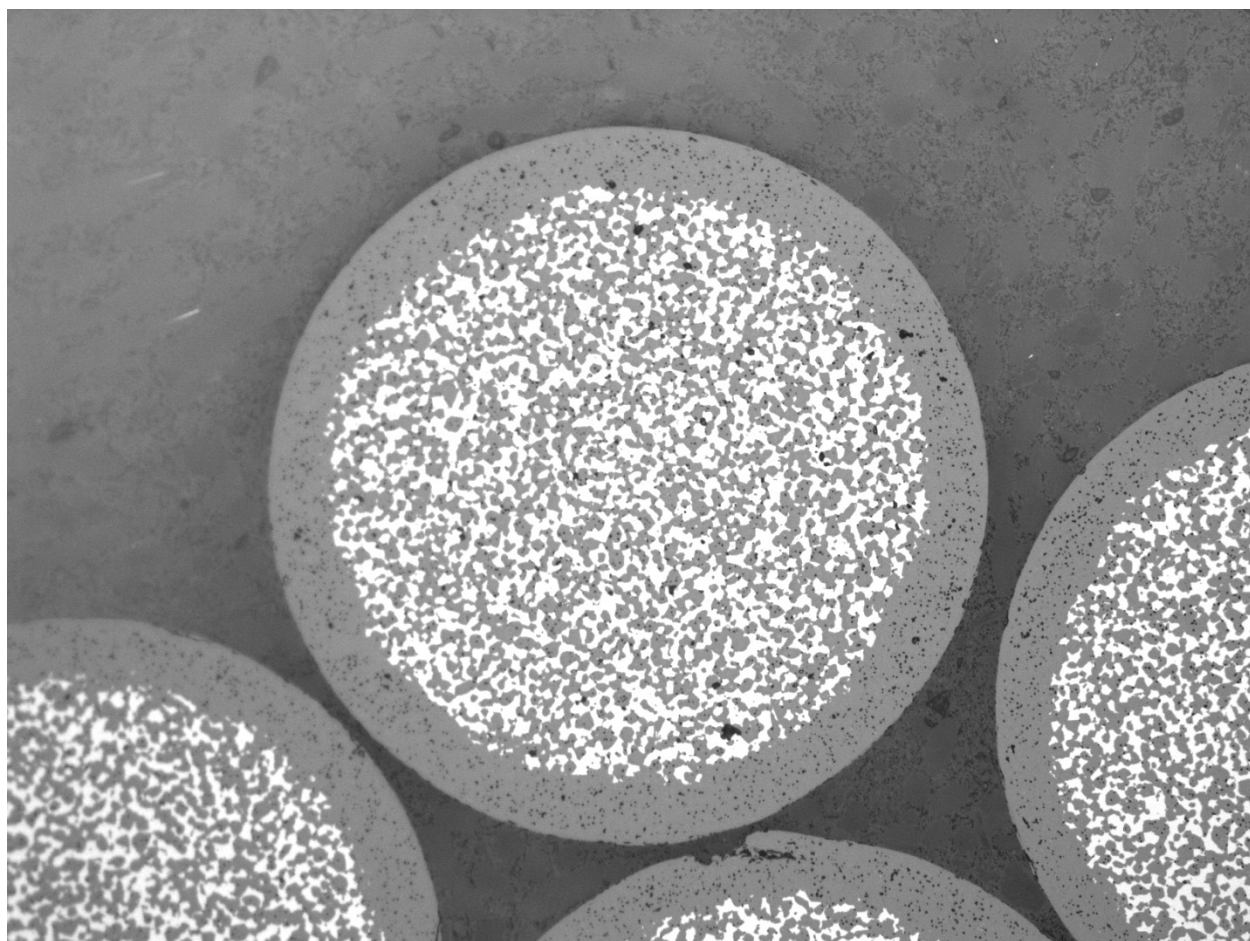
P17030905N098 segmented



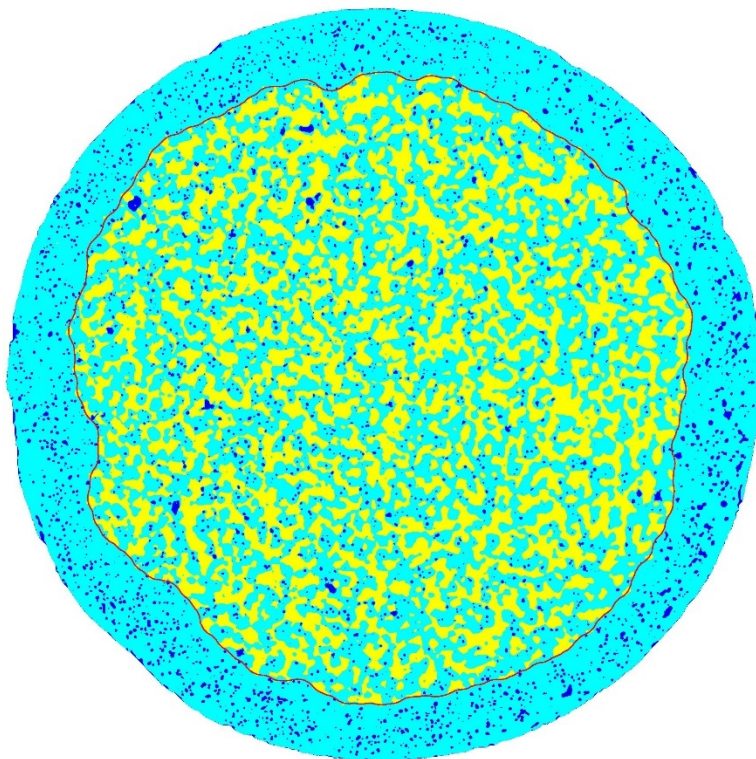
P17030905N098



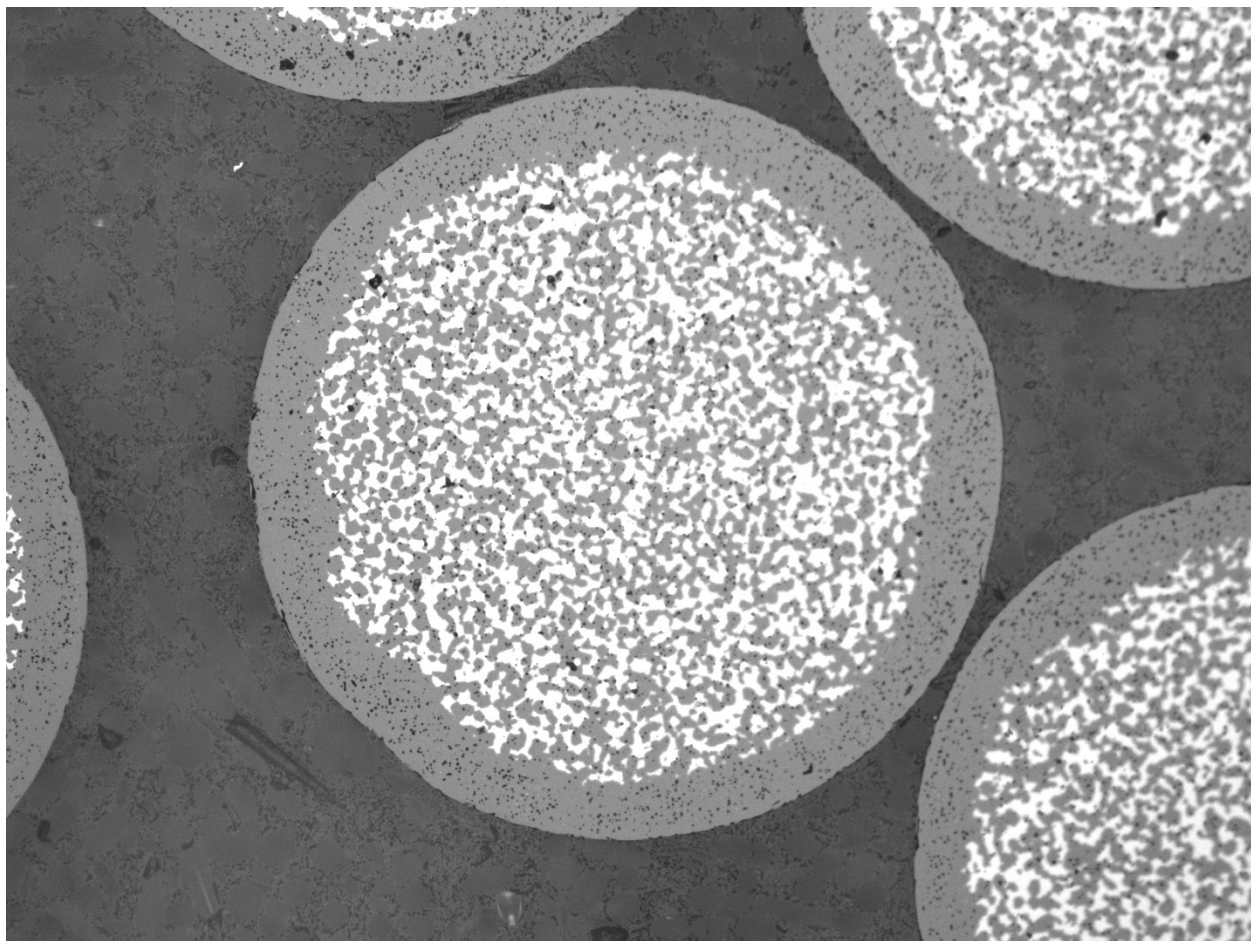
P17030905N099 segmented



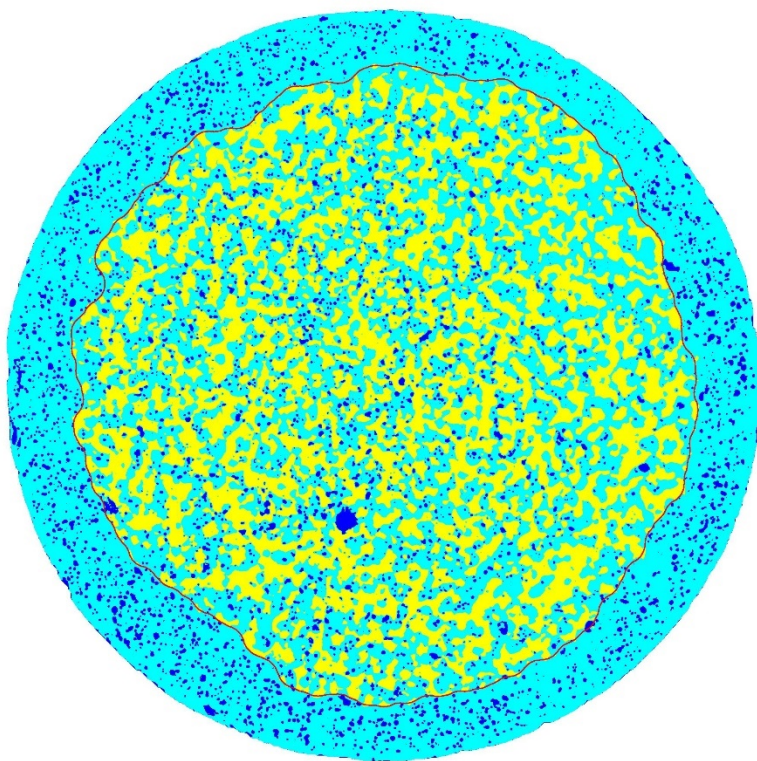
P17030905N099



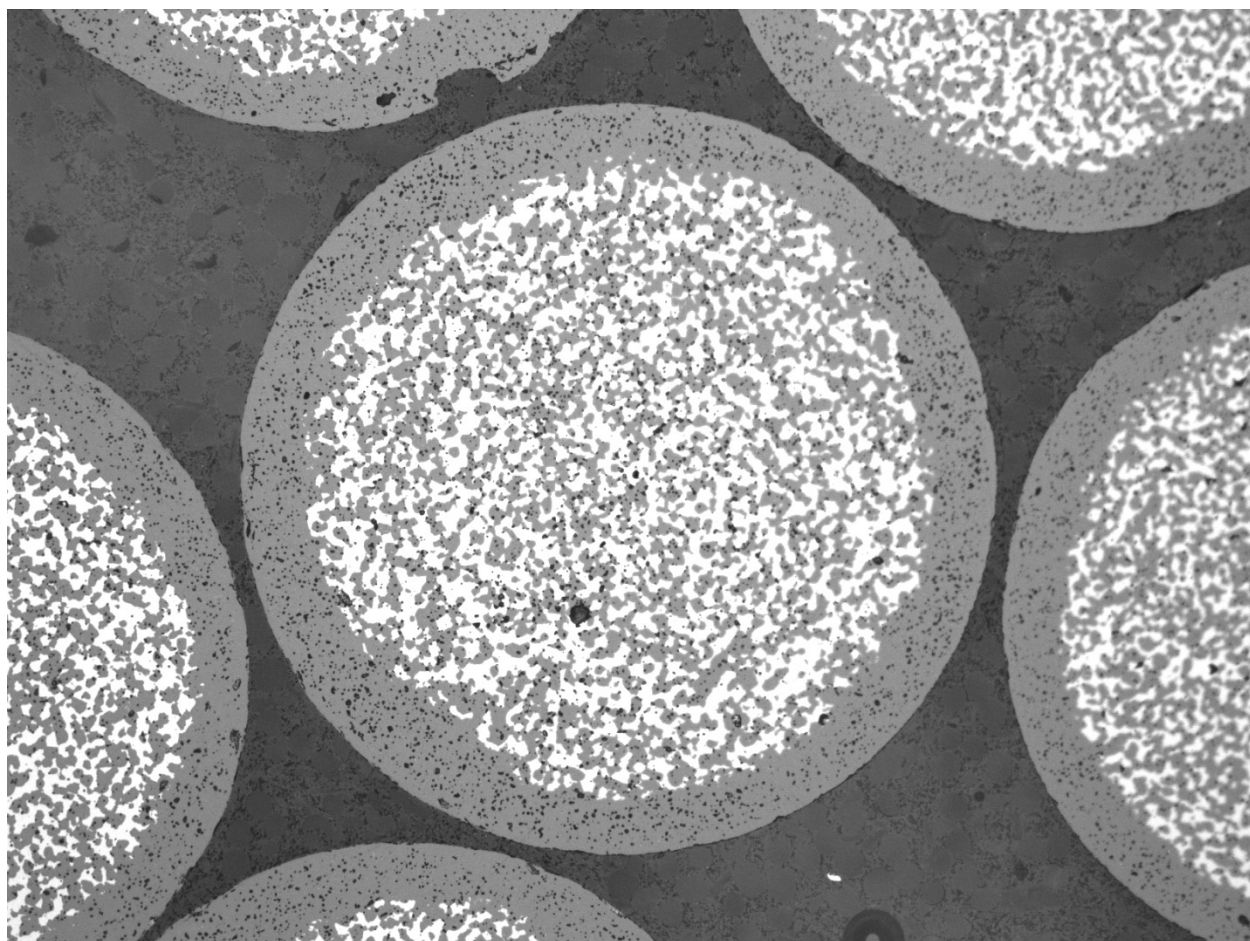
P17030905N100 segmented



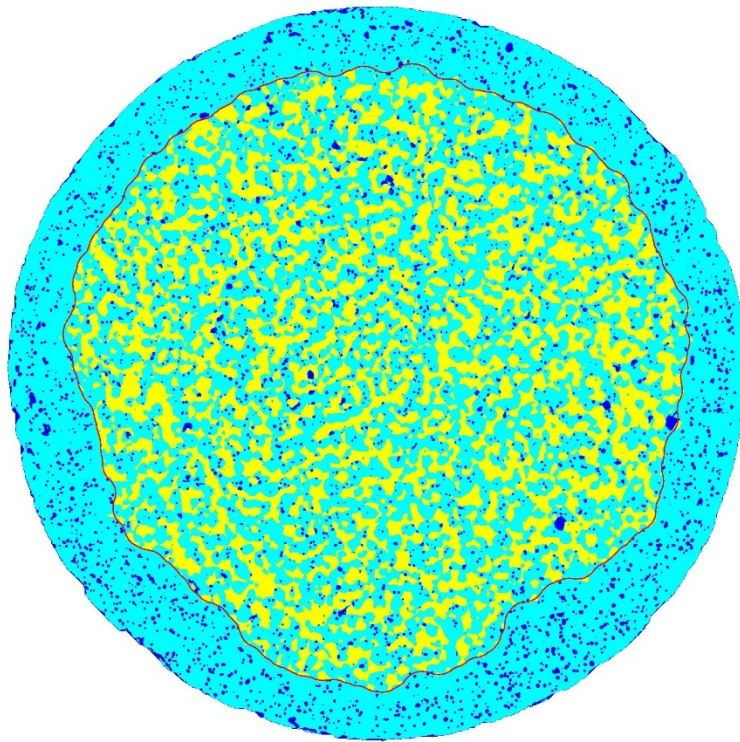
P17030905N100



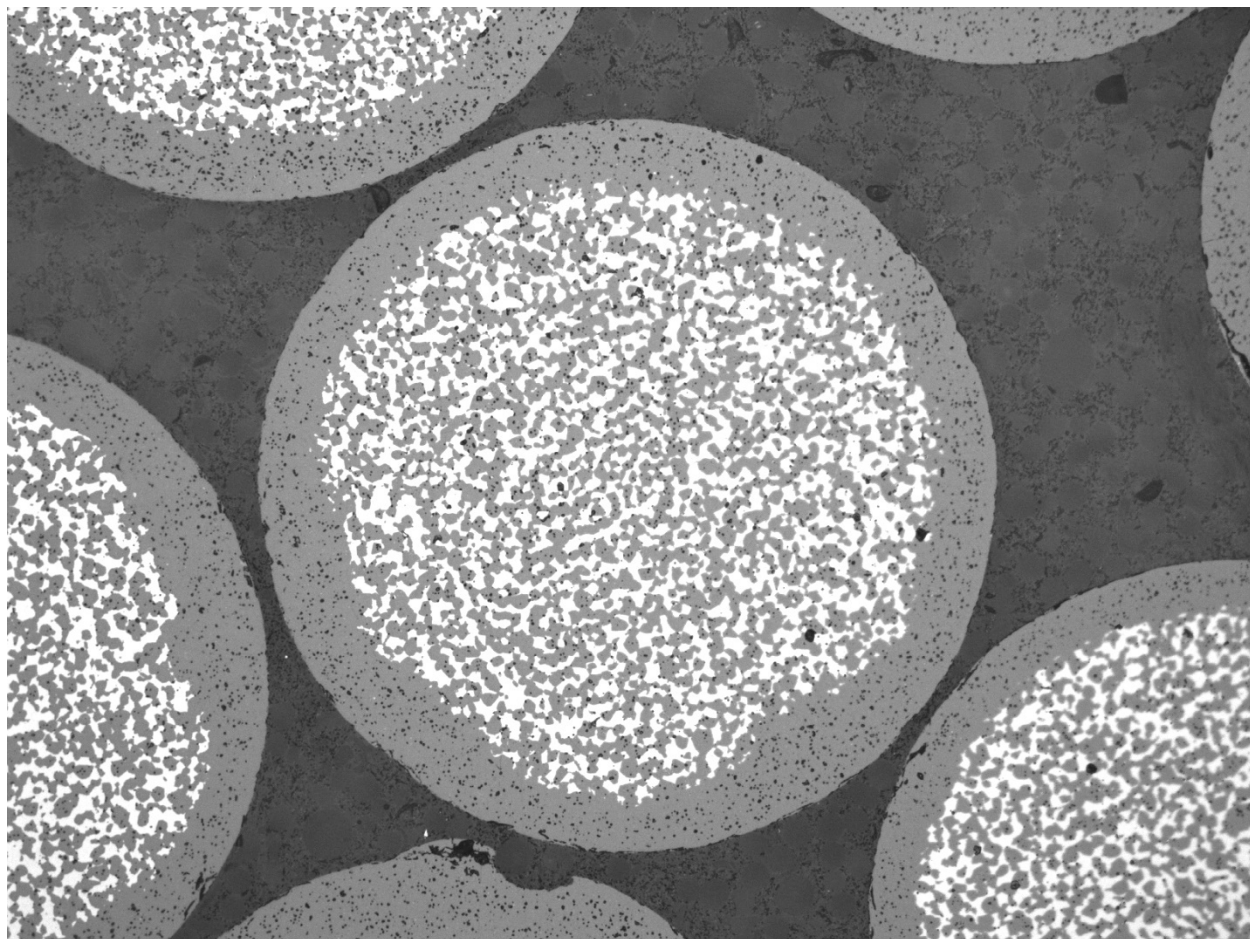
P17030905N101 segmented



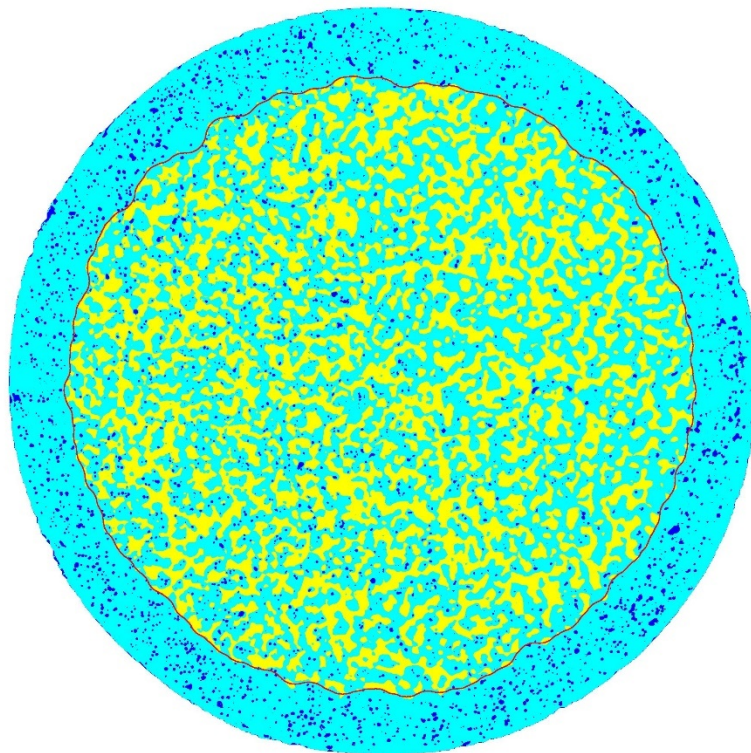
P17030905N101



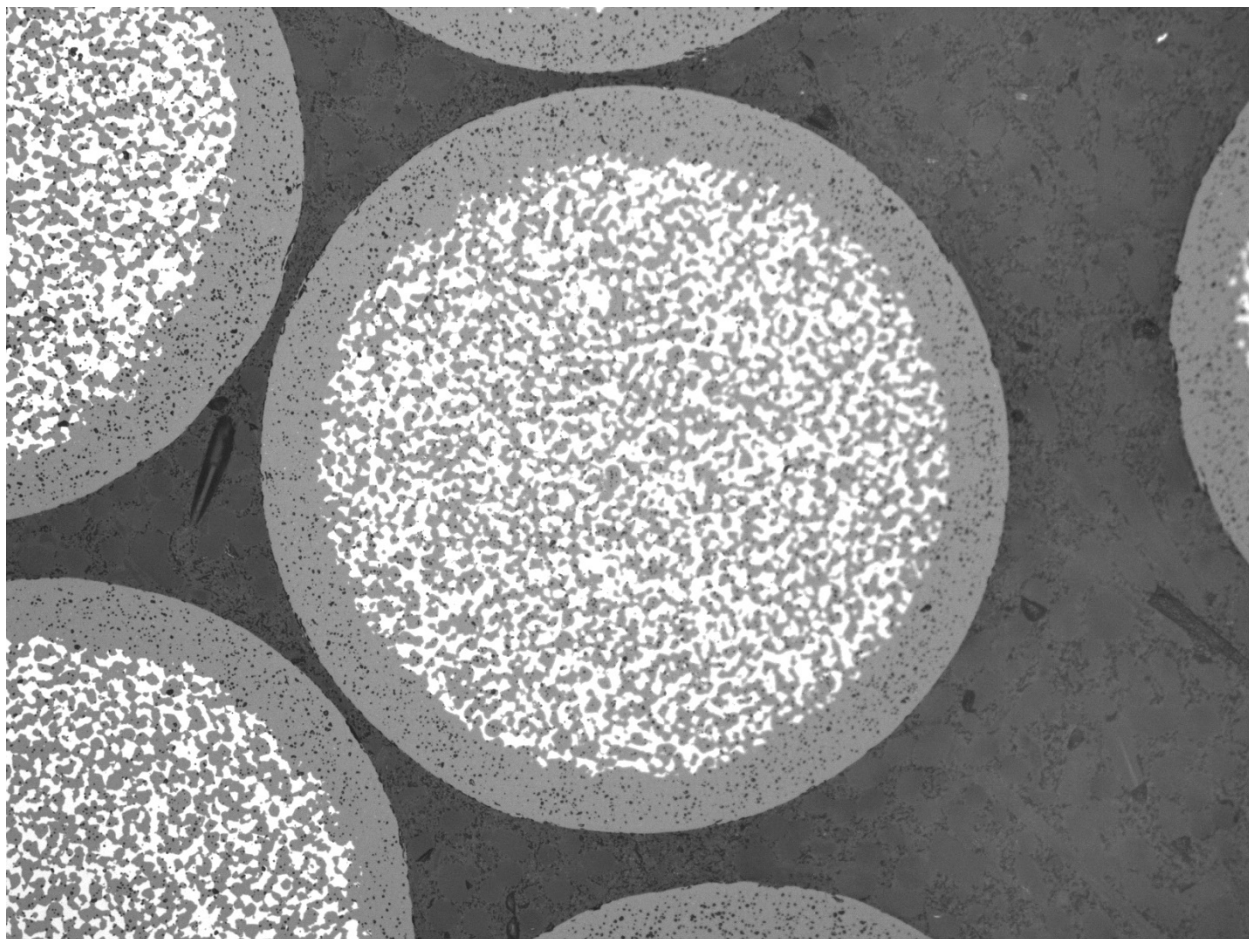
P17030905N102 segmented



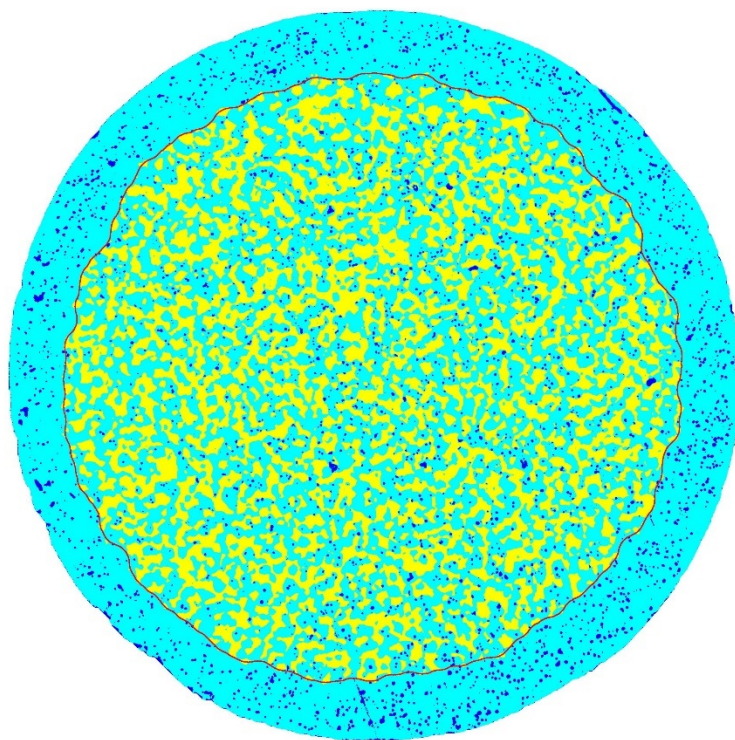
P17030905N102



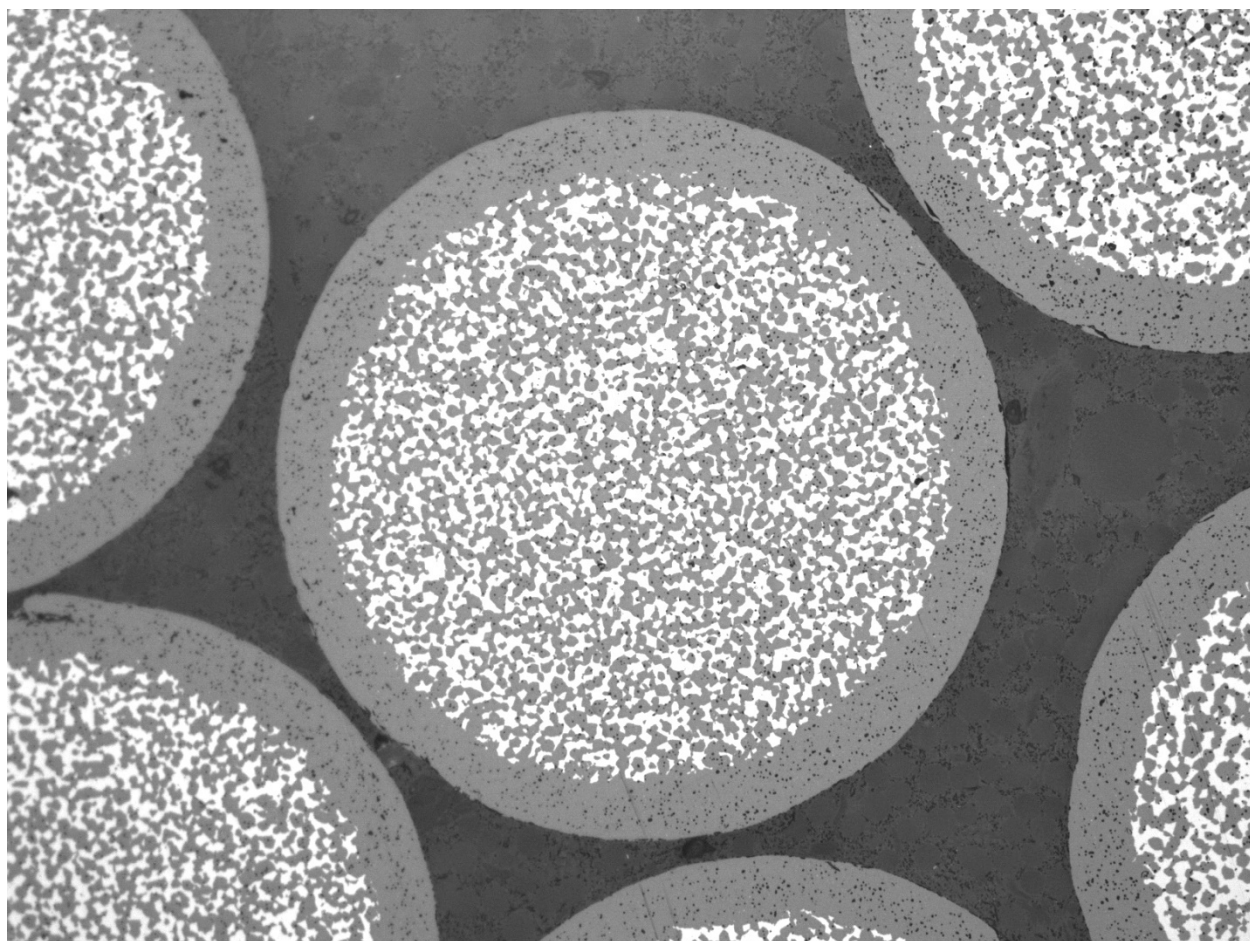
P17030905N103 segmented



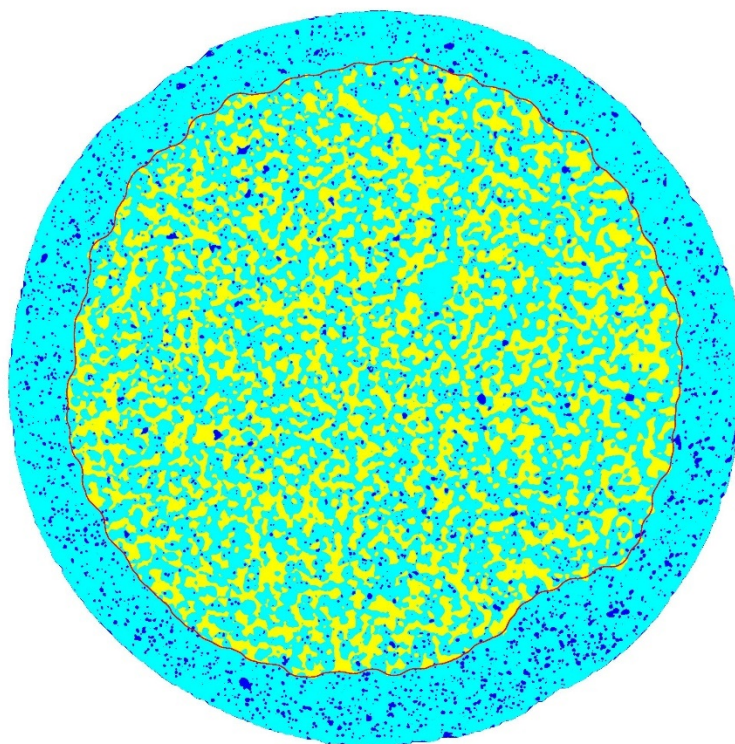
P17030905N103



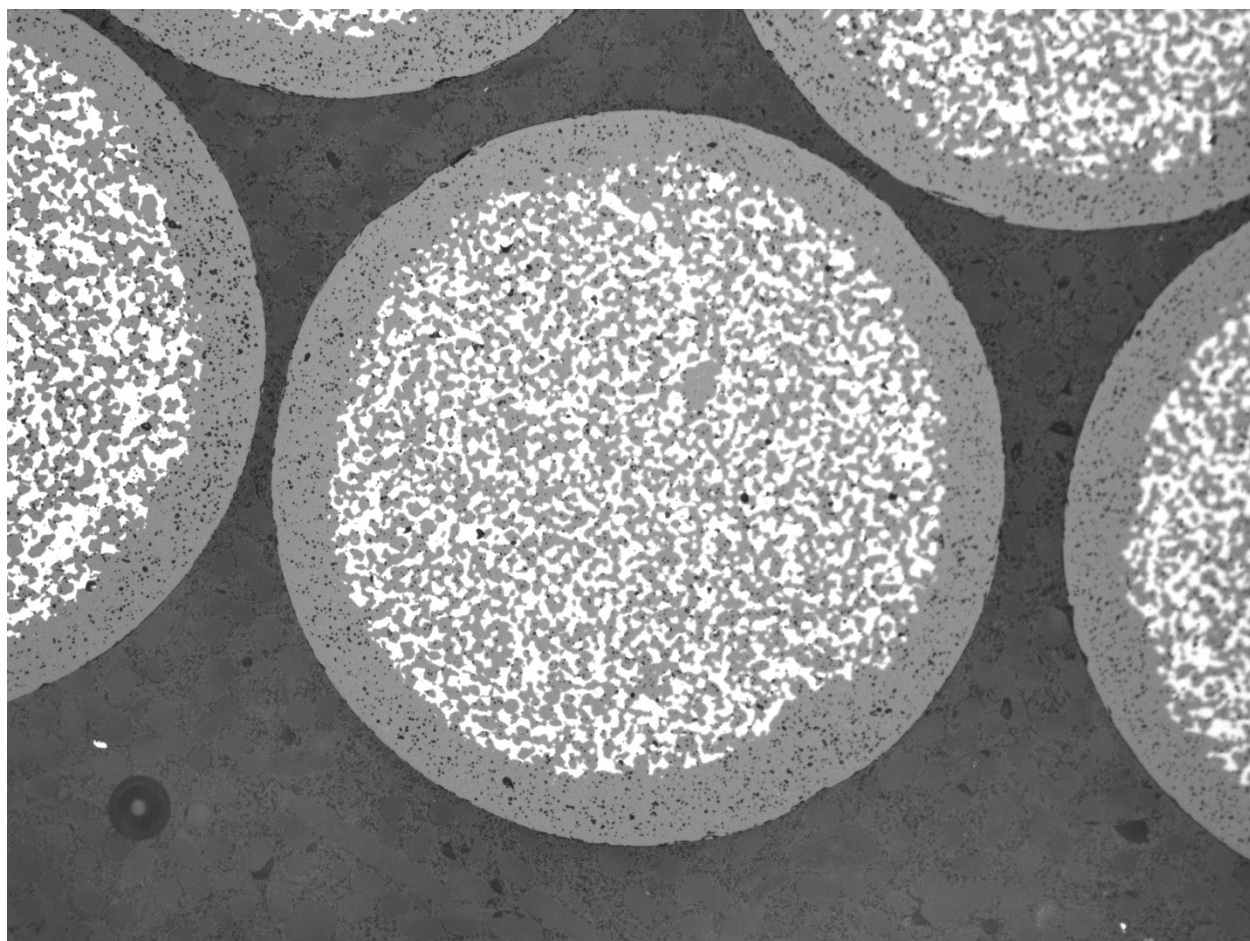
P17030905N104 segmented



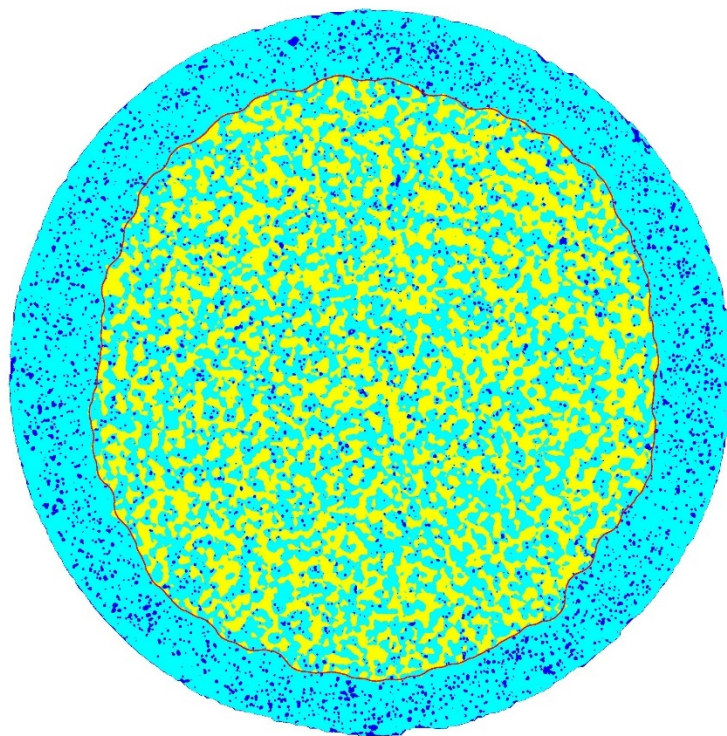
P17030905N104



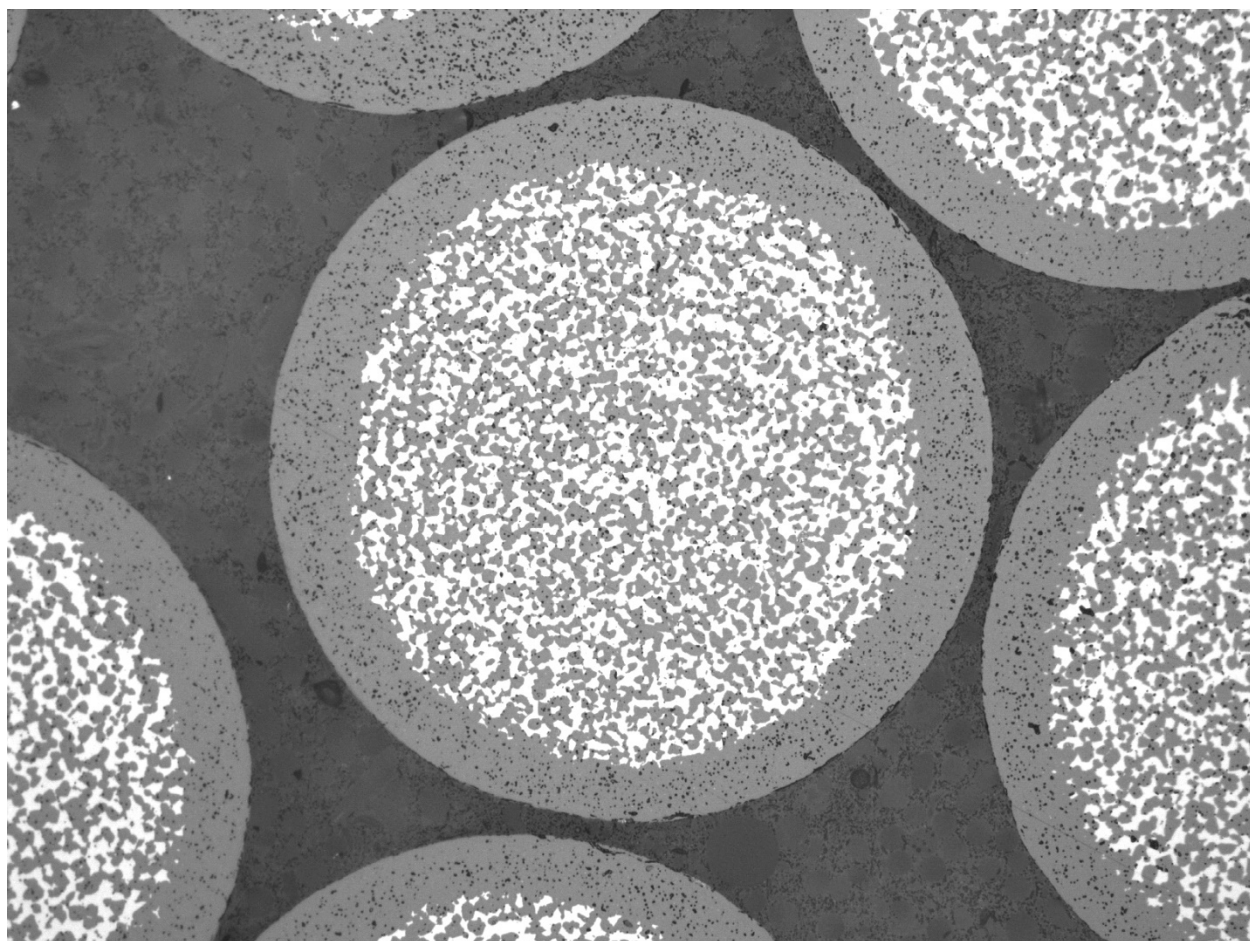
P17030905N105 segmented



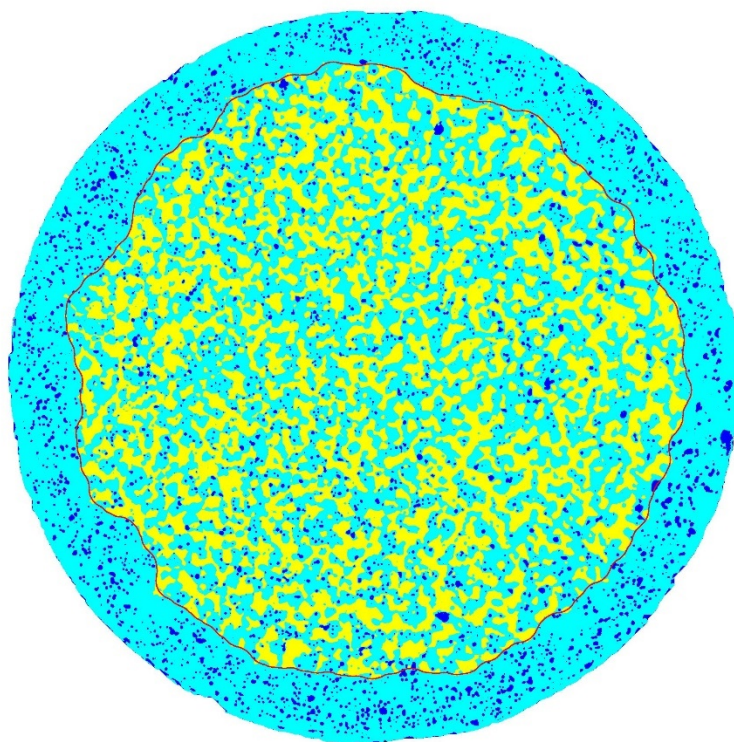
P17030905N105



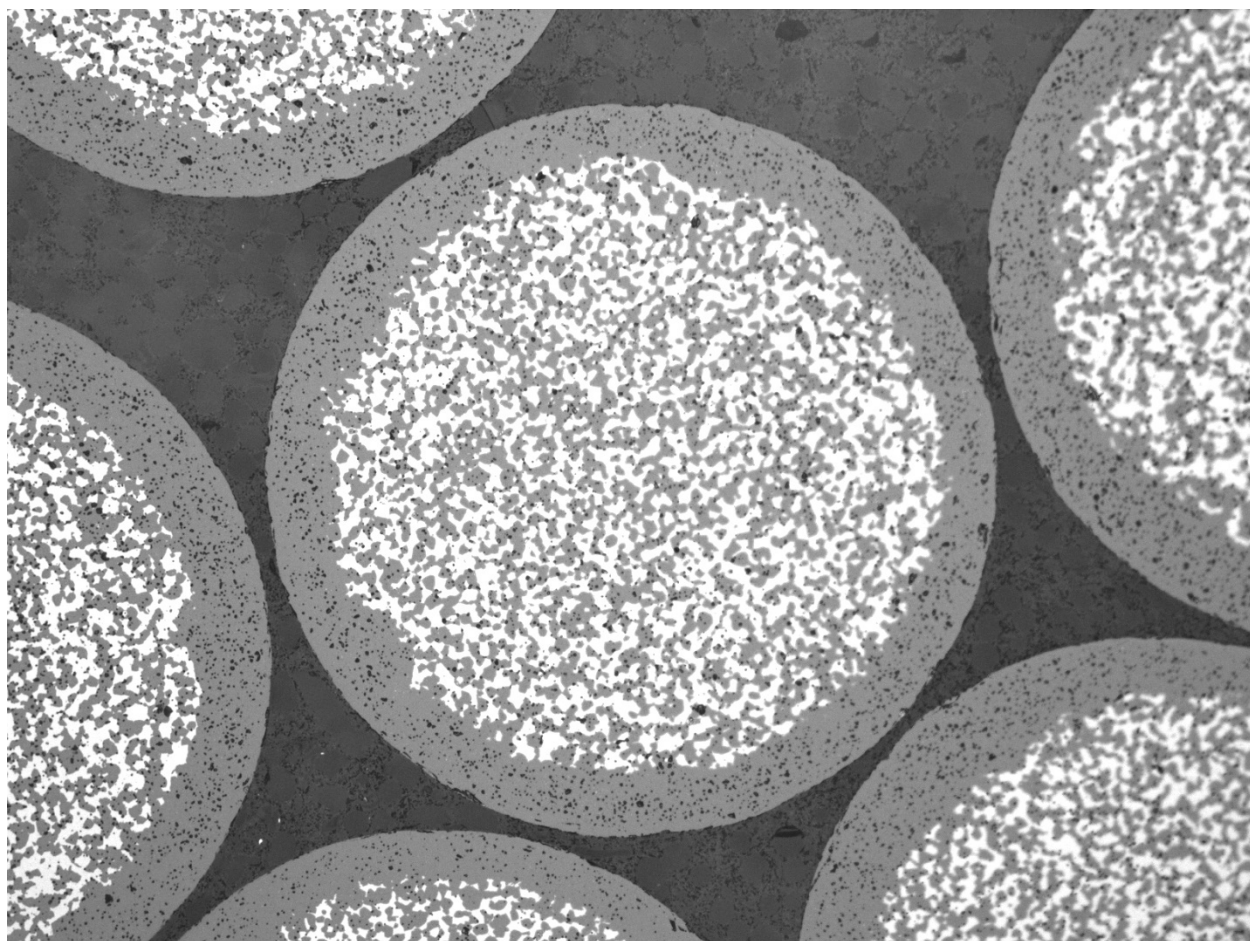
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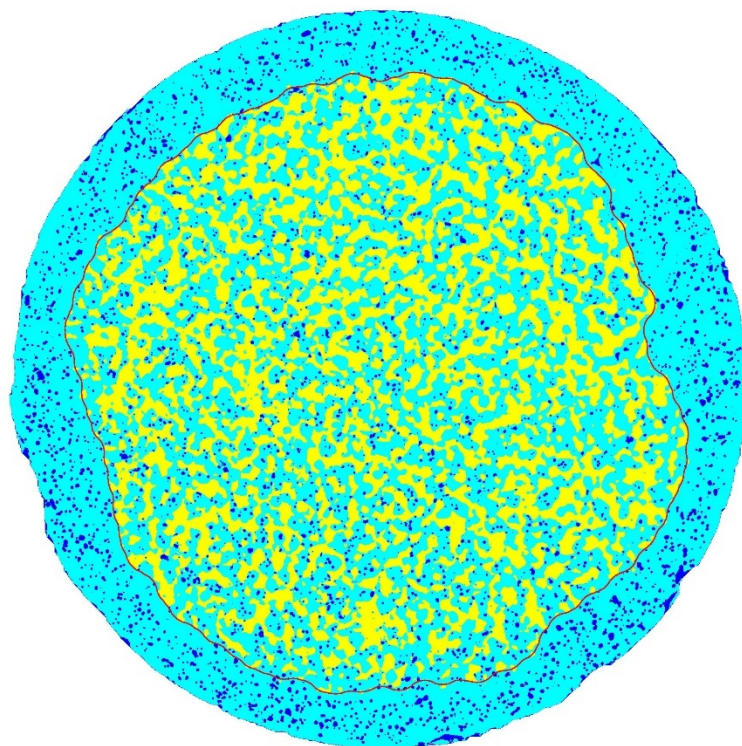
P17030905N106



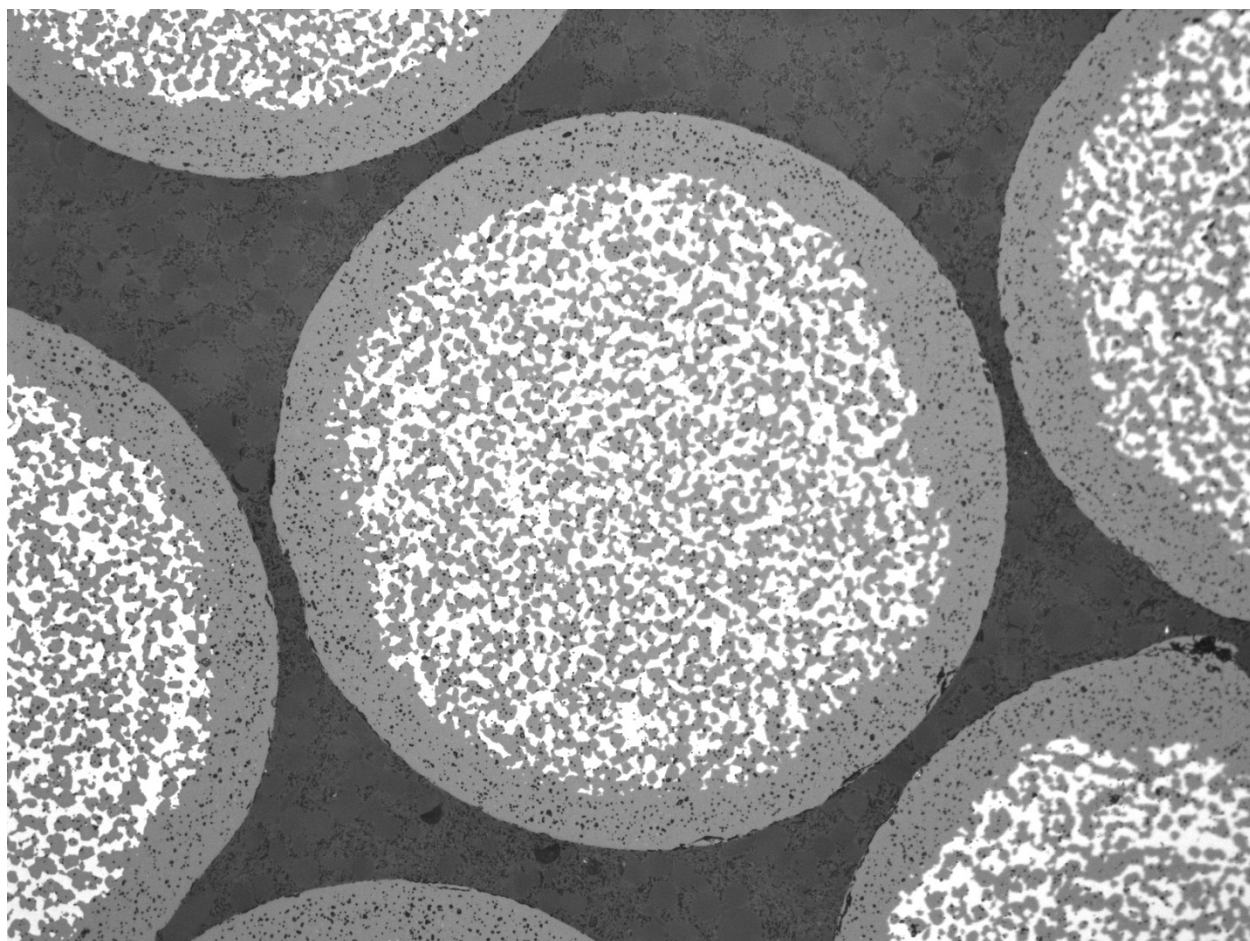
P17030905N107 segmented



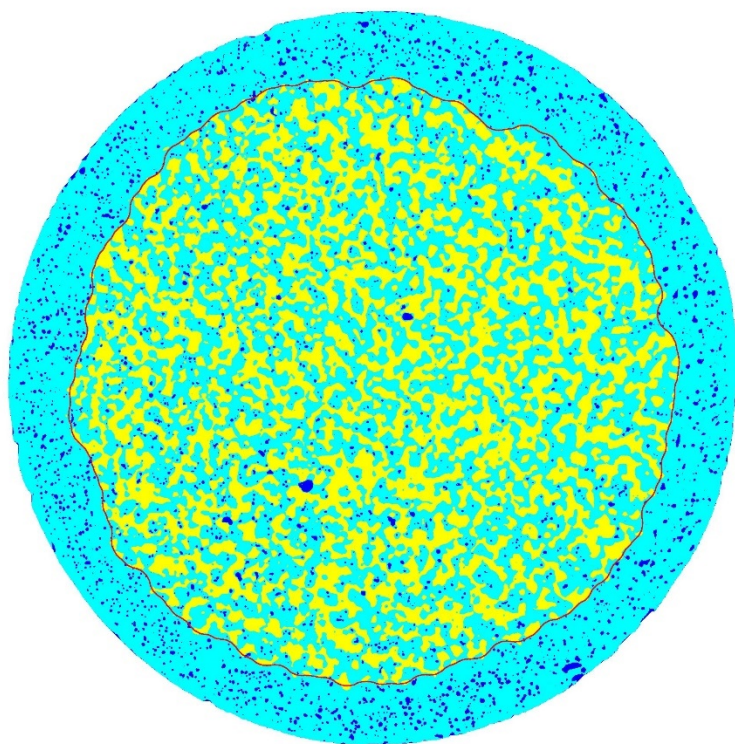
P17030905N107



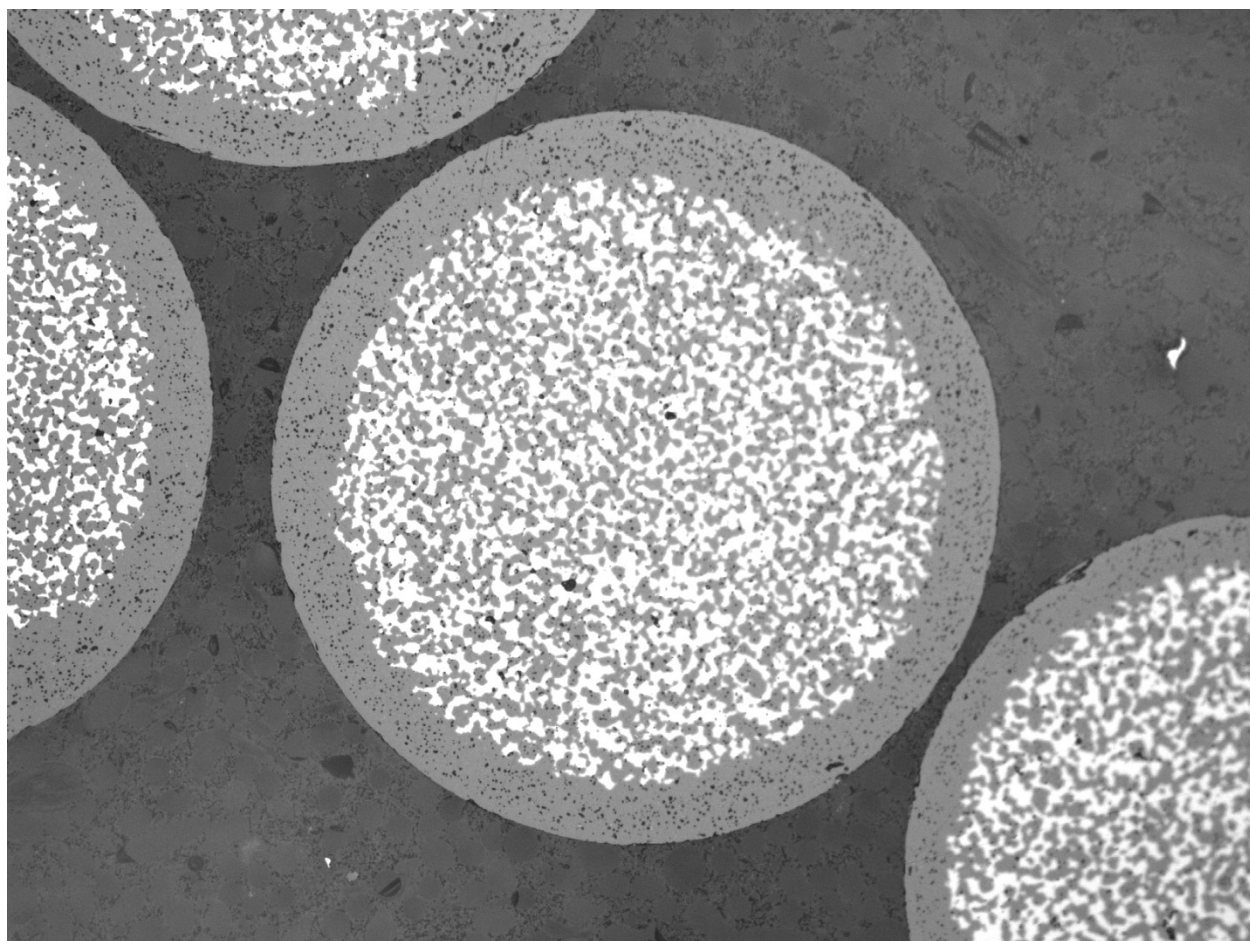
P17030905N108 segmented



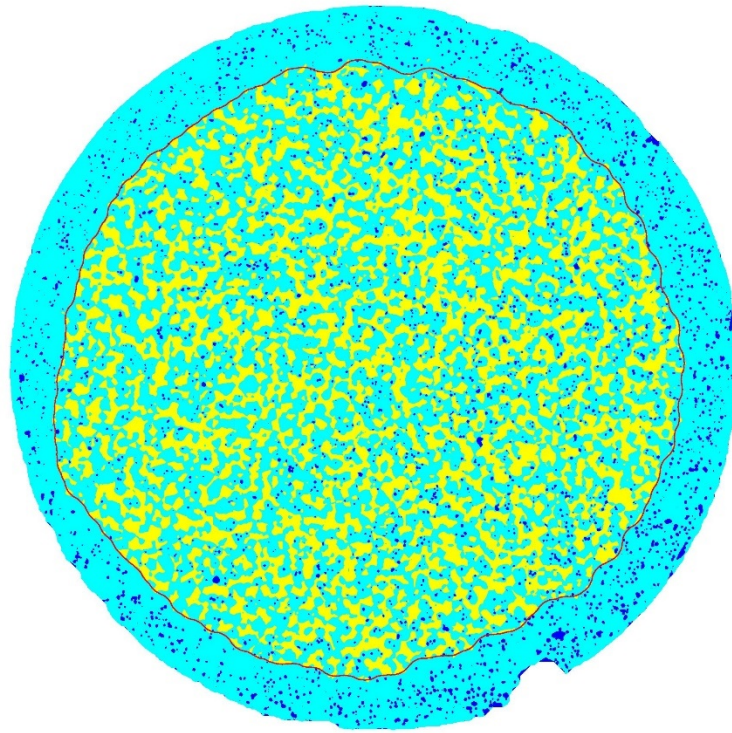
P17030905N108



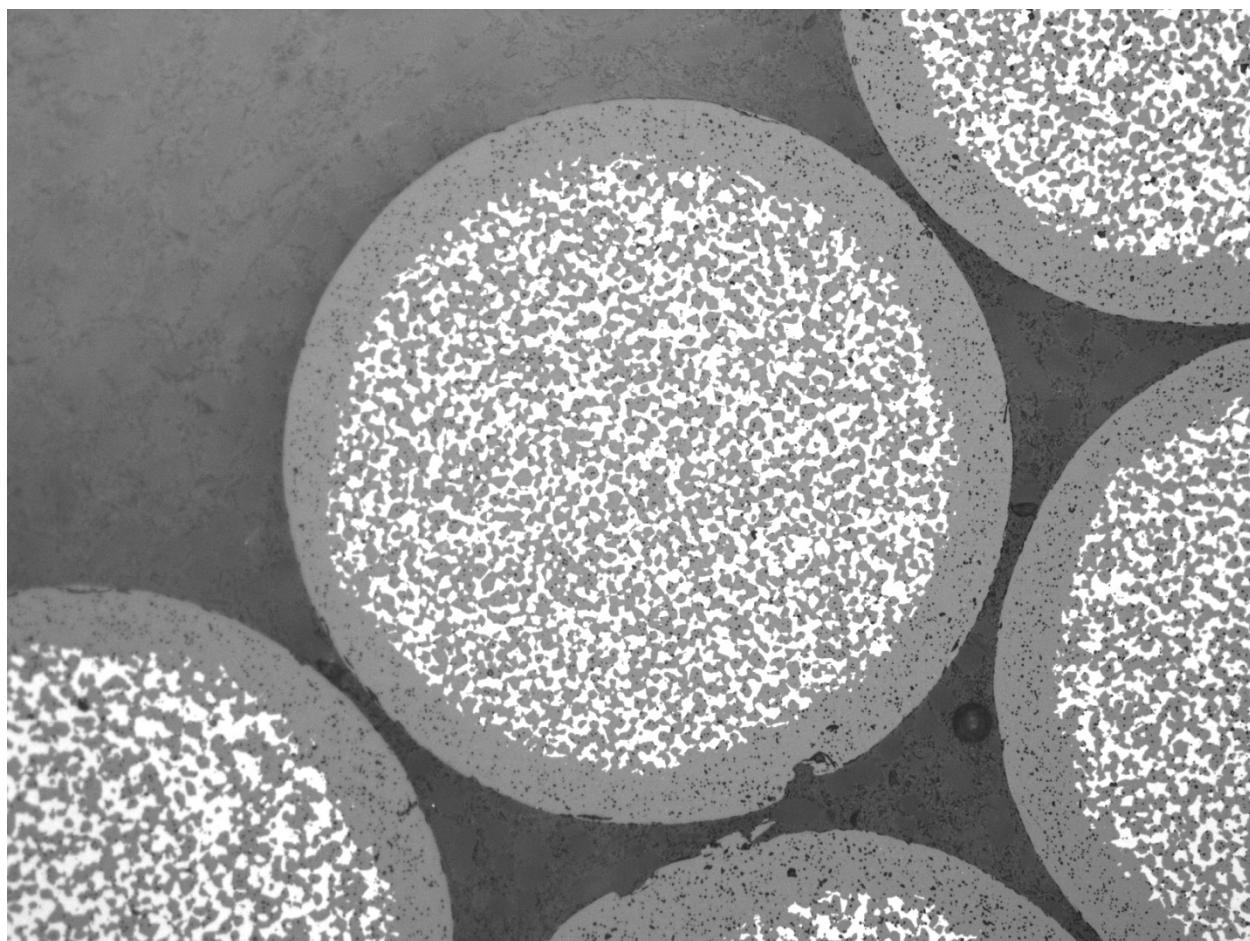
P17030905N109 segmented



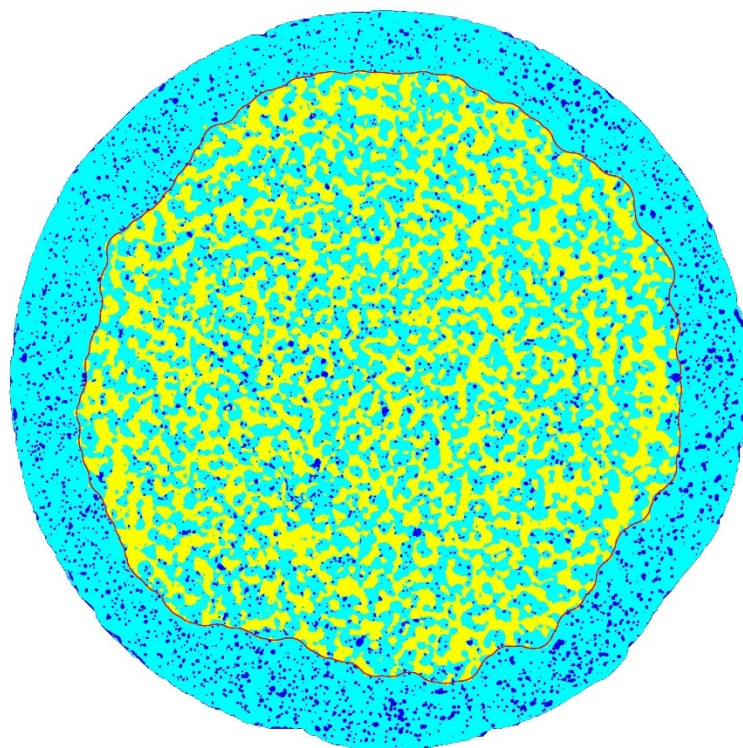
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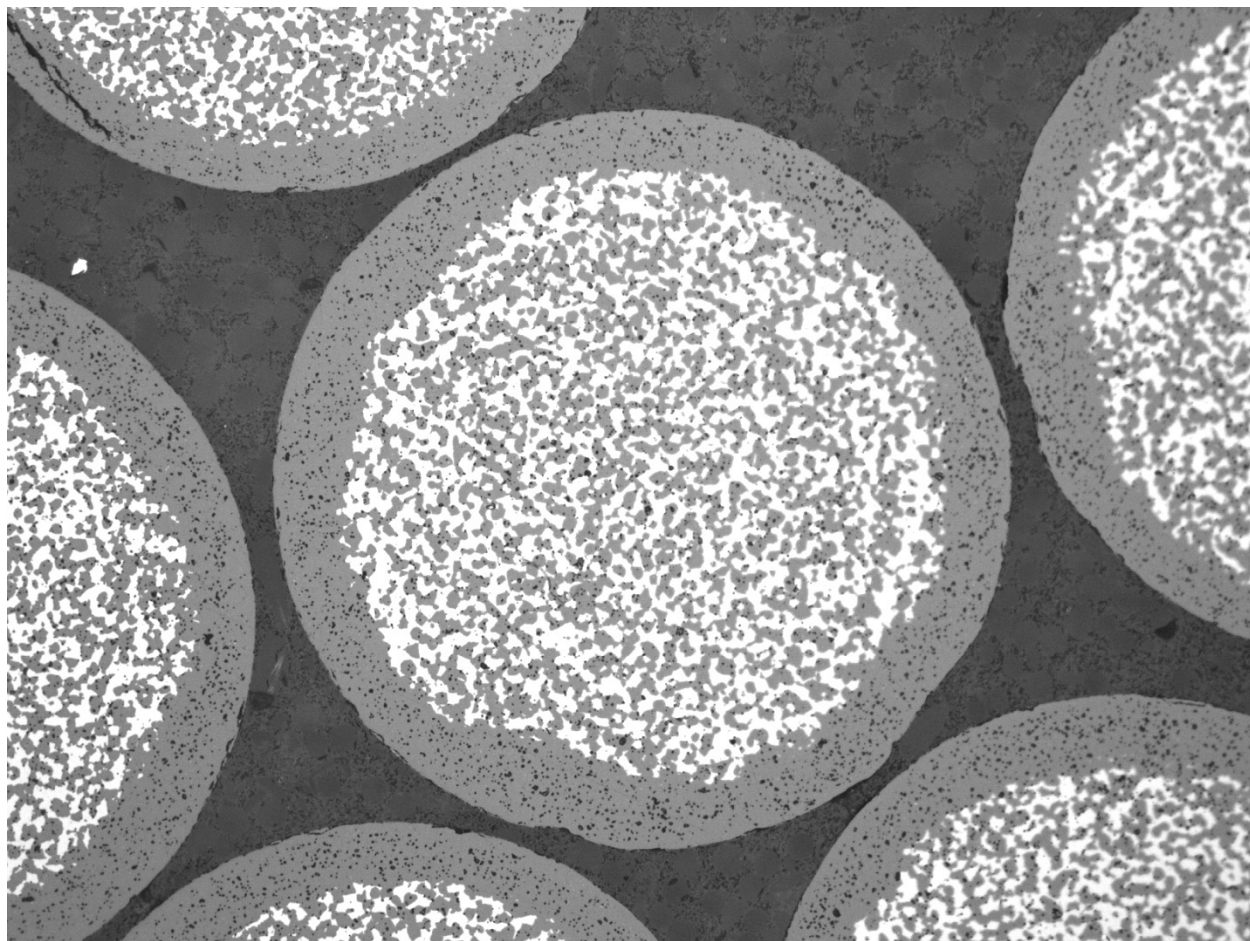
P17030905N112 segmented



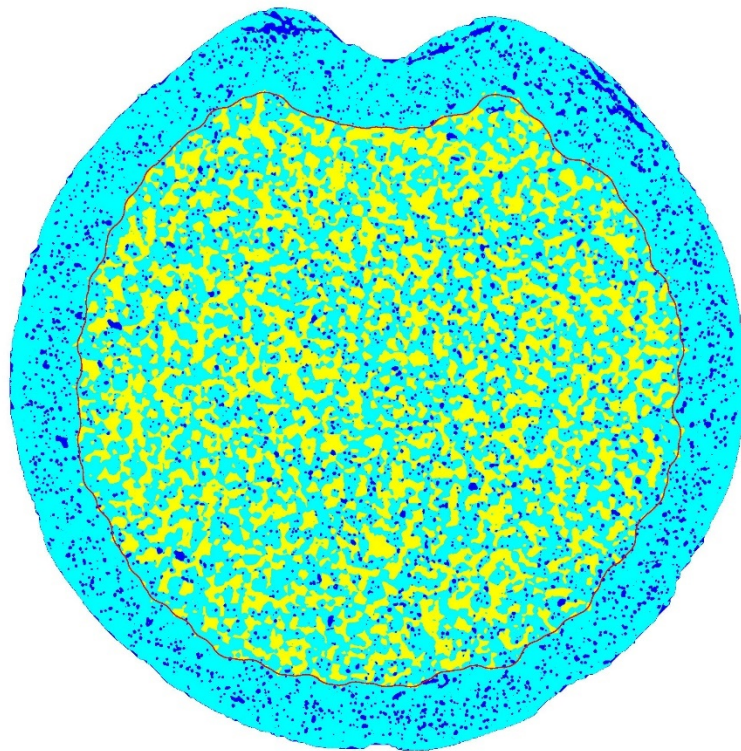
P17030905N112



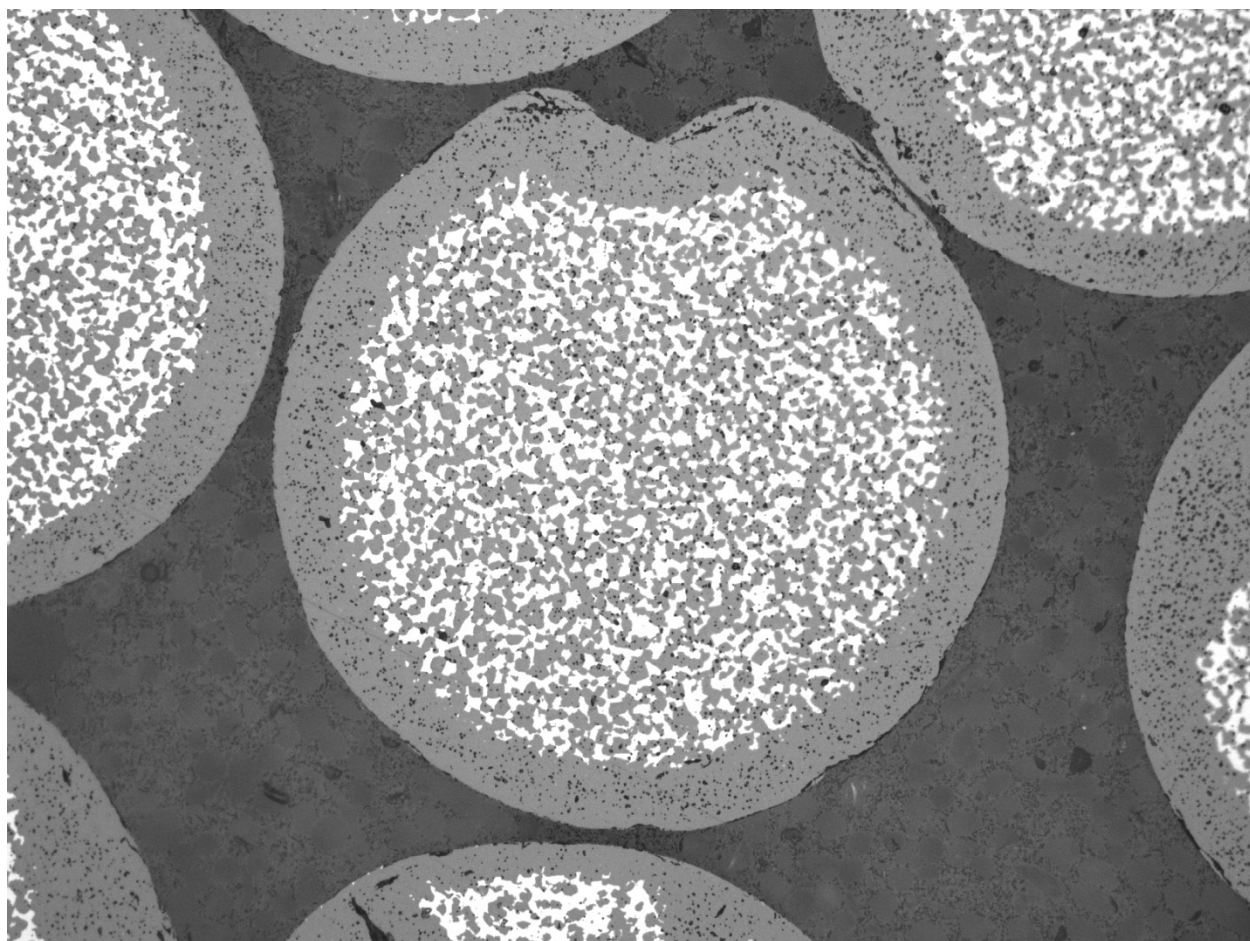
P17030905N113 segmented



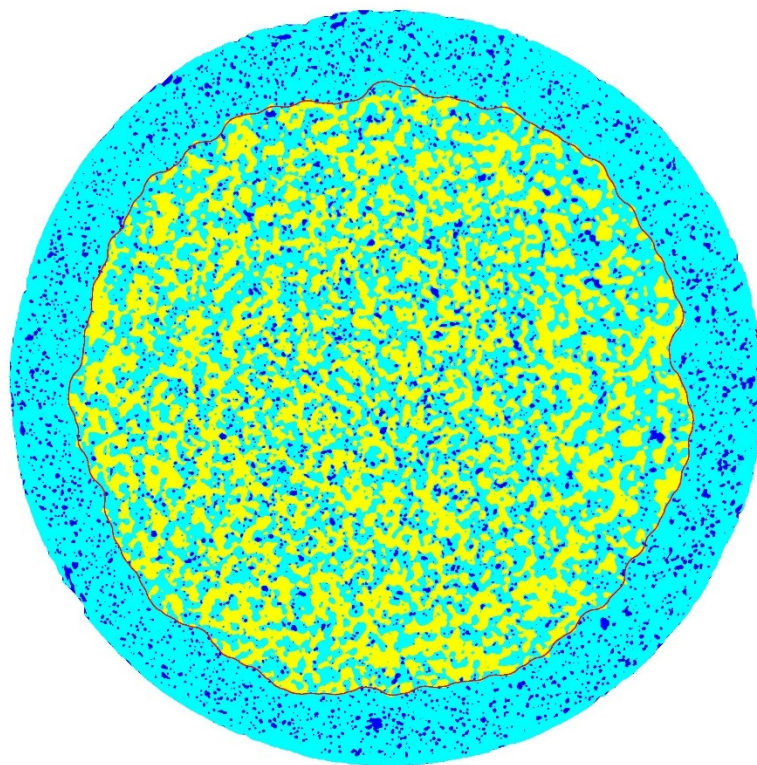
P17030905N113



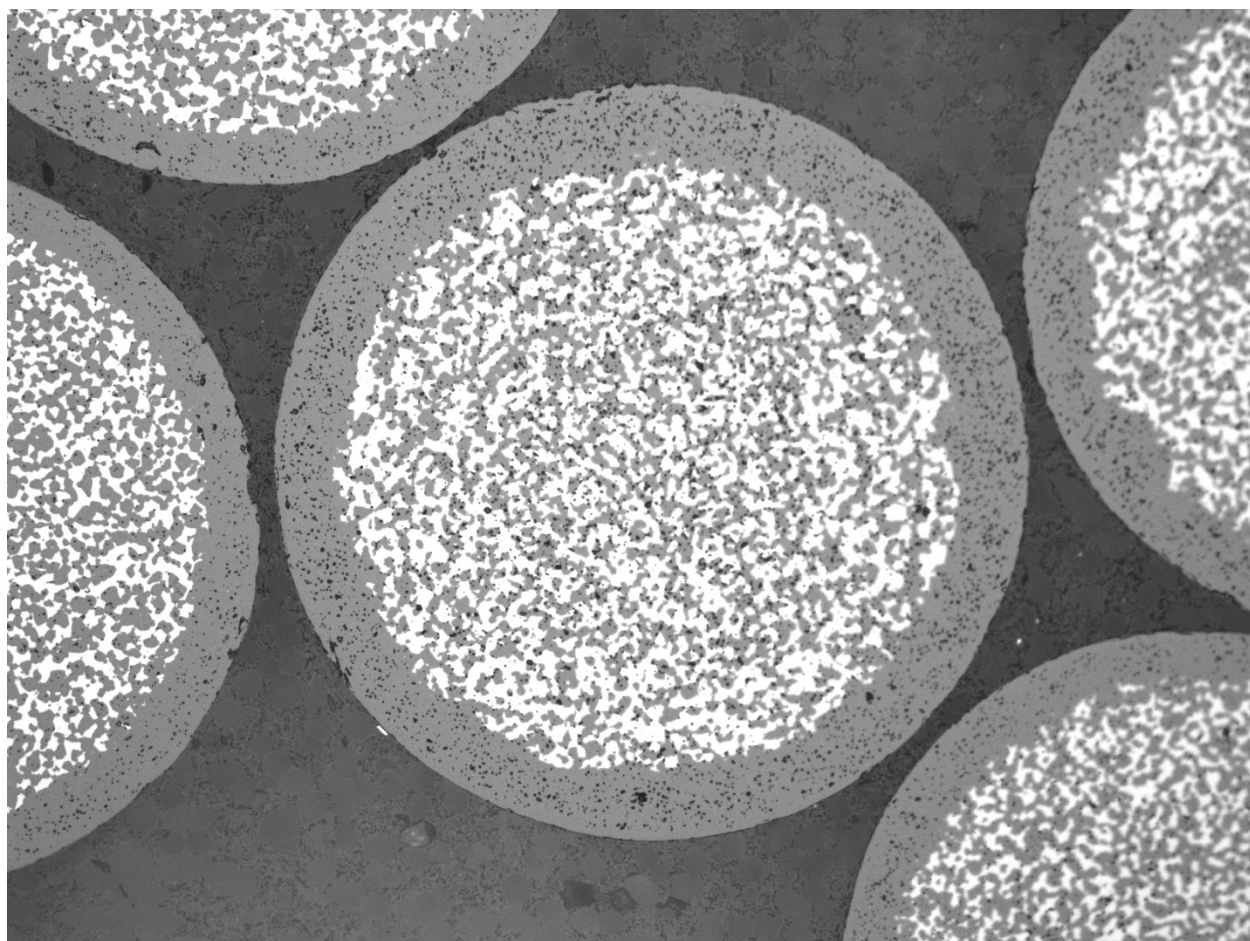
P17030905N114 segmented



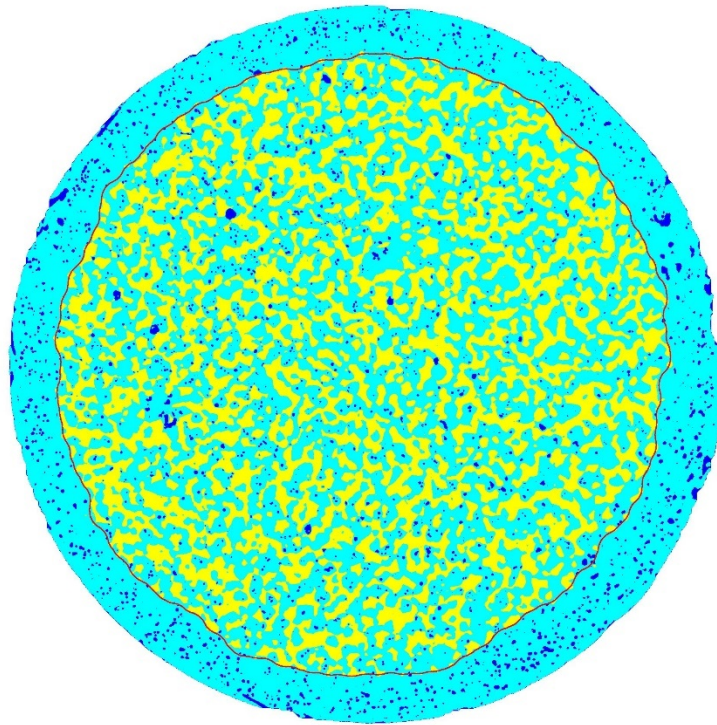
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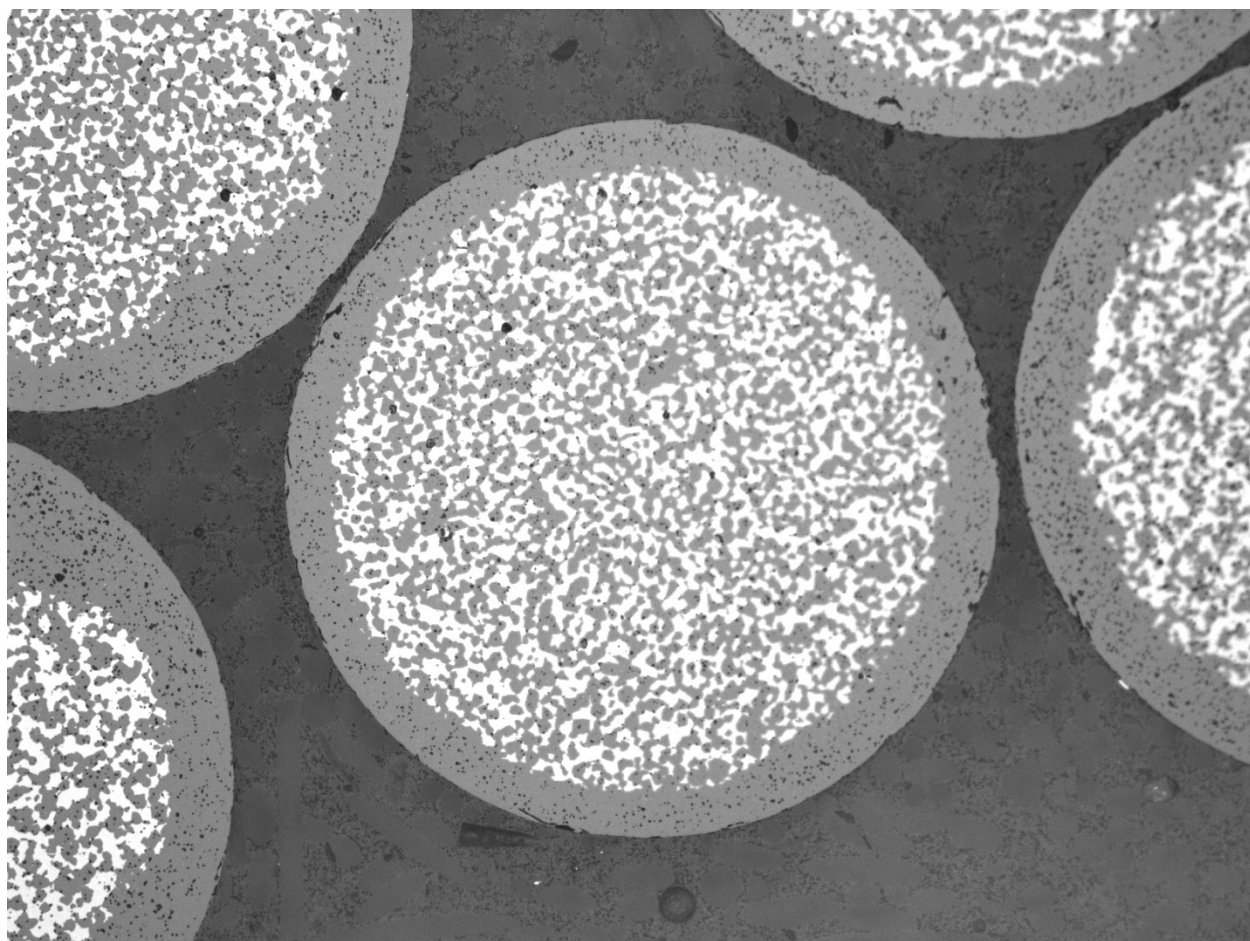
P17030905N115 segmented



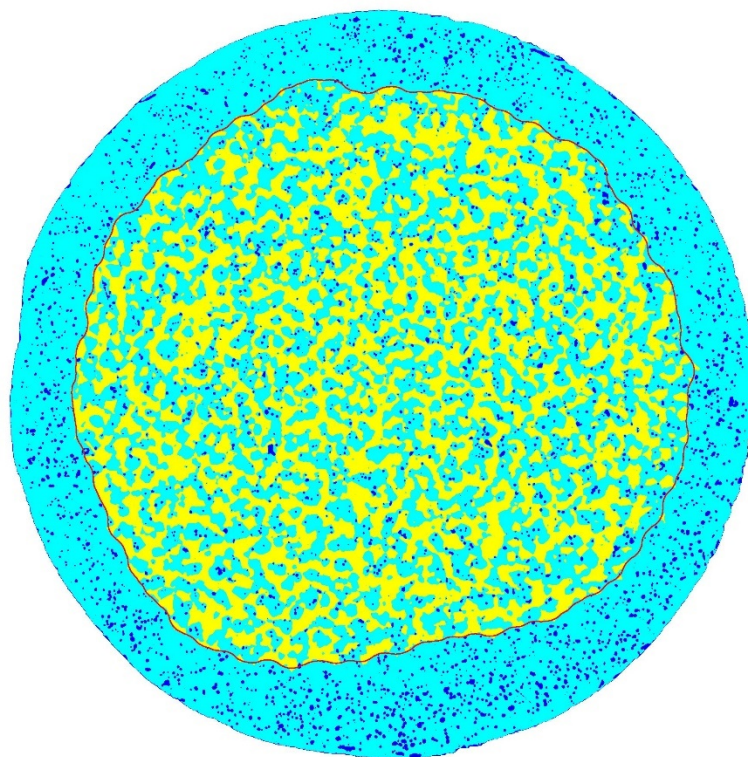
P17030905N115



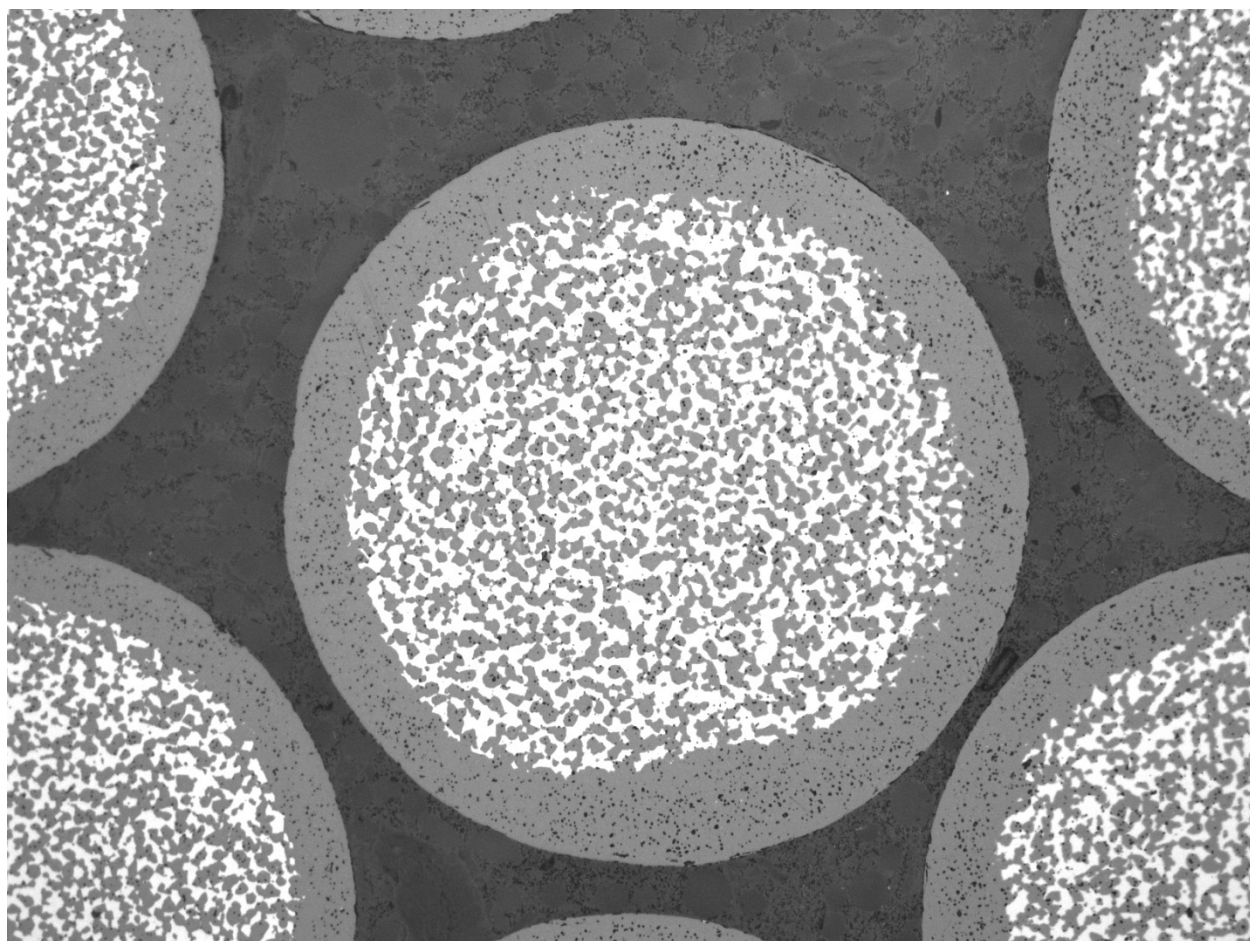
P17030905N116 segmented



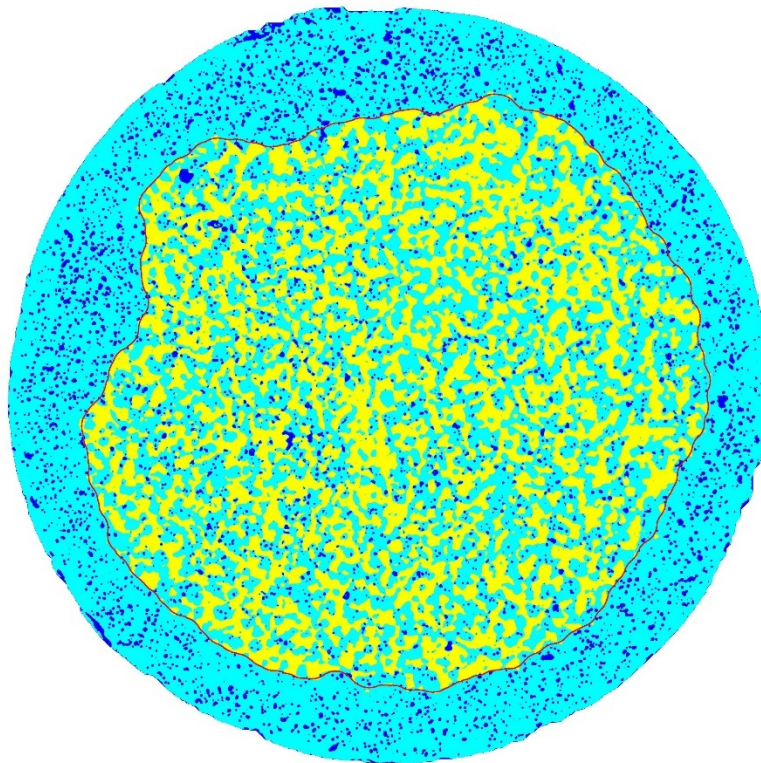
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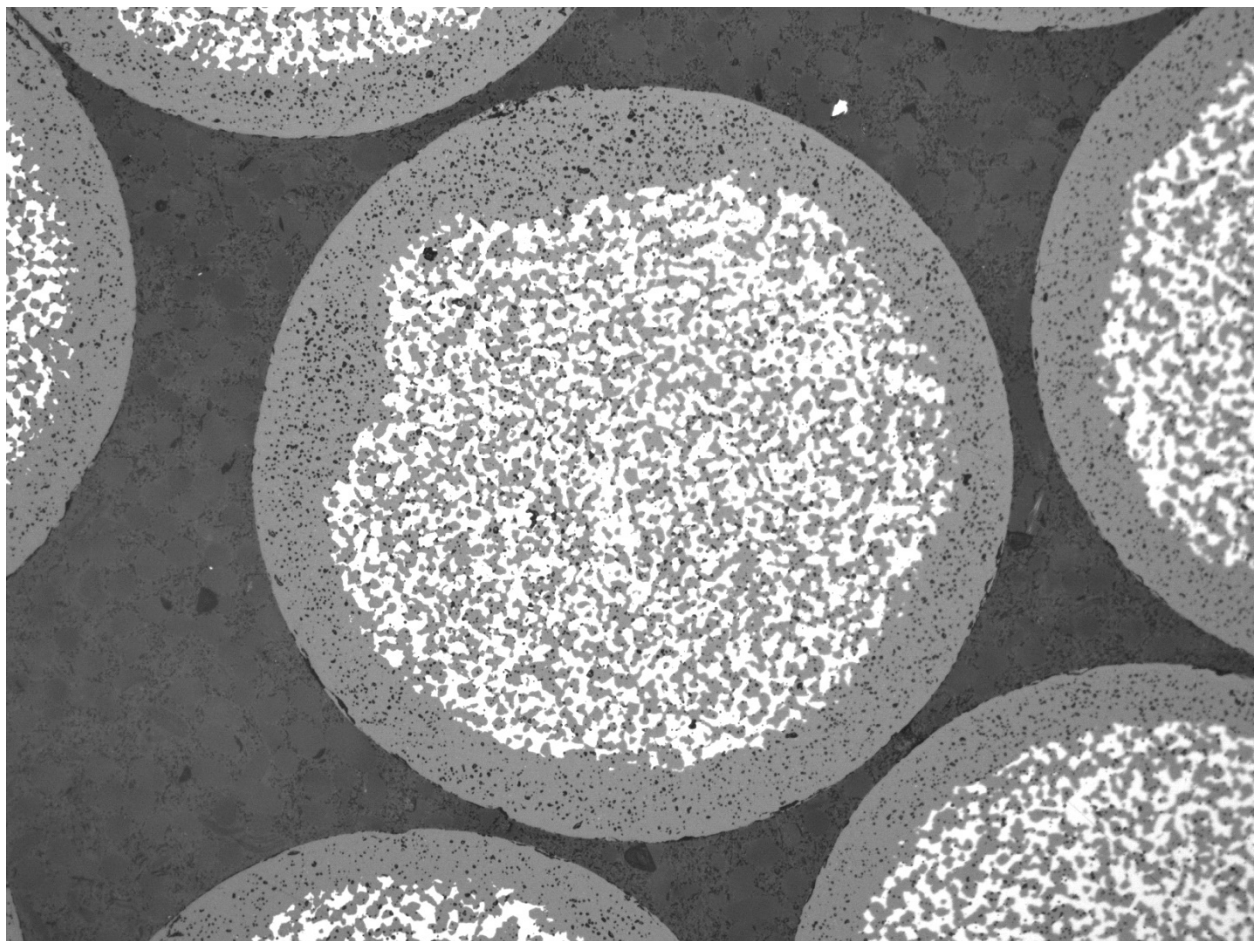
P17030905N117 segmented



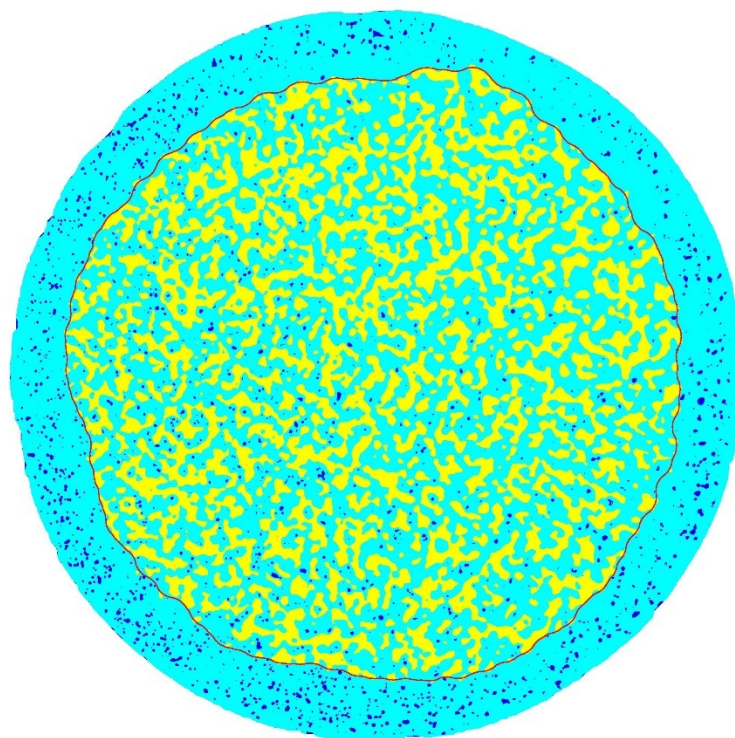
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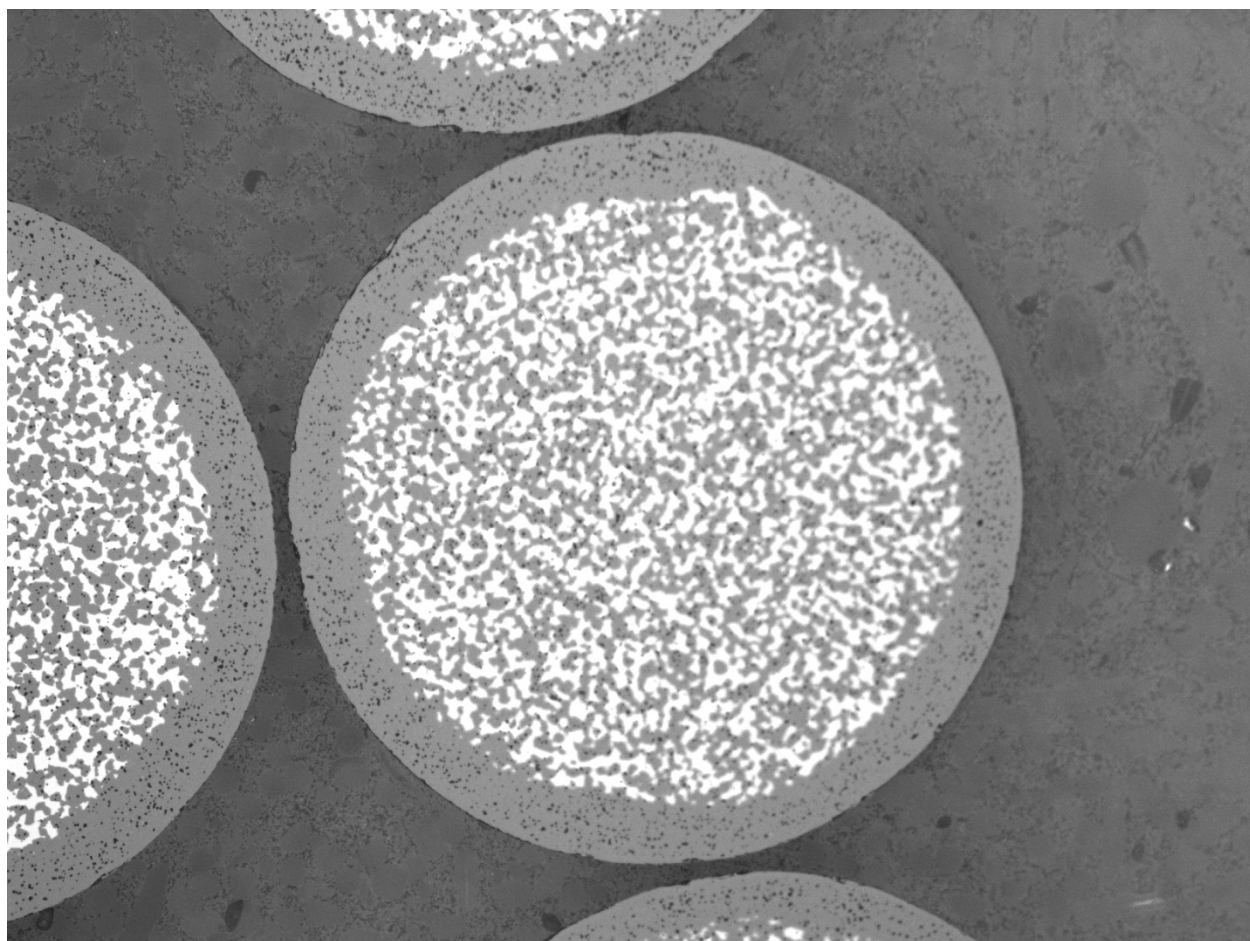
P17030905N118 segmented



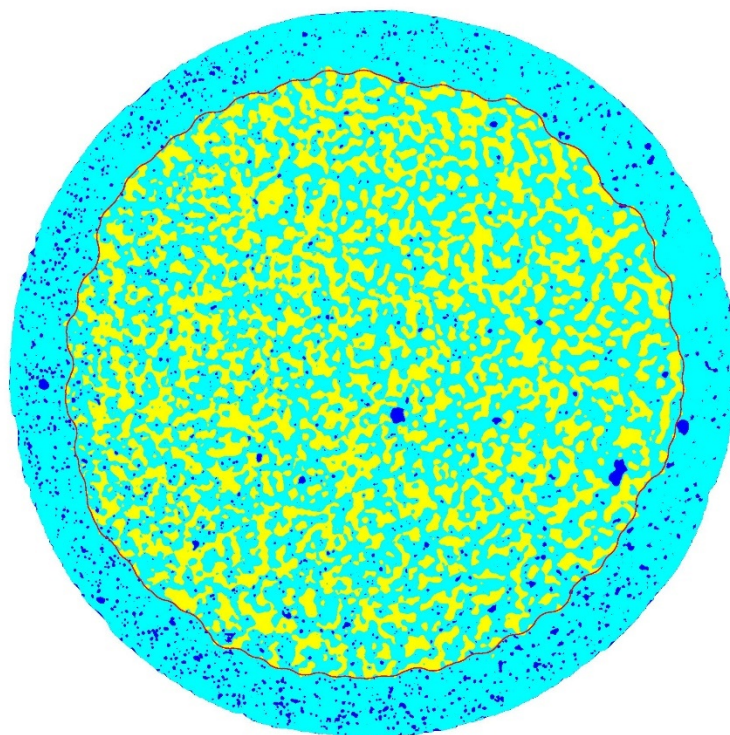
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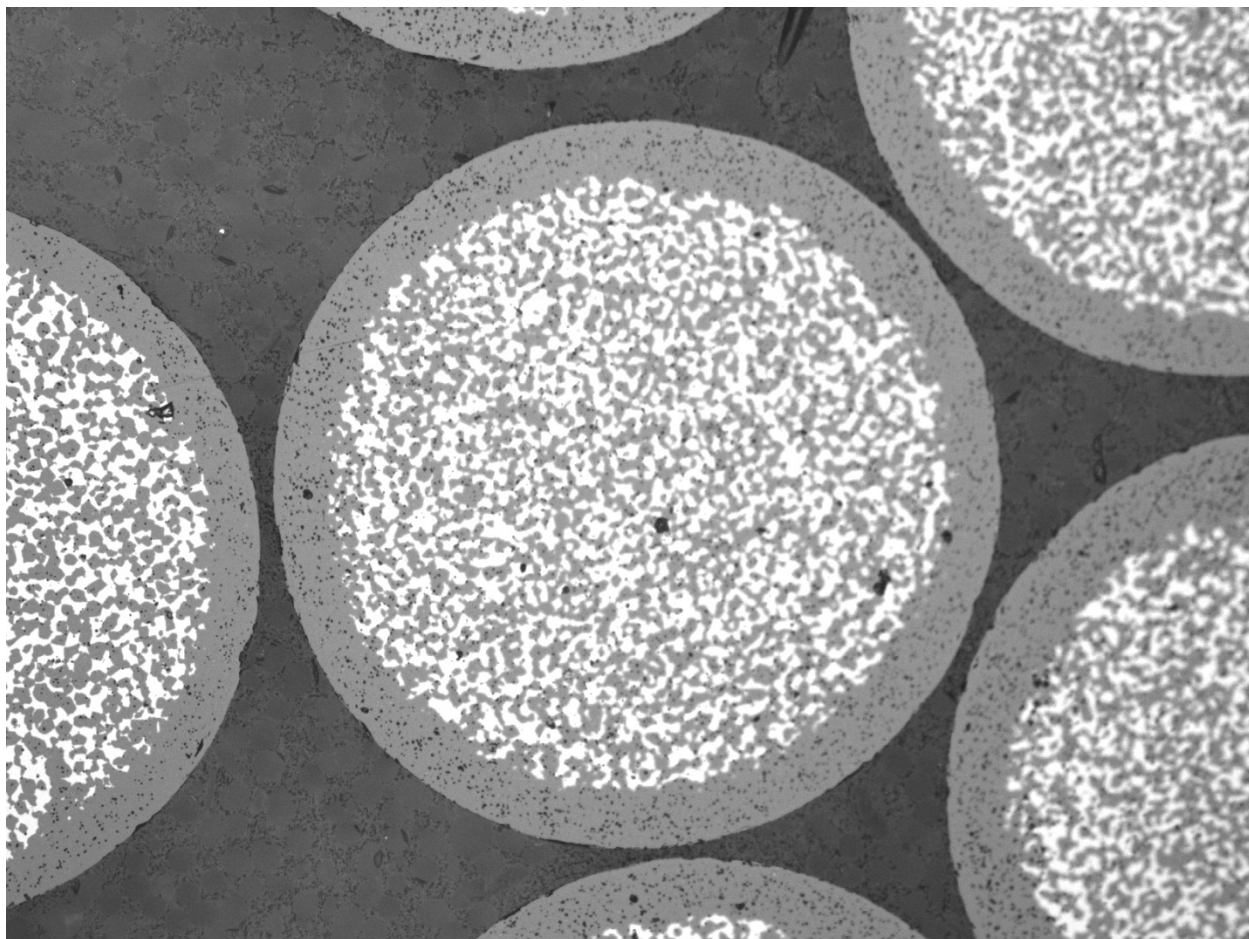
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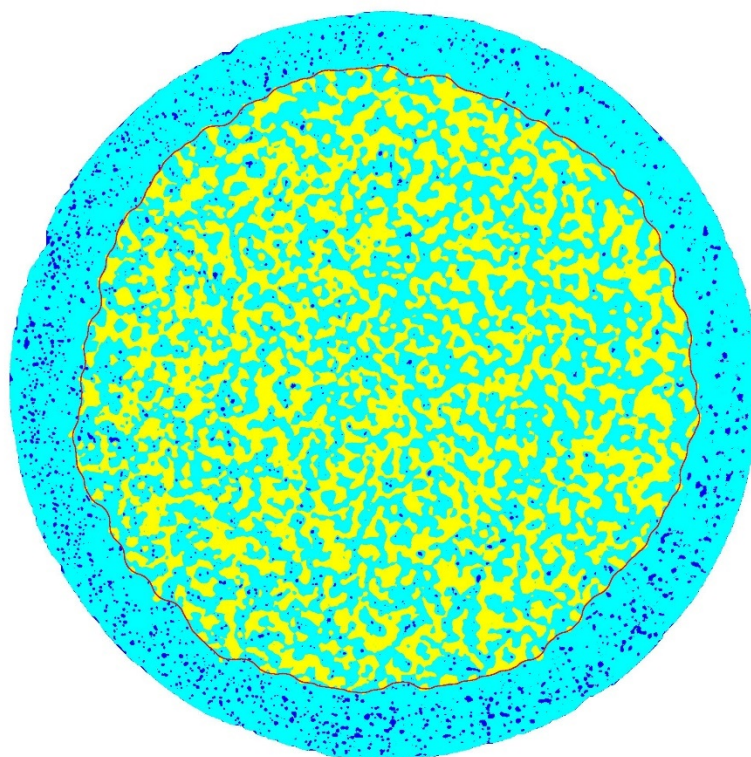
P17030905N119



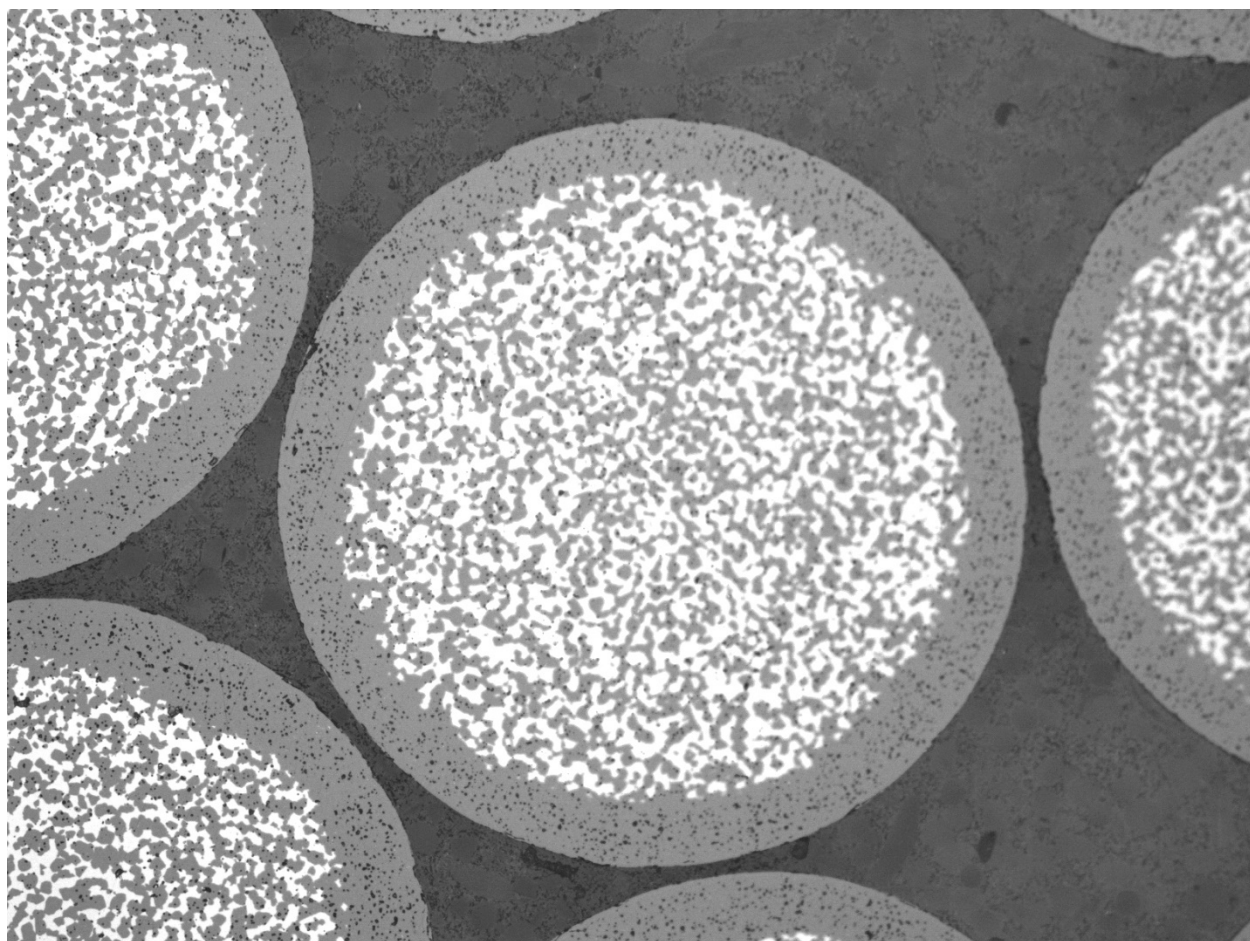
P17030905N121 segmented



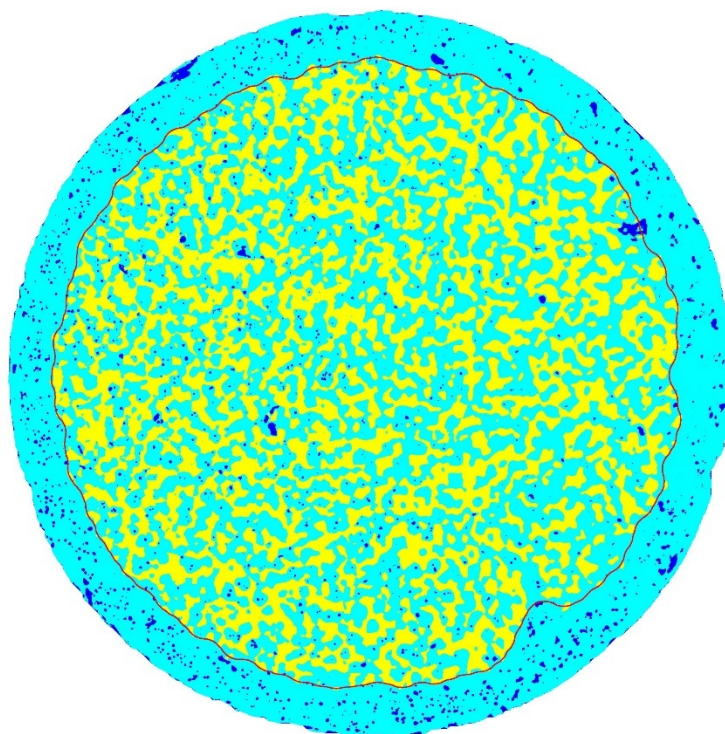
P17030905N121



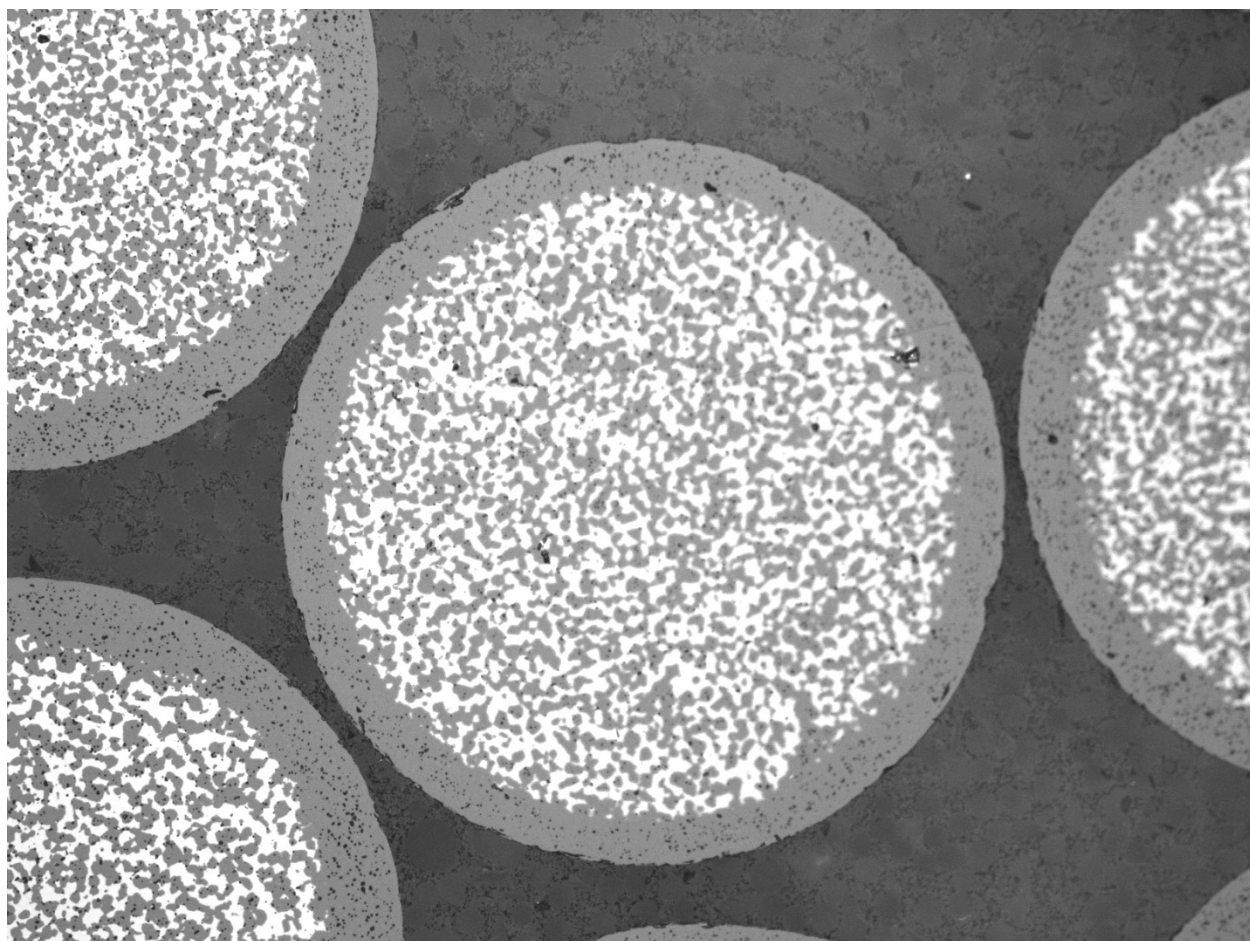
P17030905N122 segmented



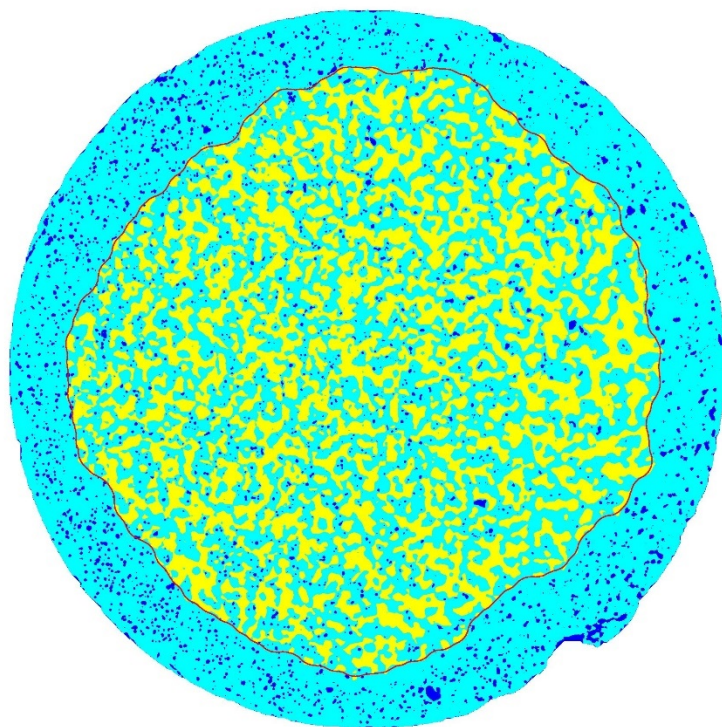
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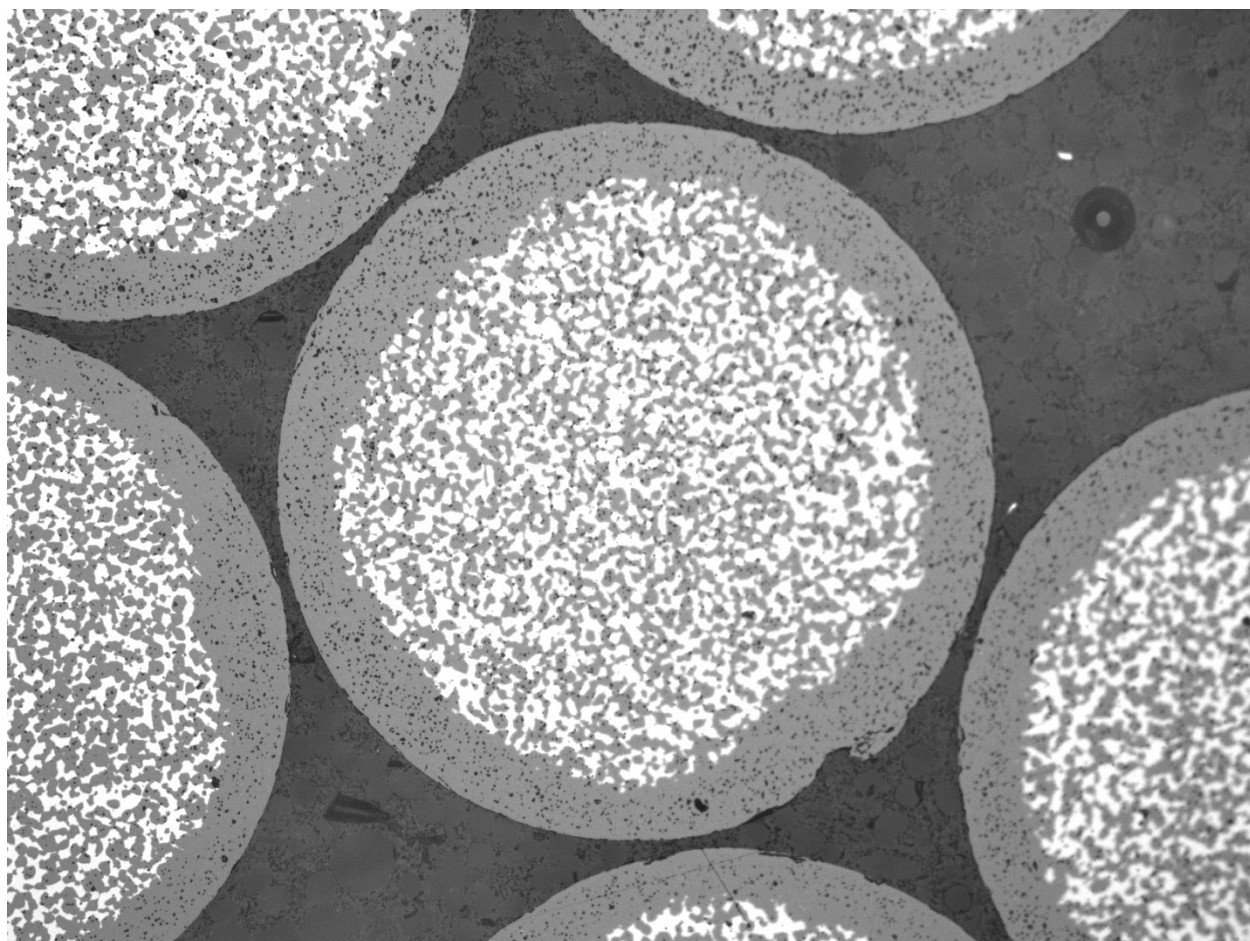
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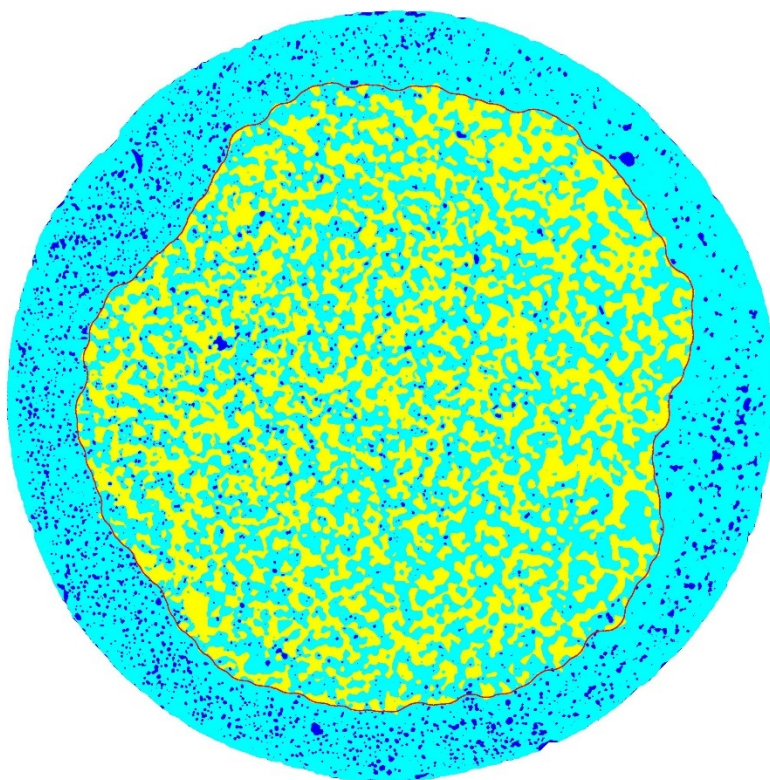
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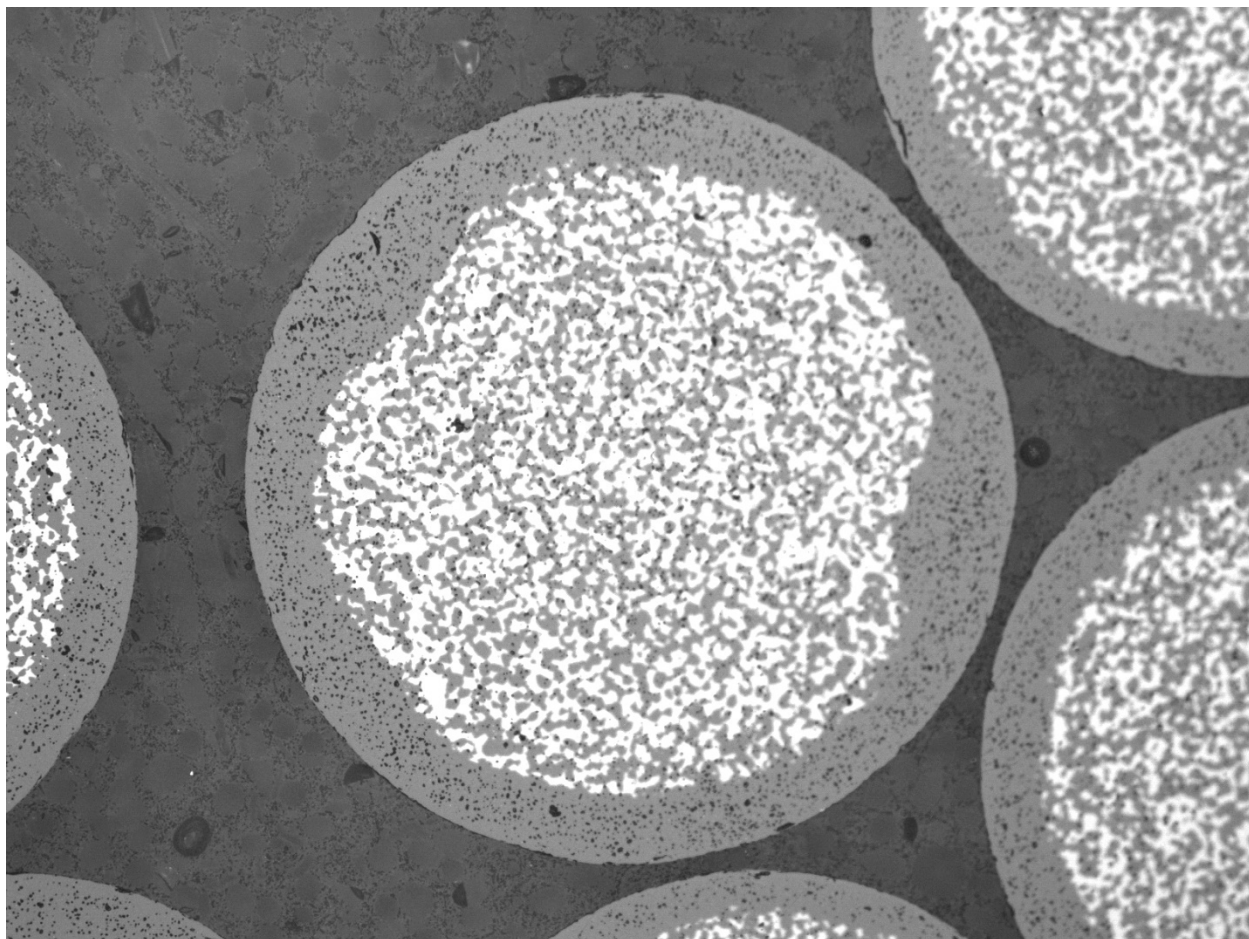
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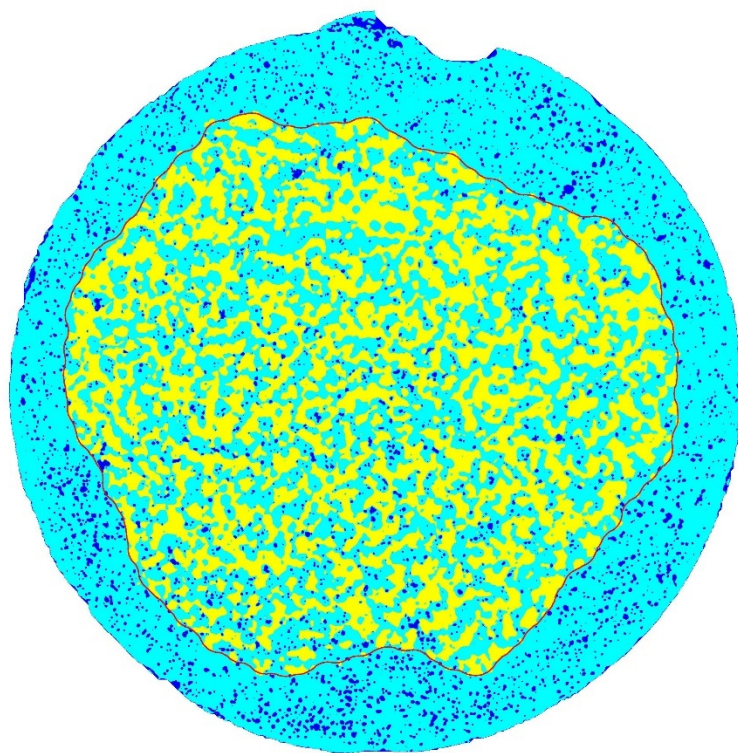
P17030905N124



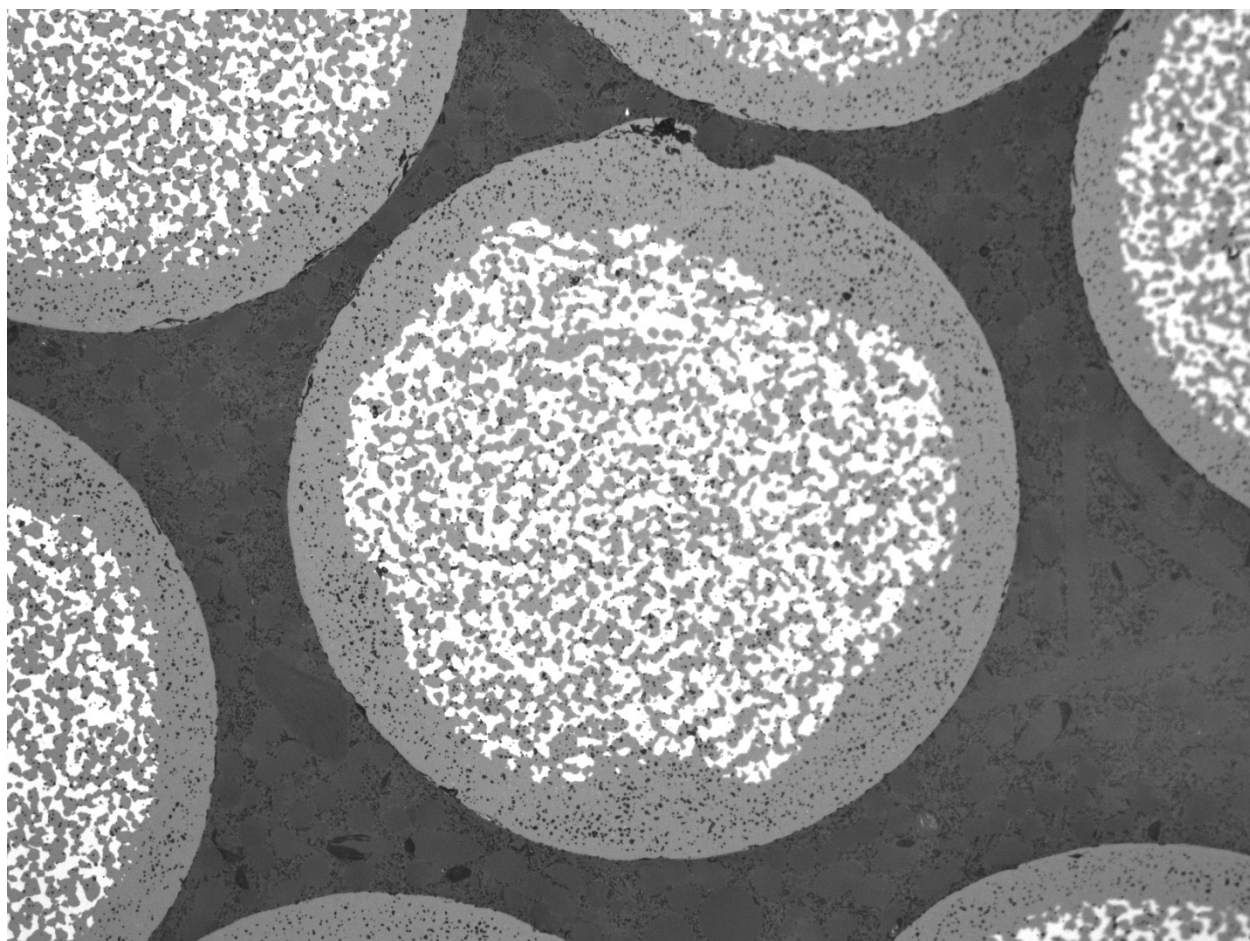
P17030905N125 segmented



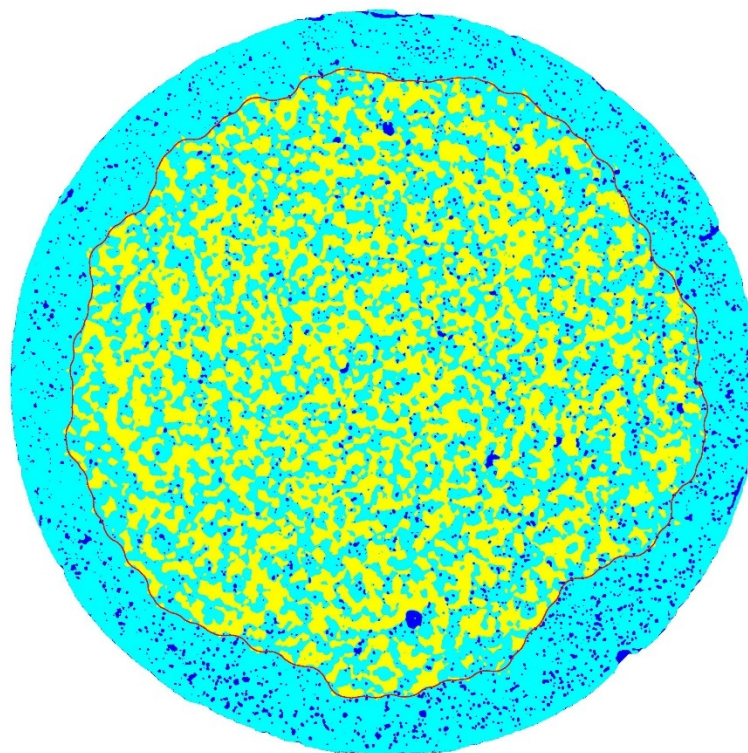
P17030905N125



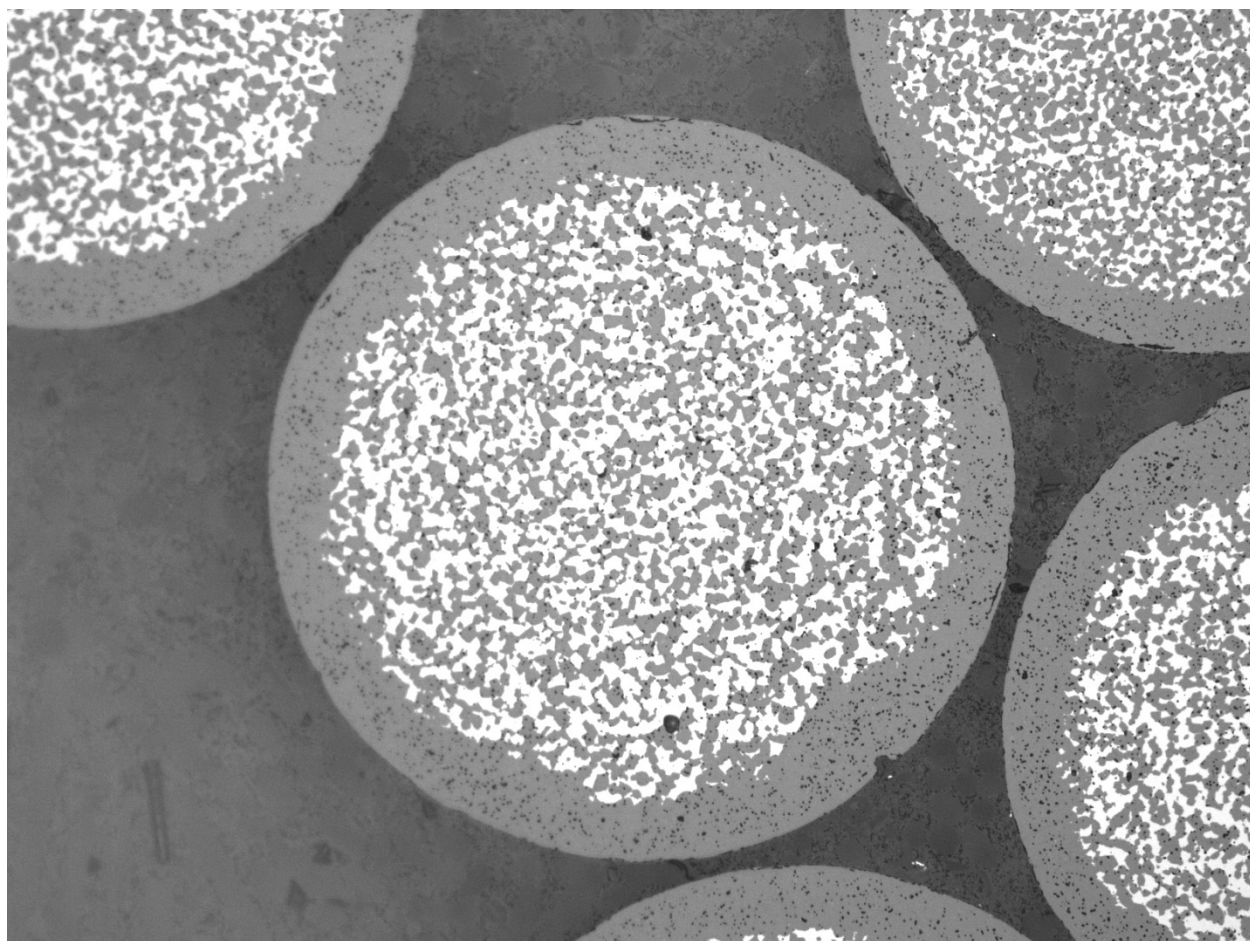
P17030905N126 segmented



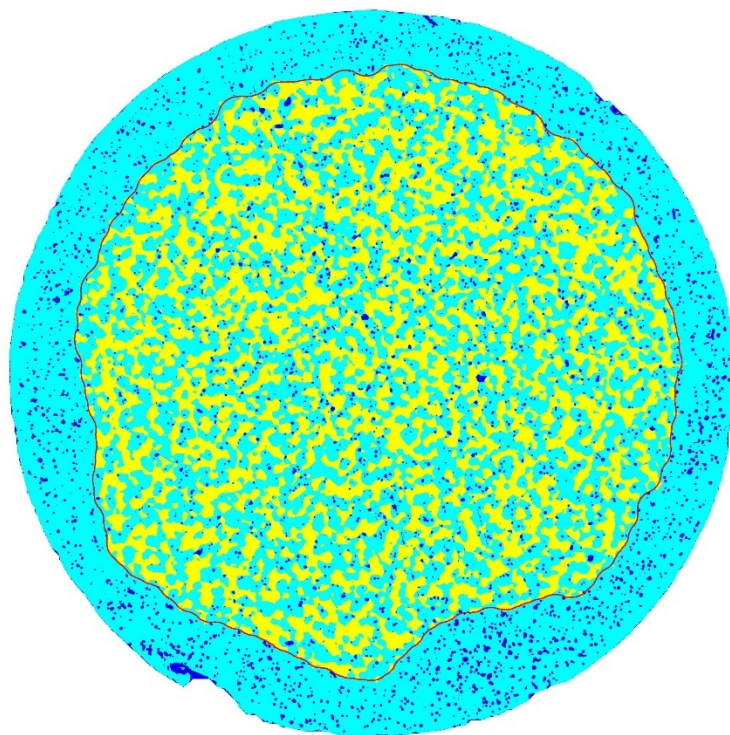
P17030905N126



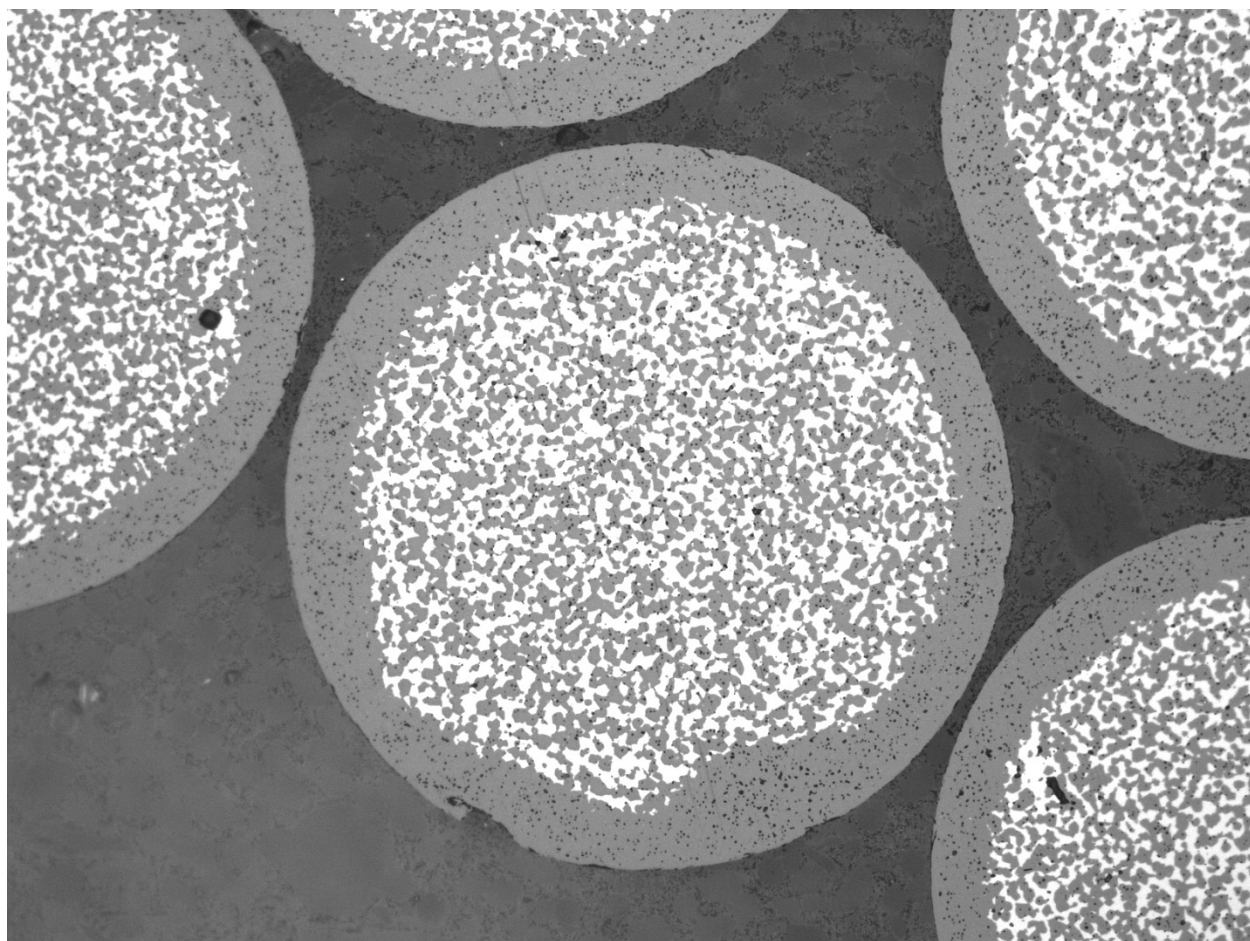
P17030905N127 segmented



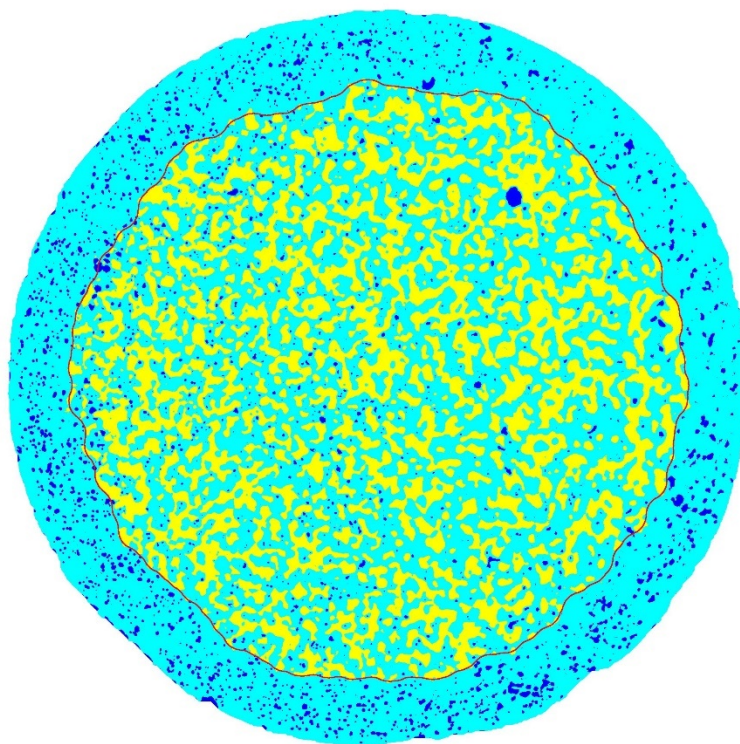
P17030905N127



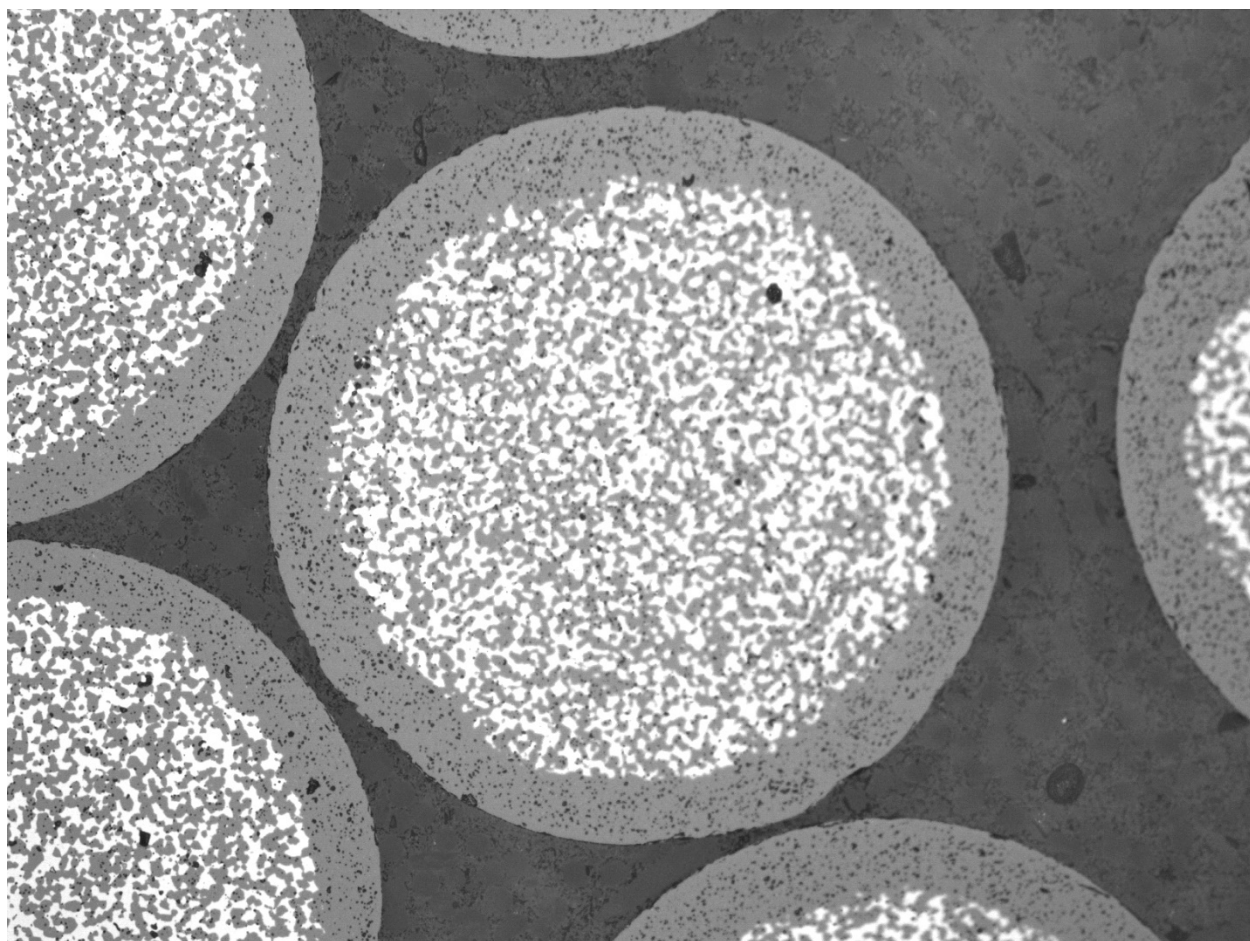
P17030905N128 segmented



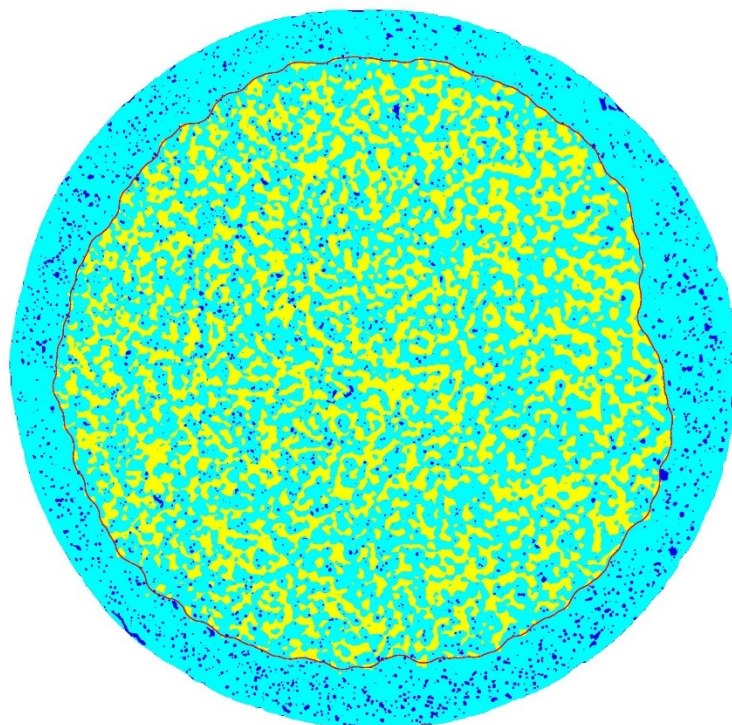
P17030905N128



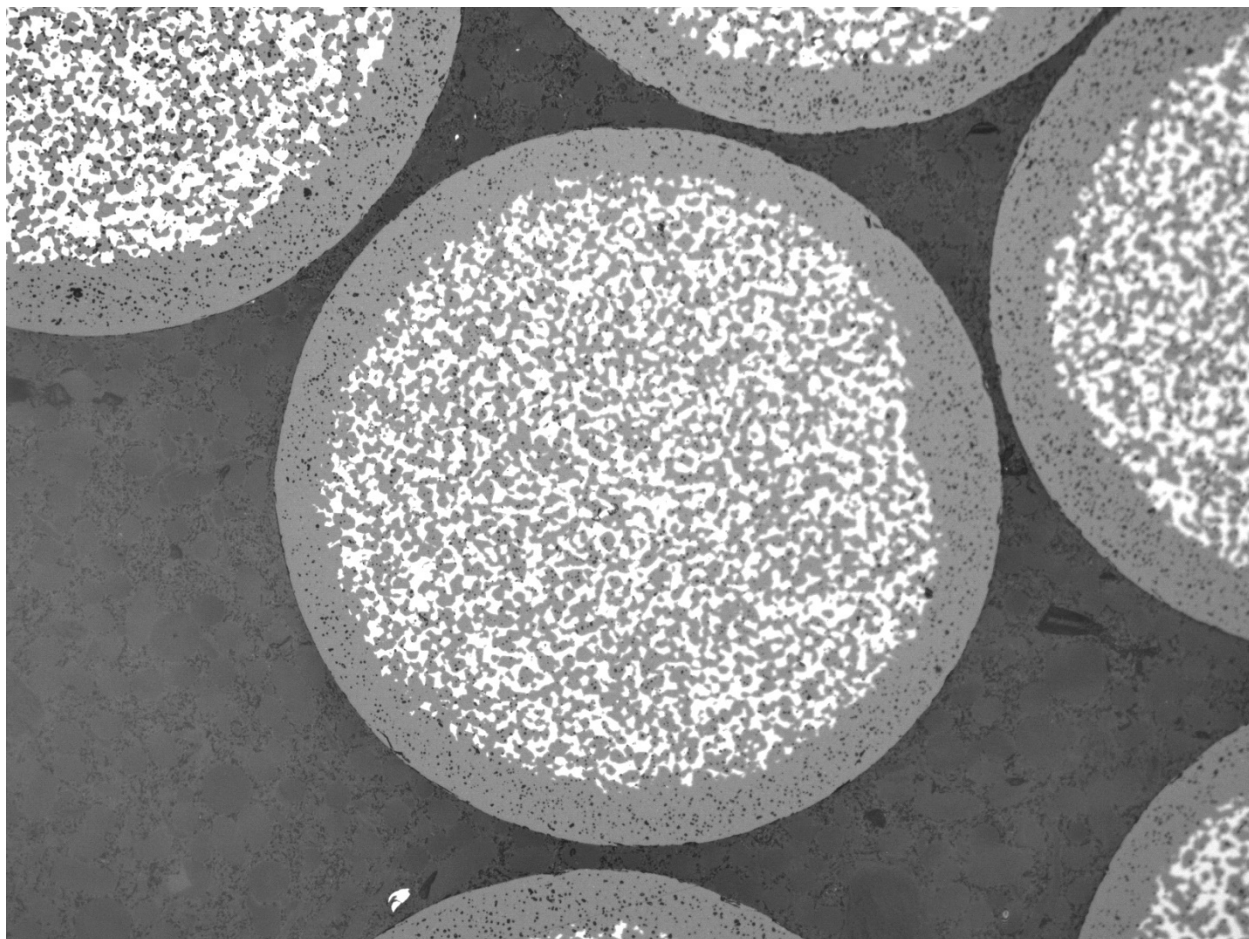
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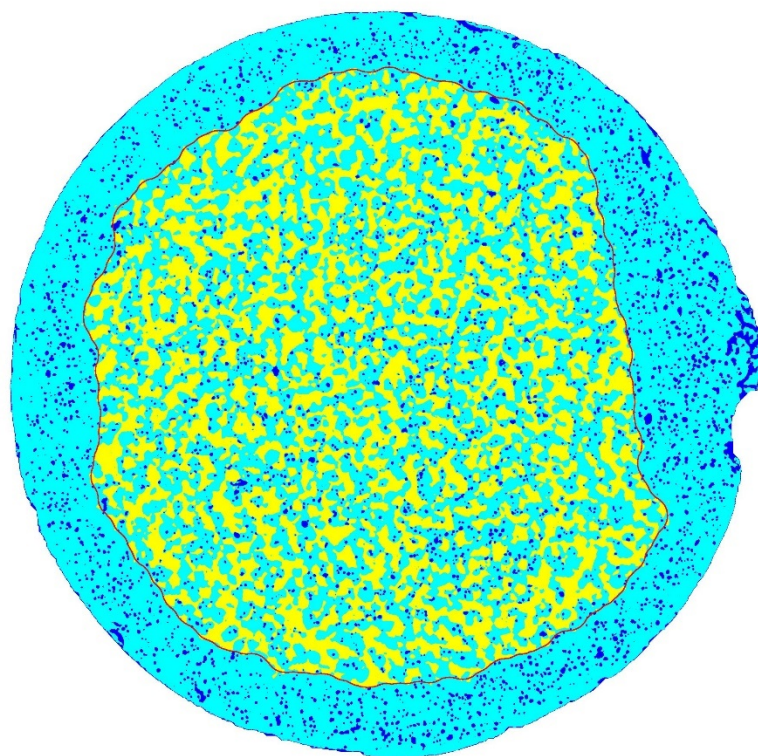
P17030905N129



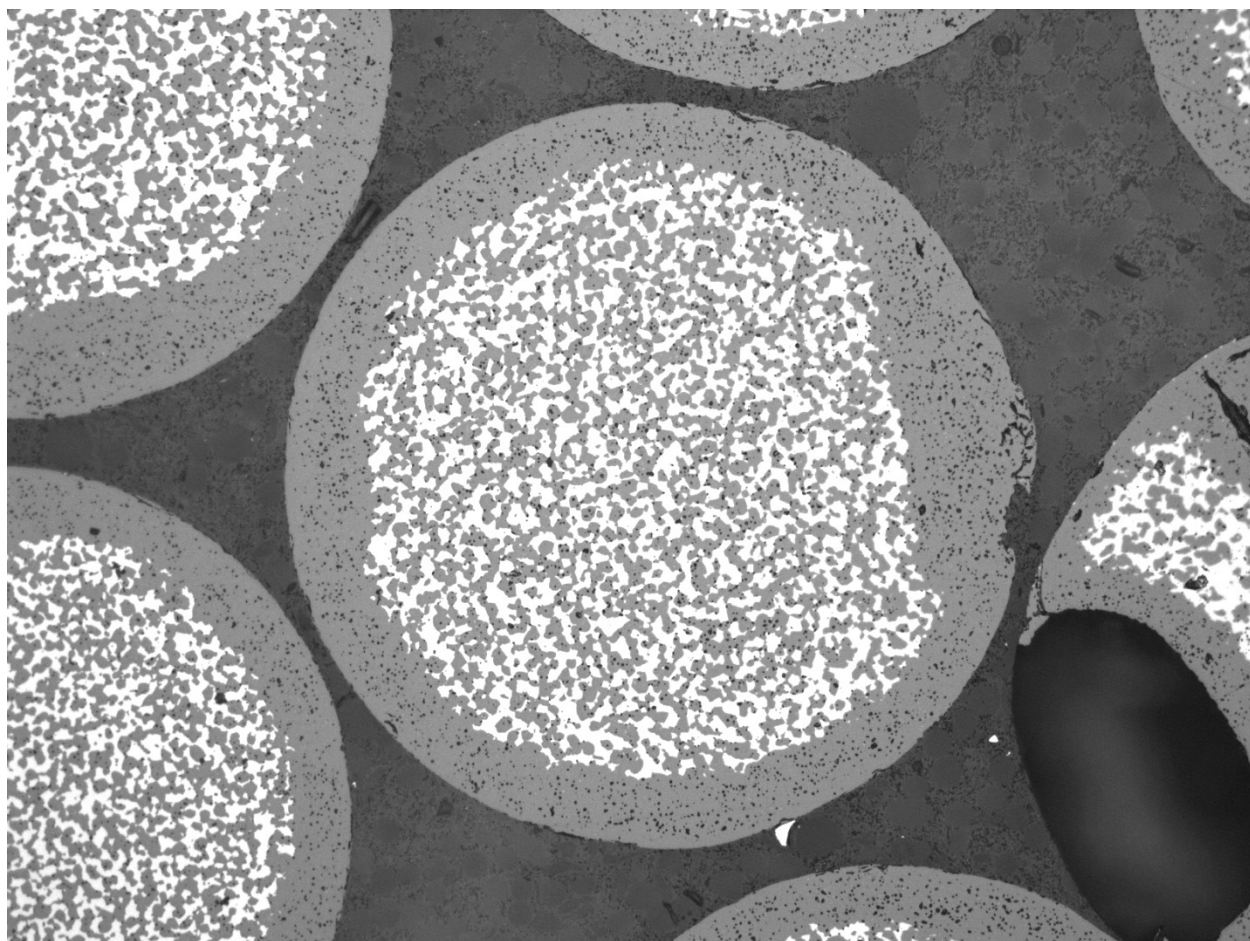
P17030905N130 segmented



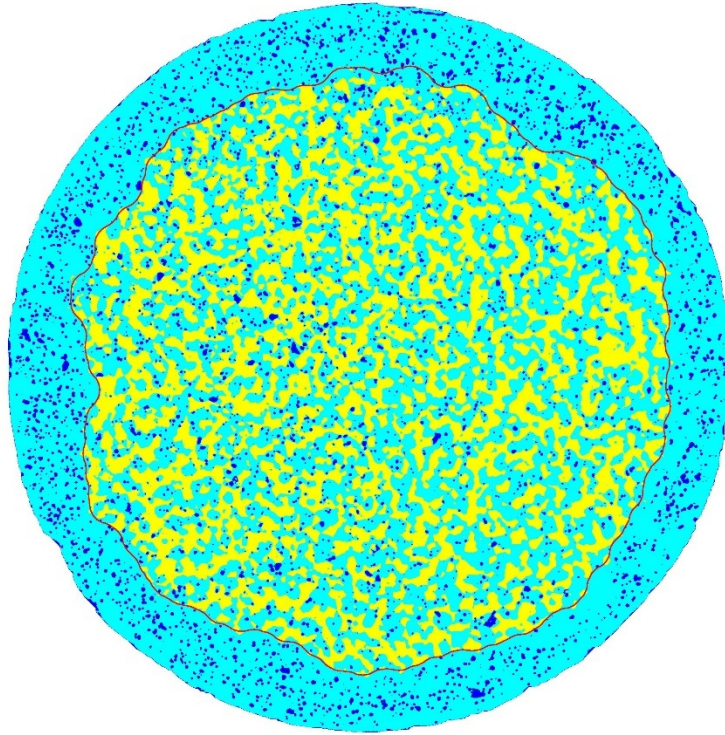
P17030905N130



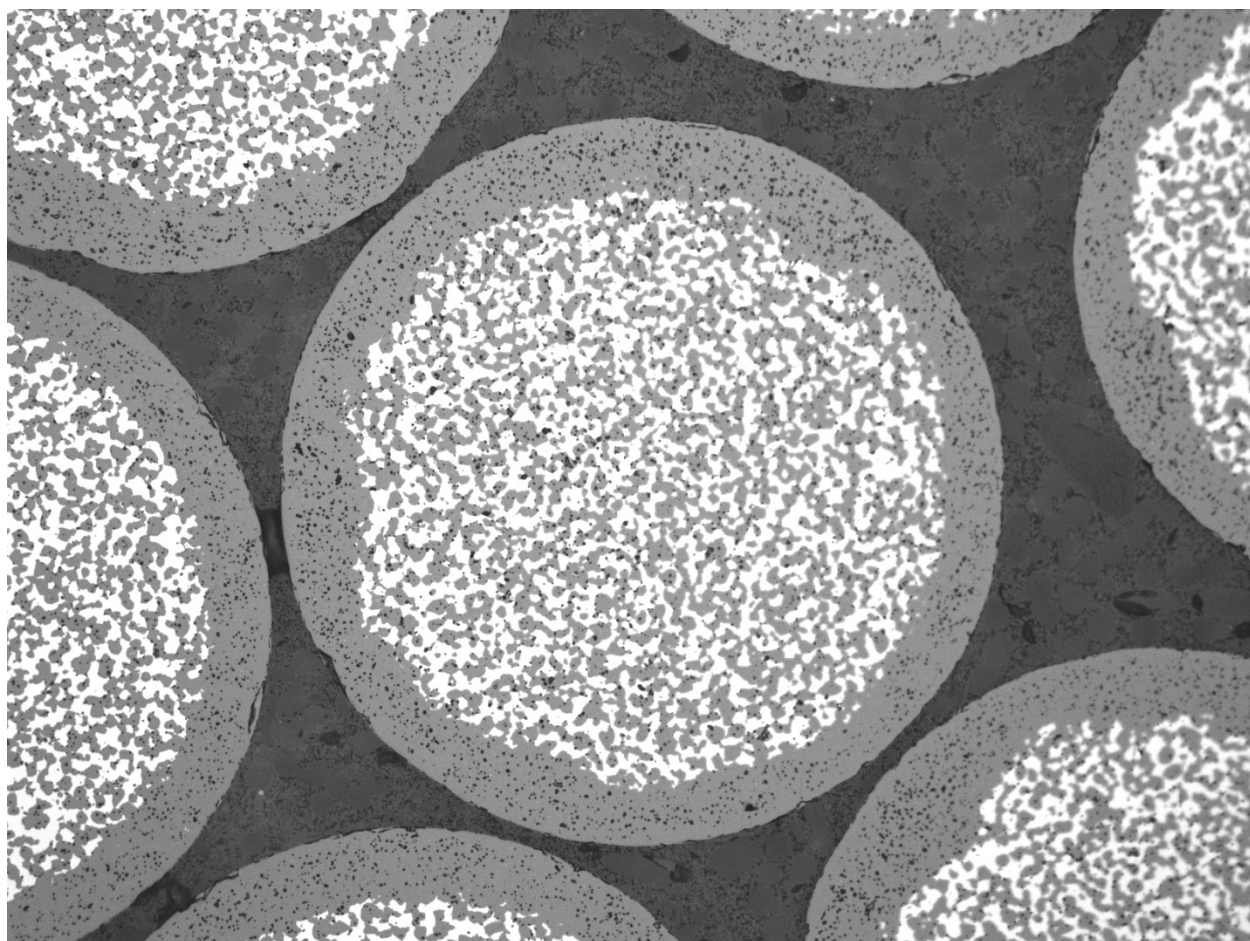
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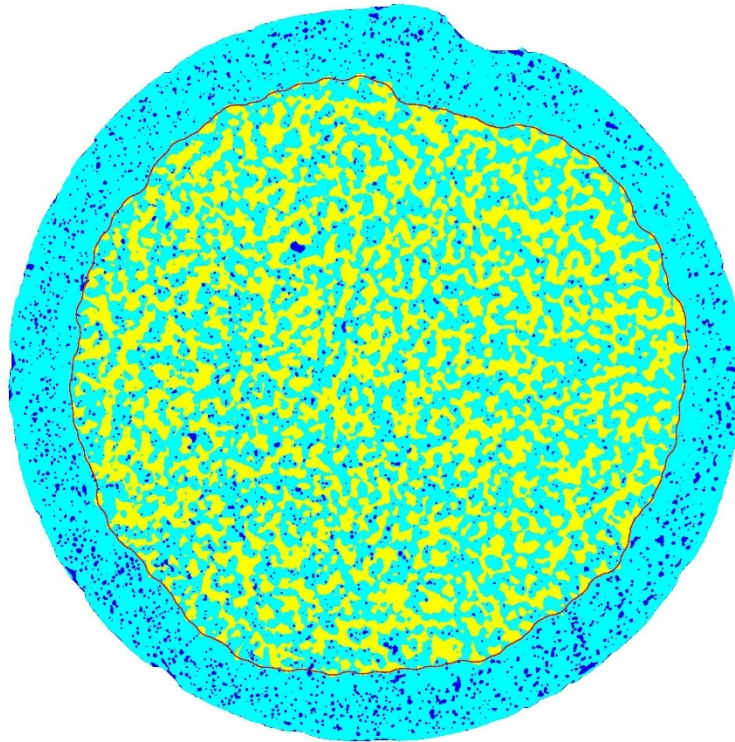
P17030905N131



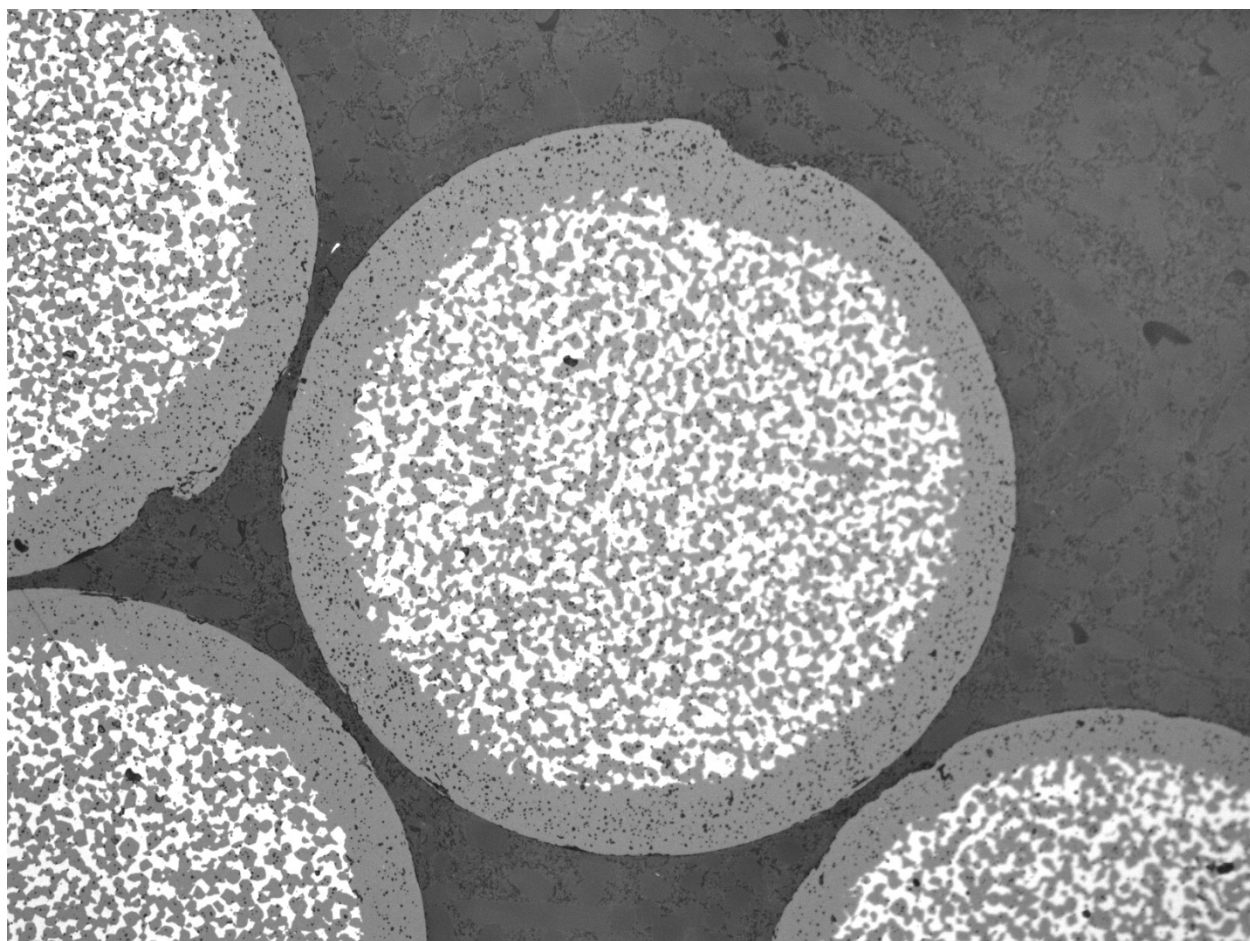
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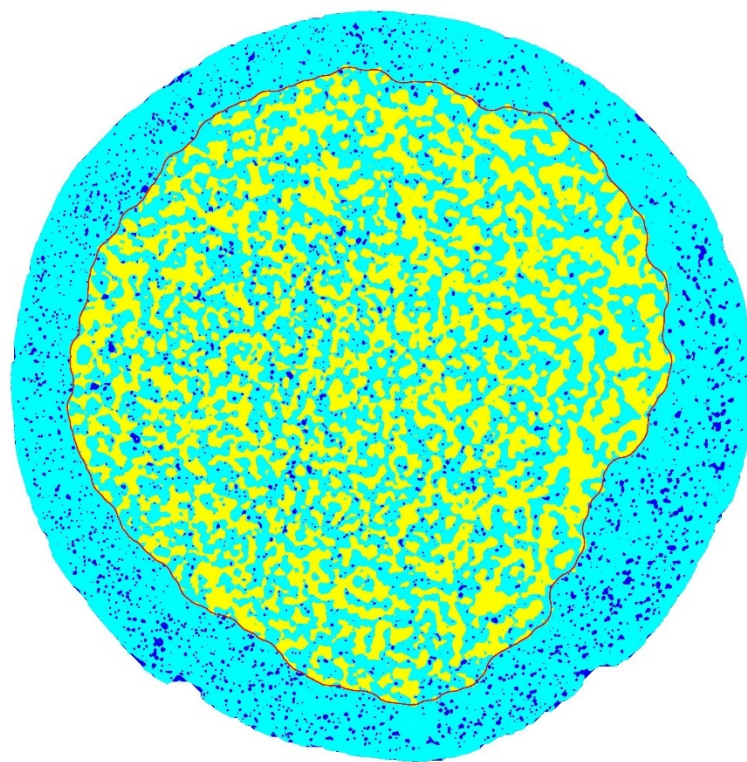
P17030905N132



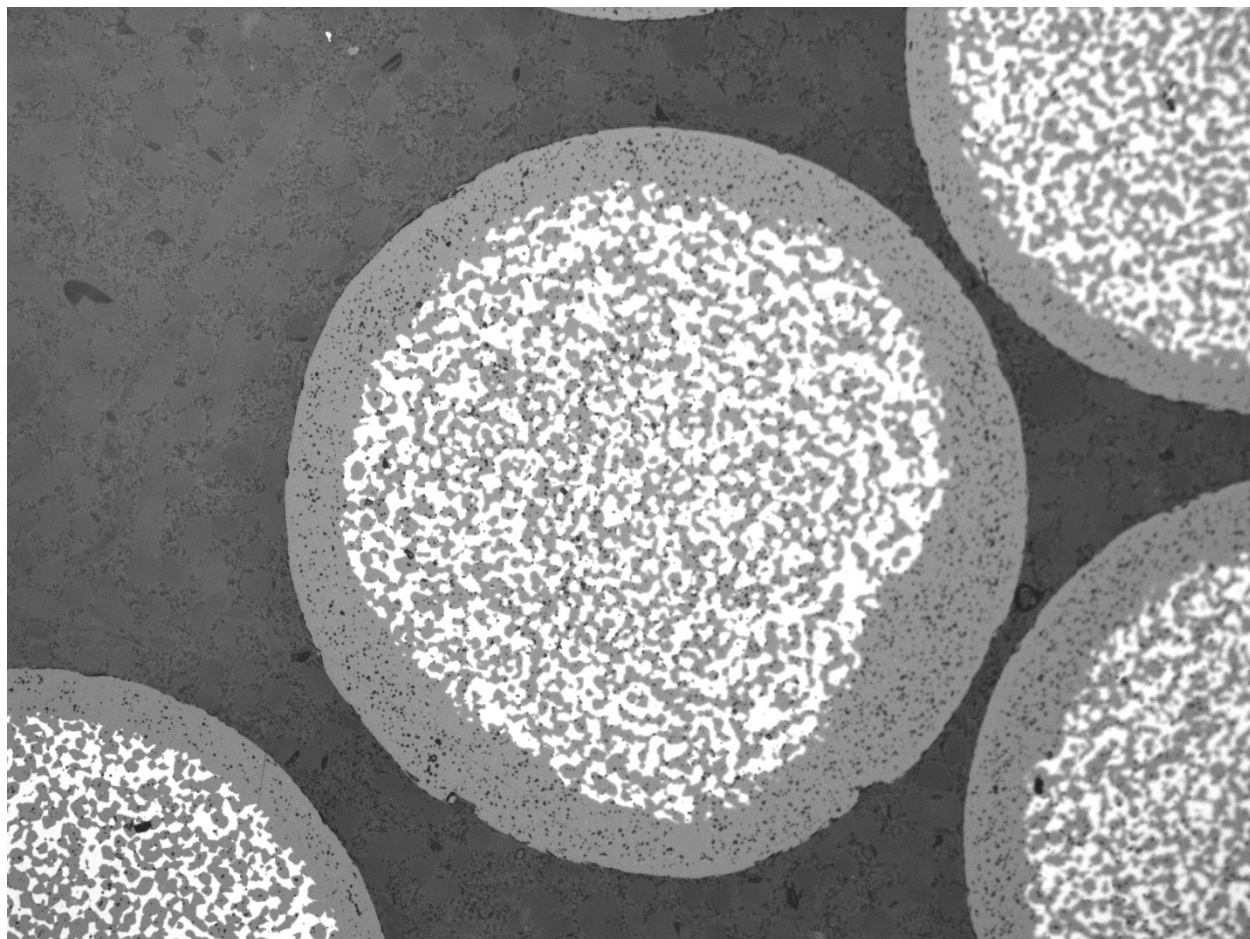
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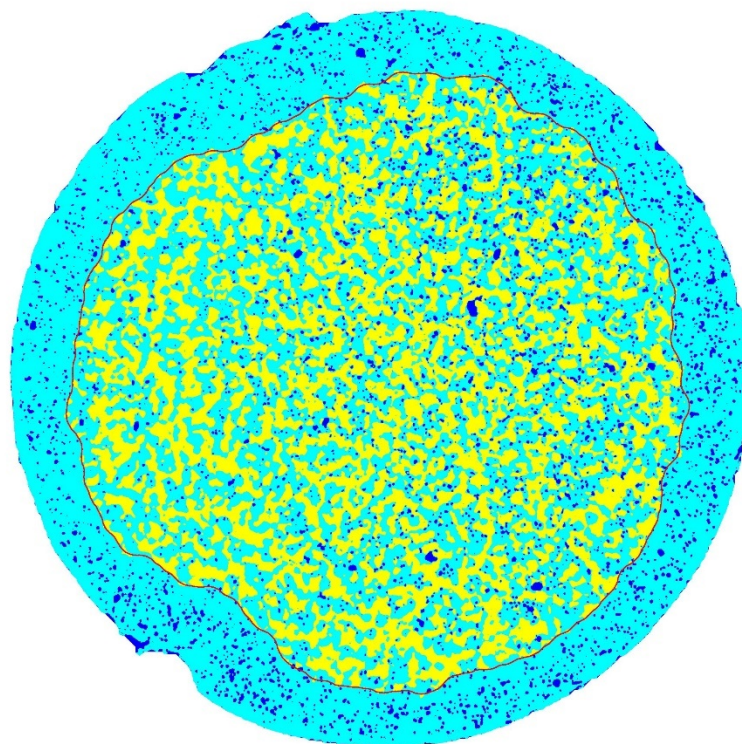
P17030905N133



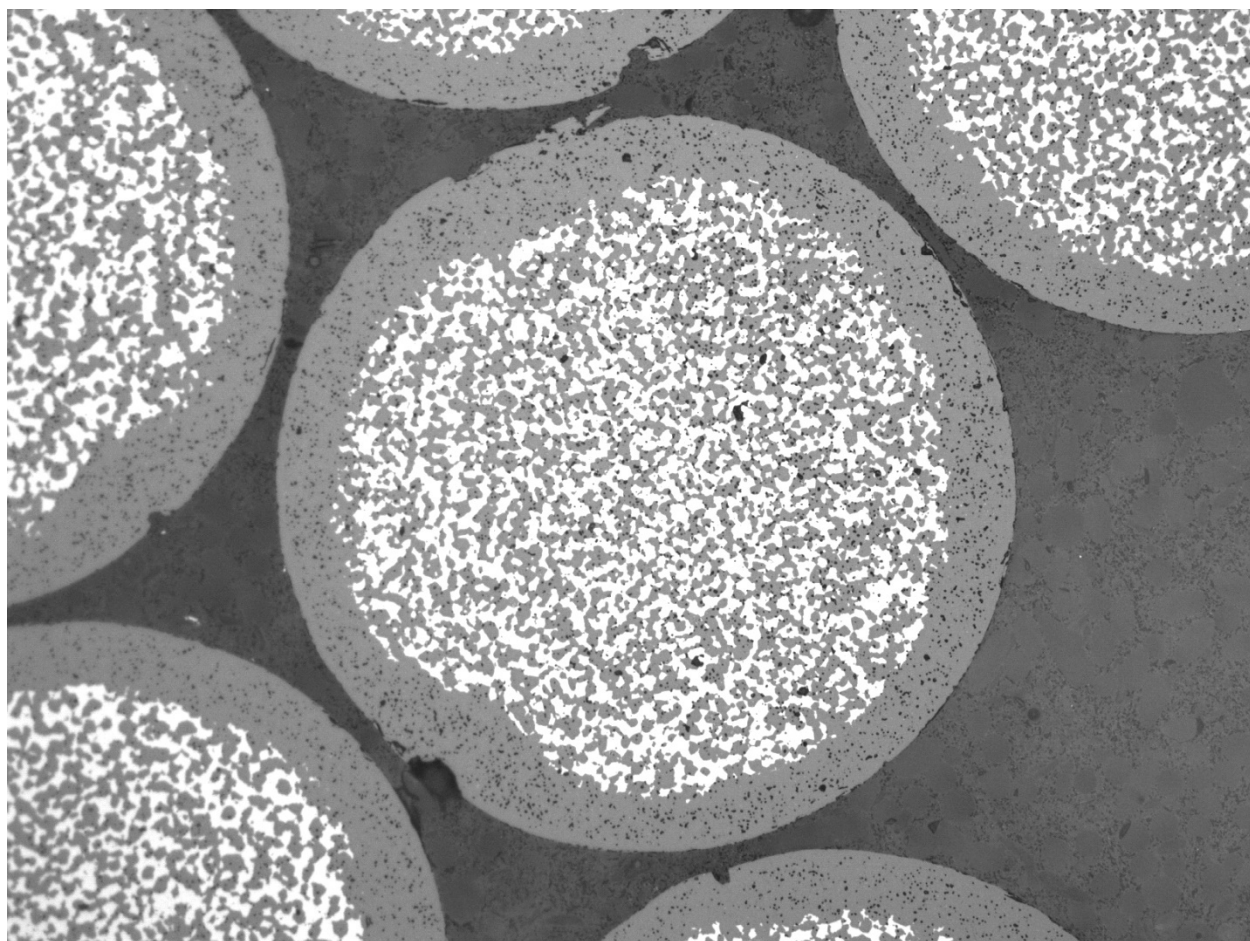
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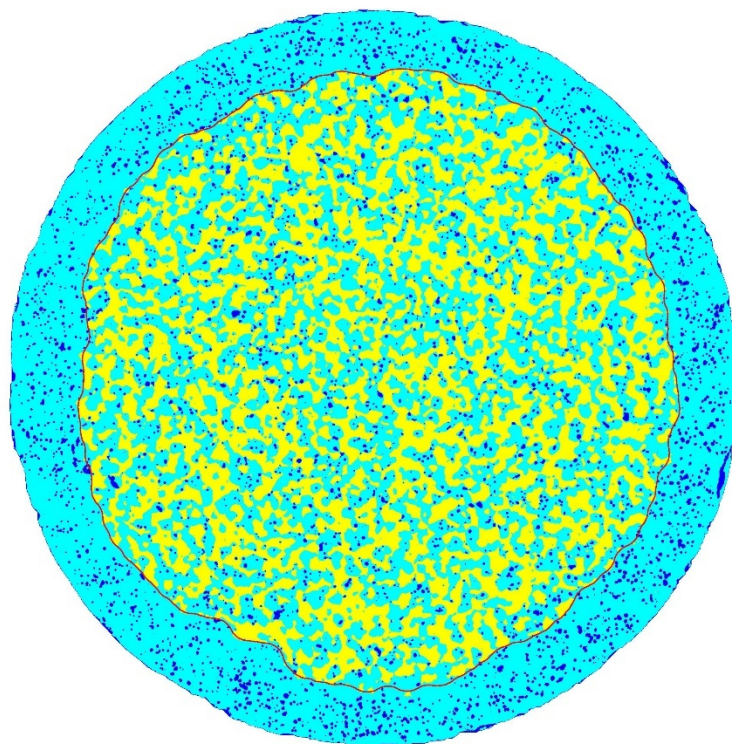
P17030905N134



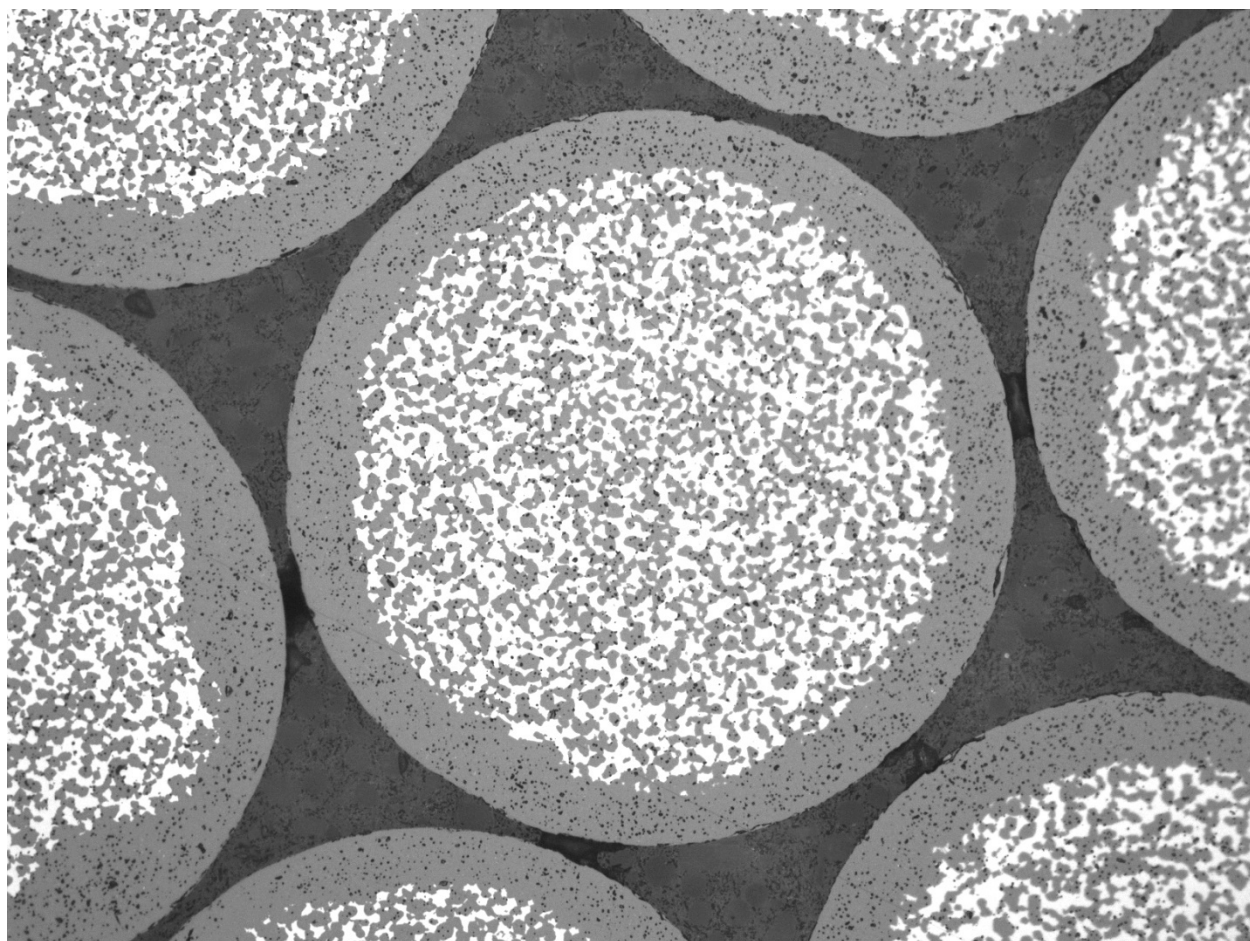
P17030905N137 segmented



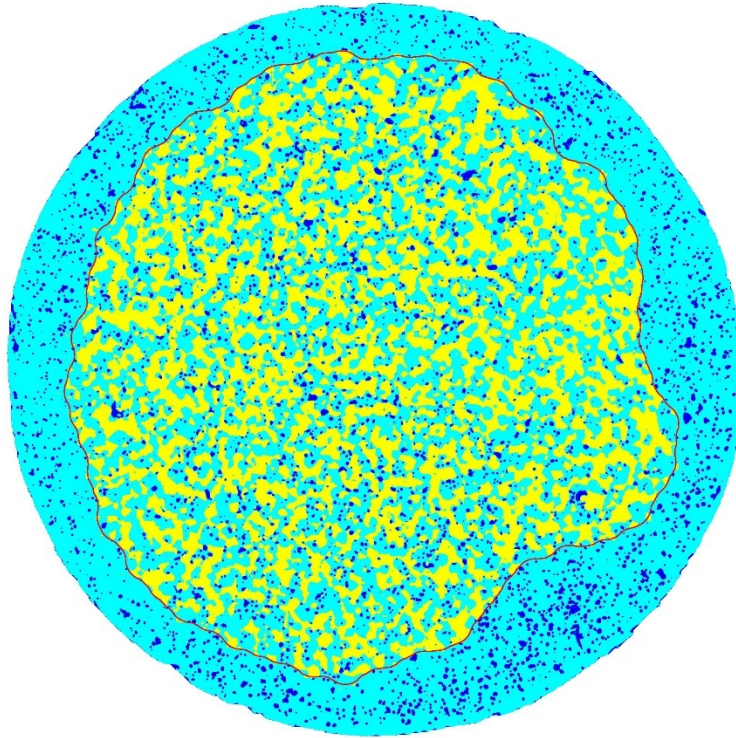
P17030905N137



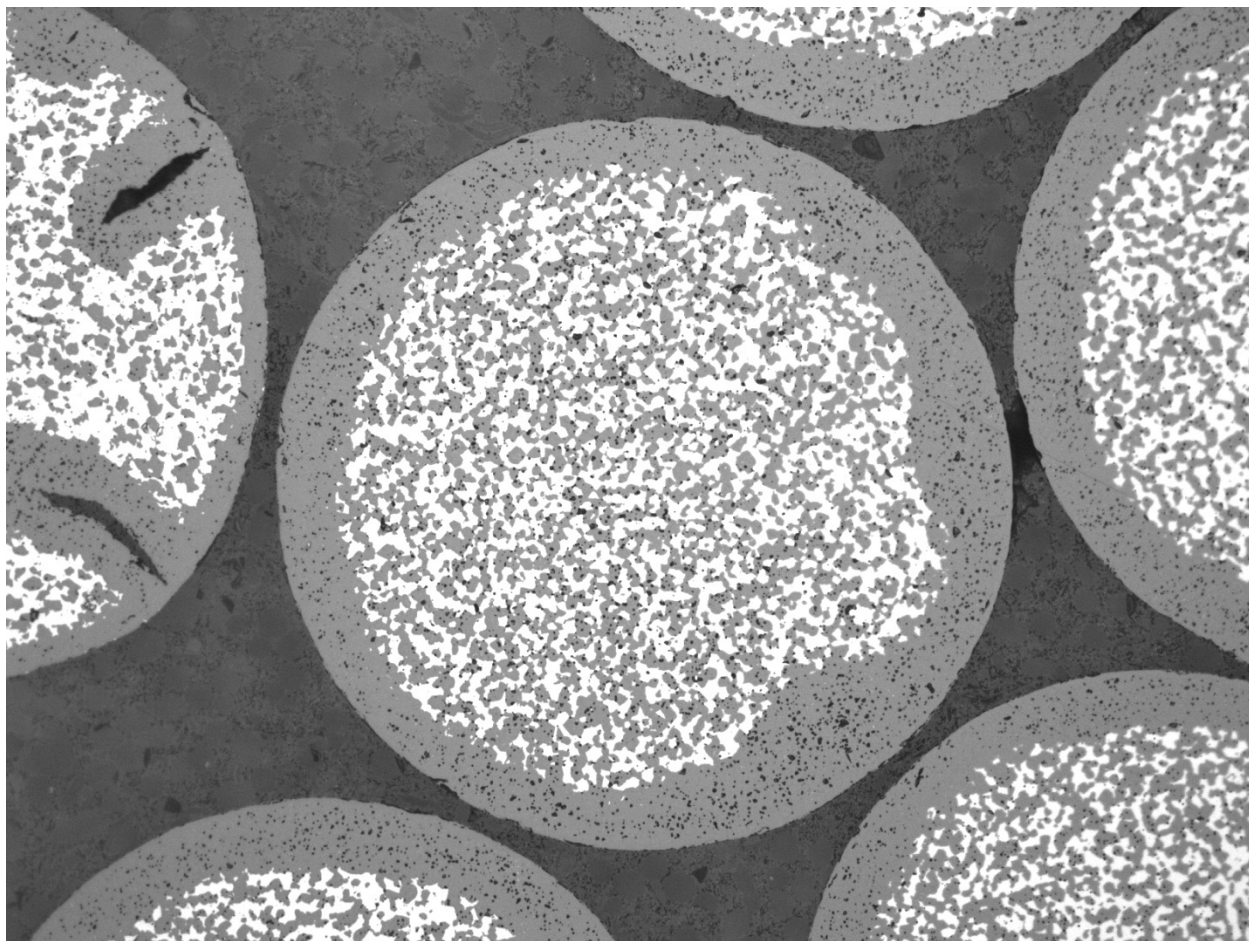
P17030905N138 segmented



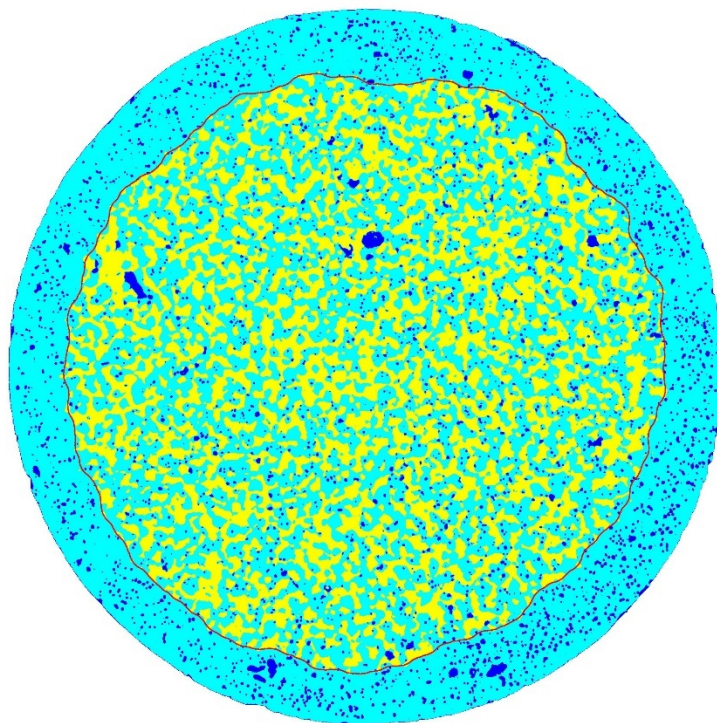
P17030905N138



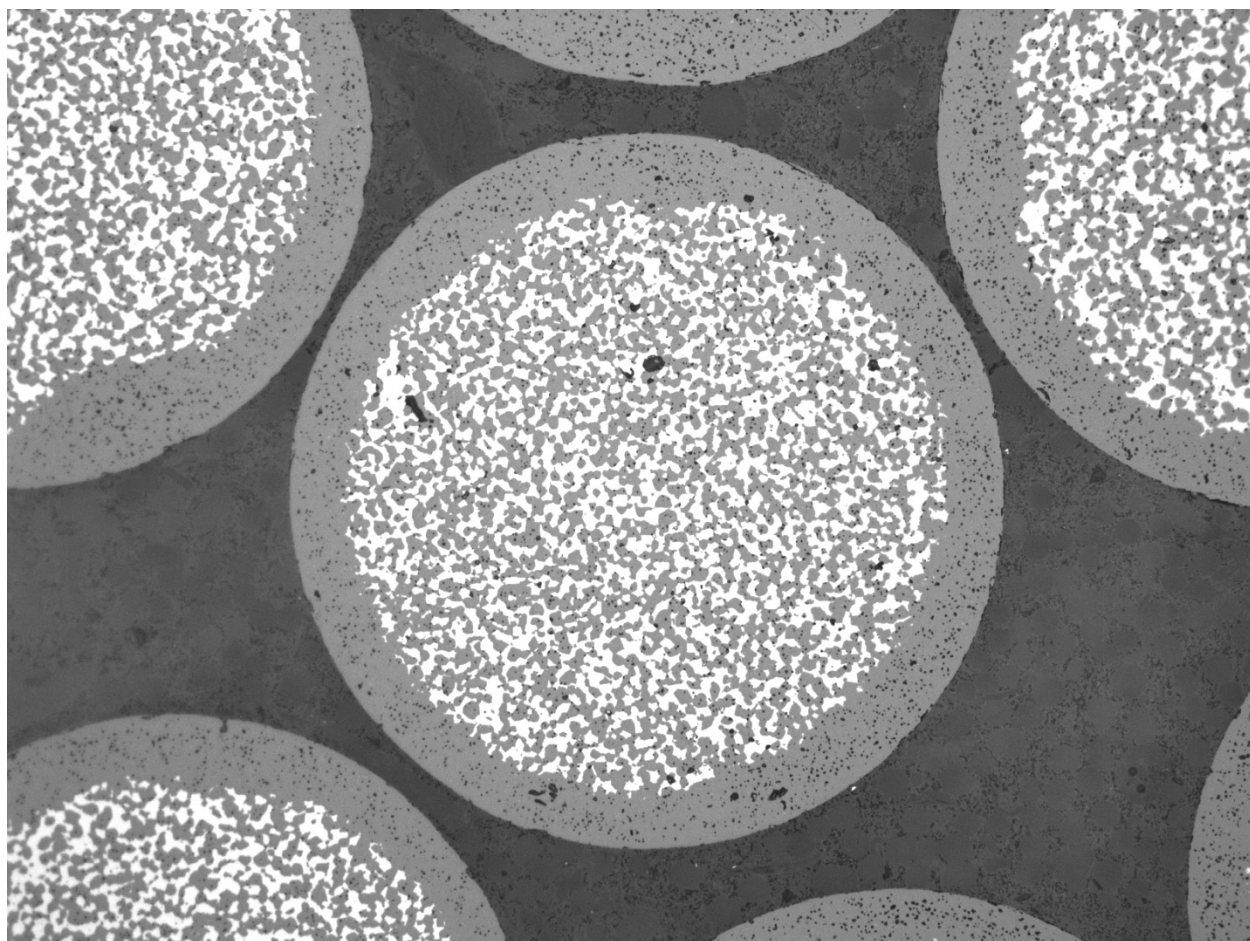
P17030905N139 segmented



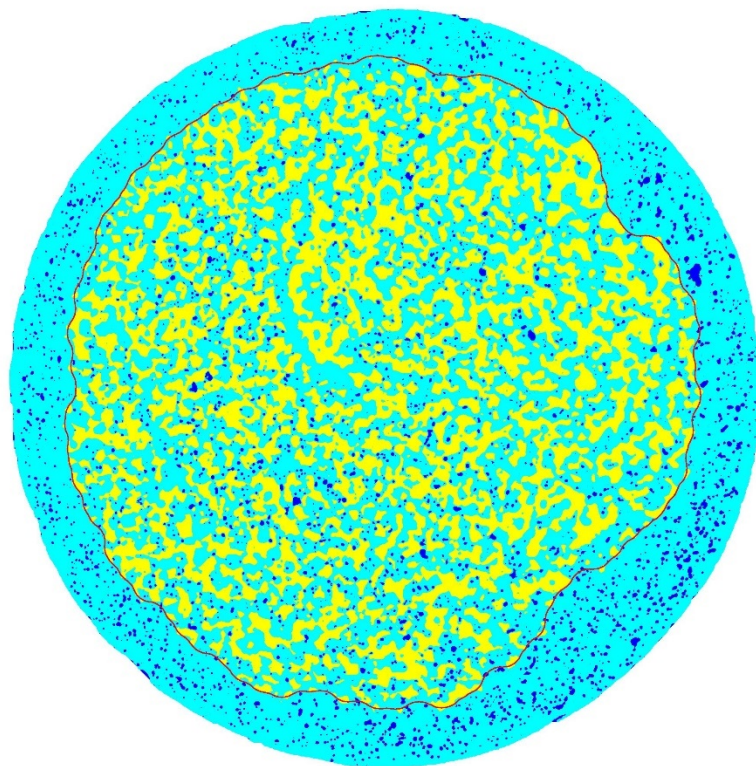
P17030905N139



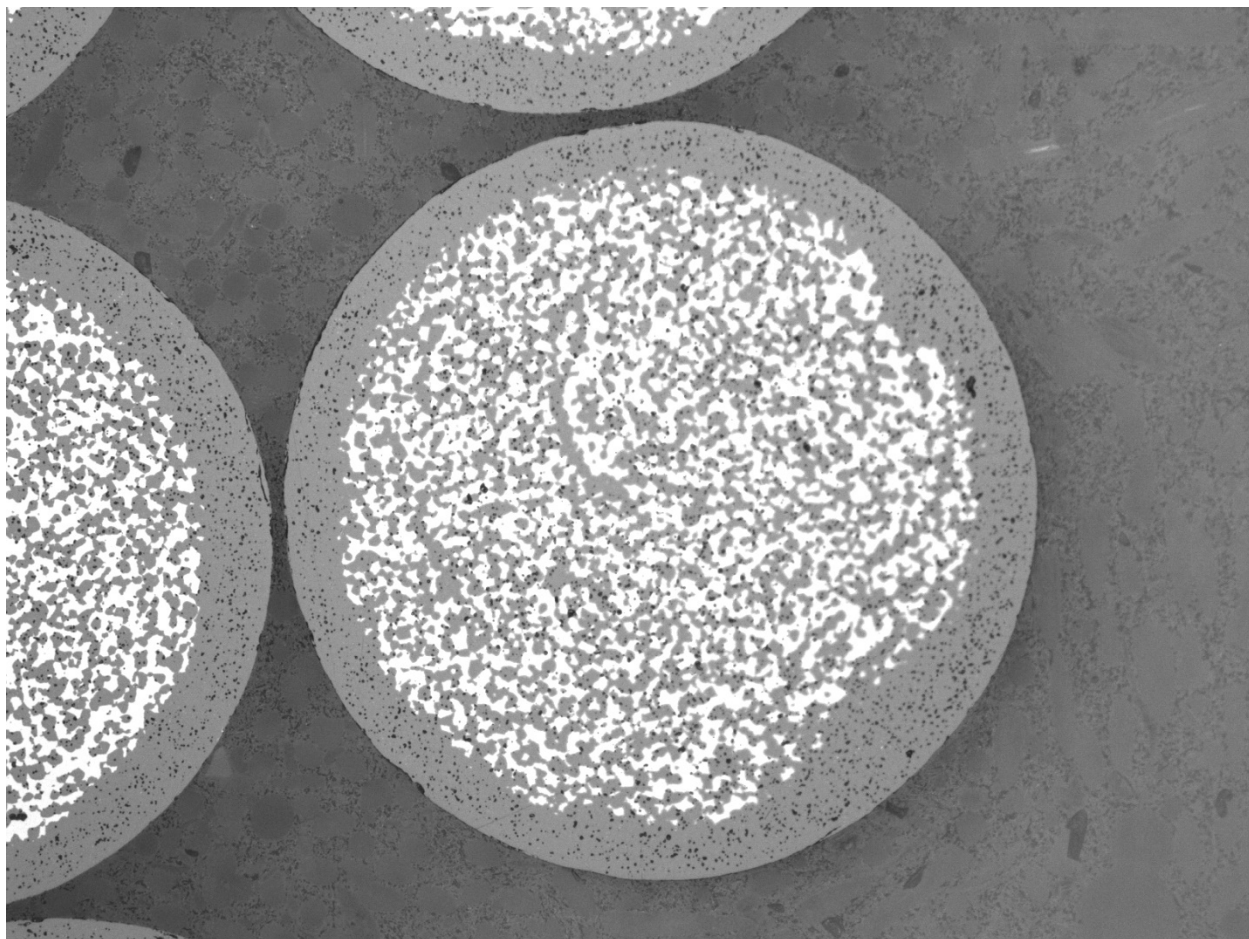
P17030905N140 segmented



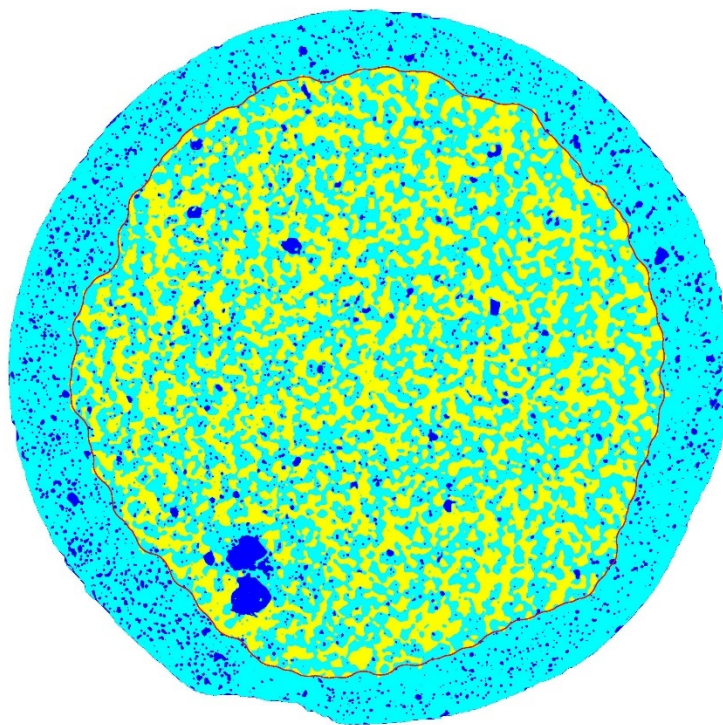
P17030905N140



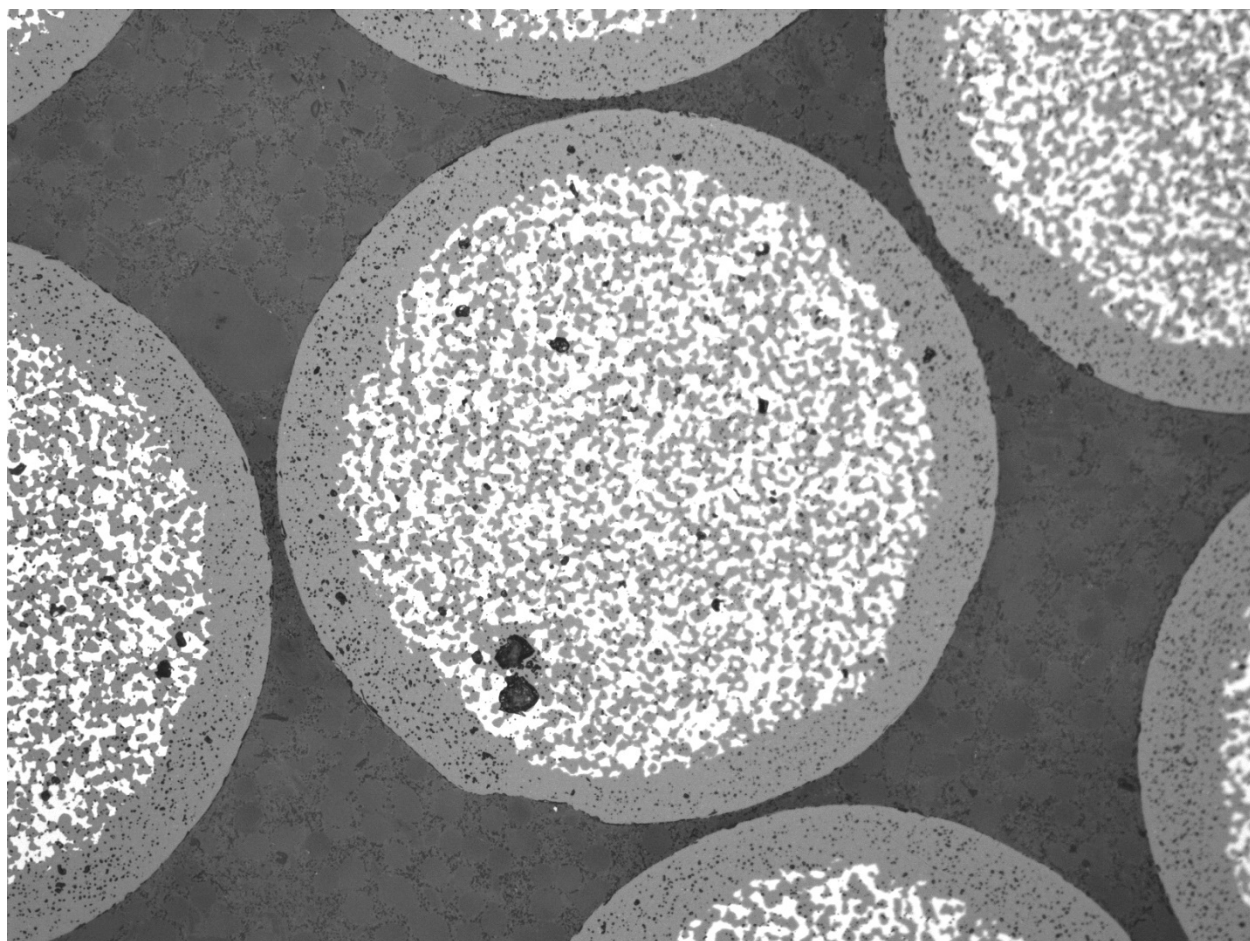
P17030905N141 segmented



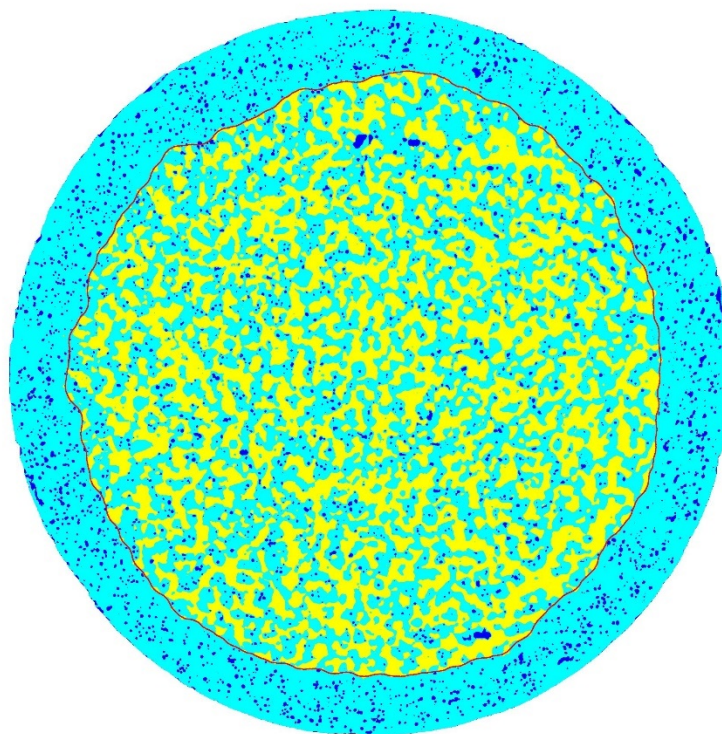
P17030905N141



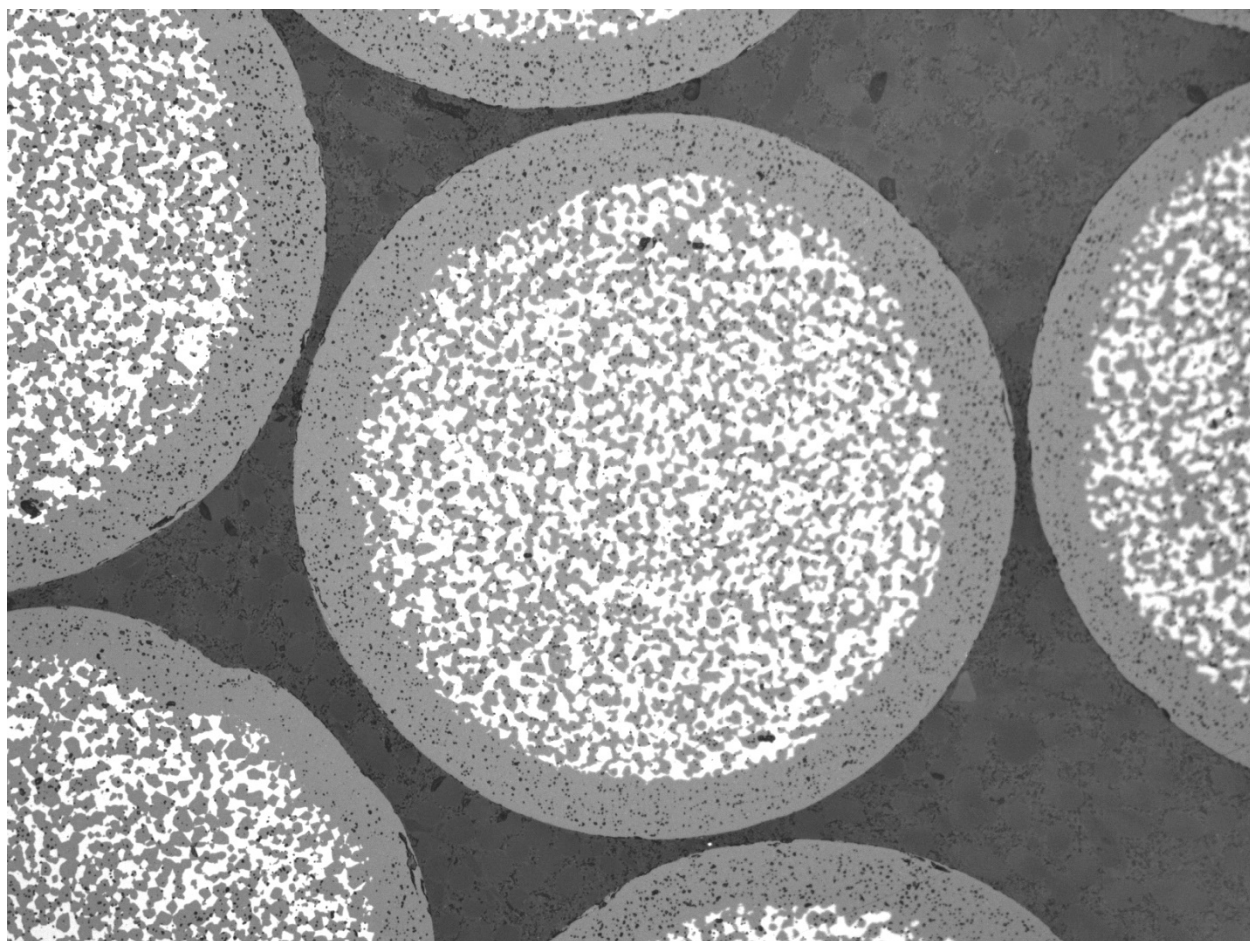
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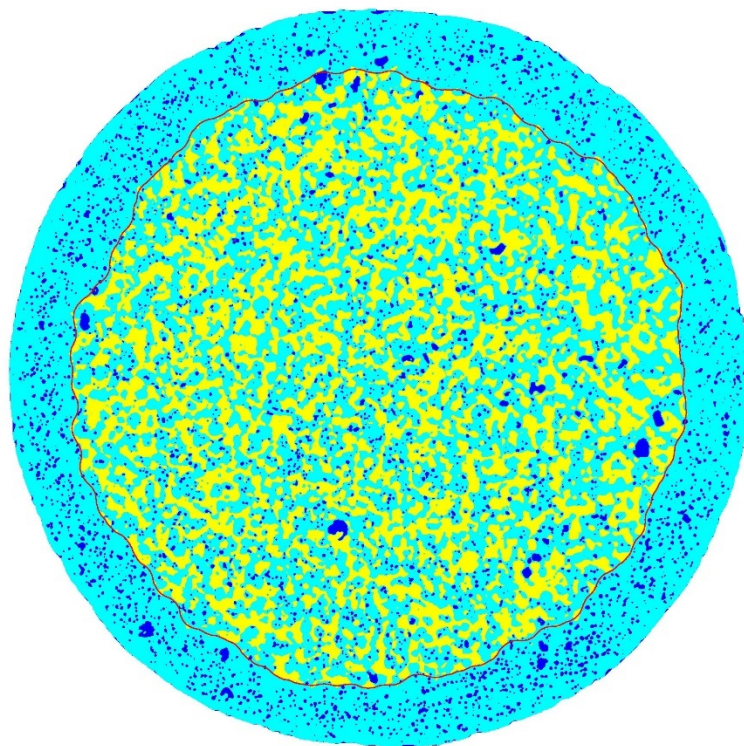
P17030905N142



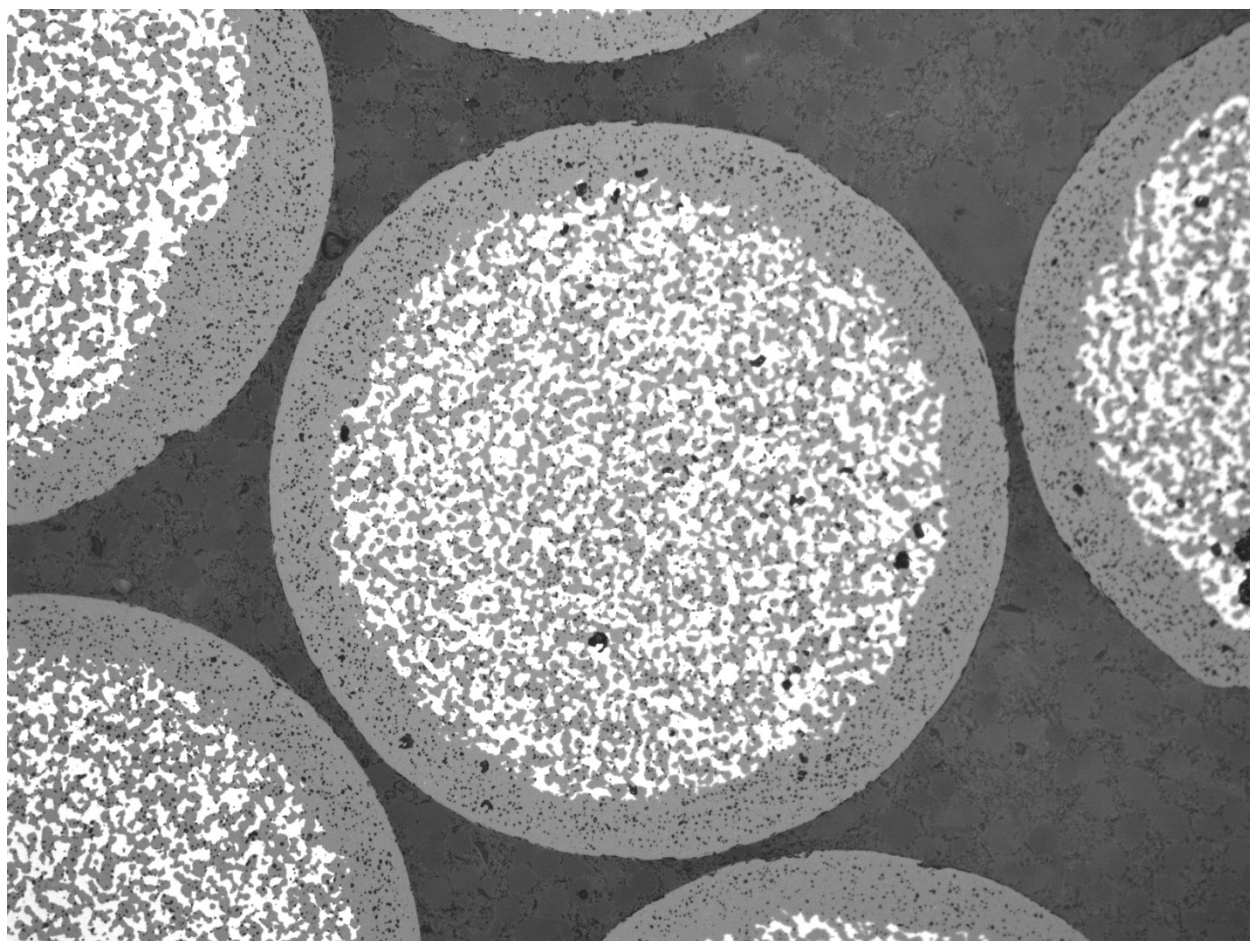
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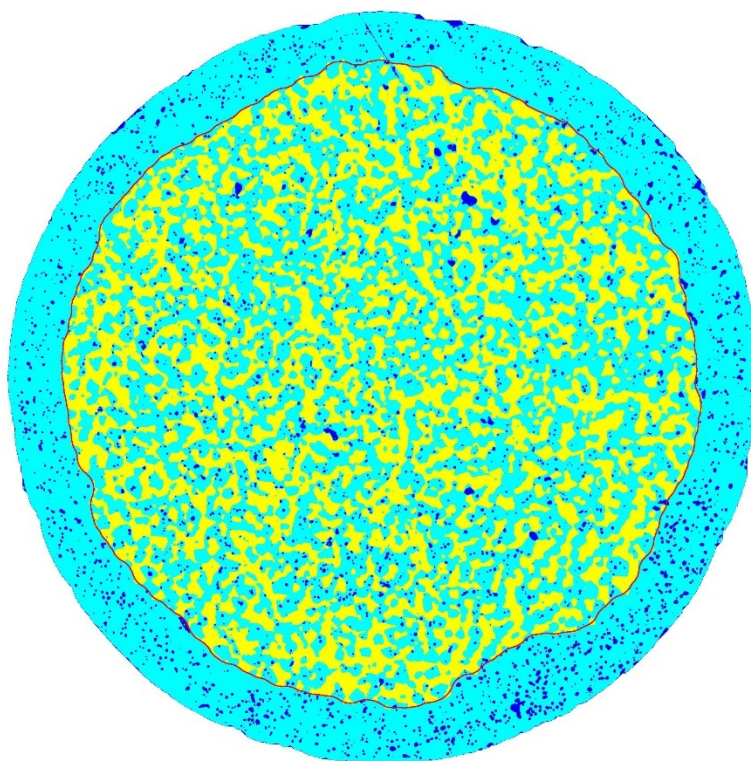
P17030905N143



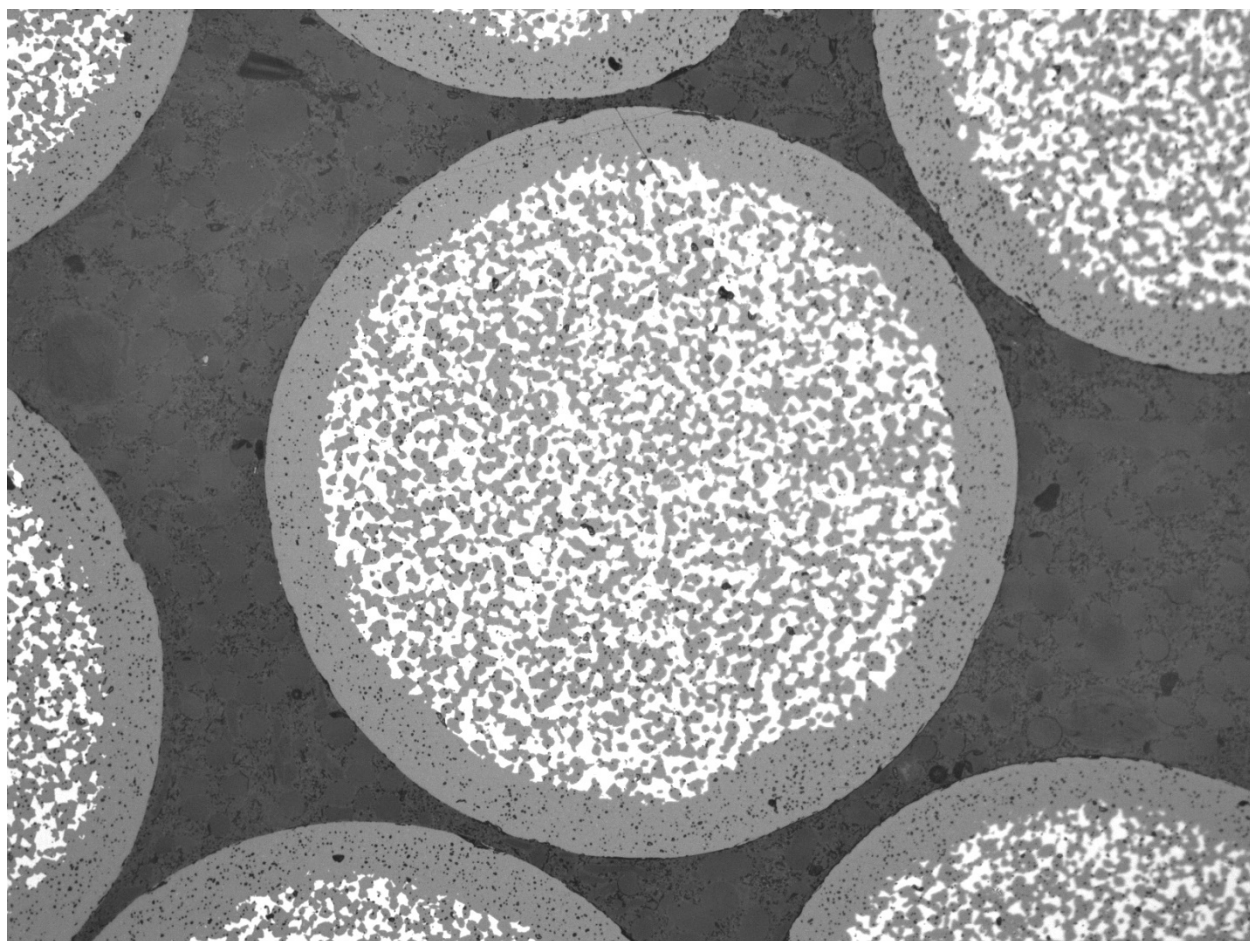
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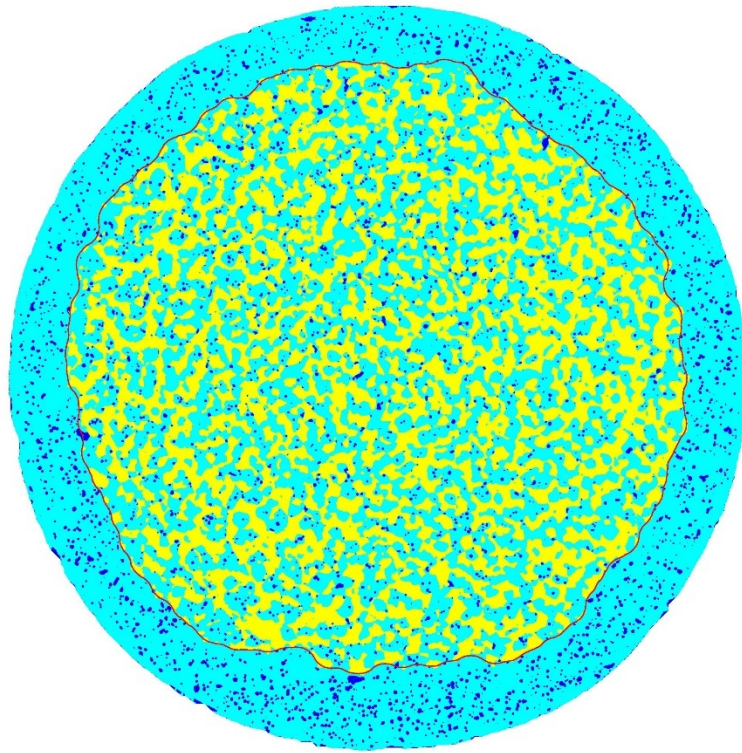
P17030905N144



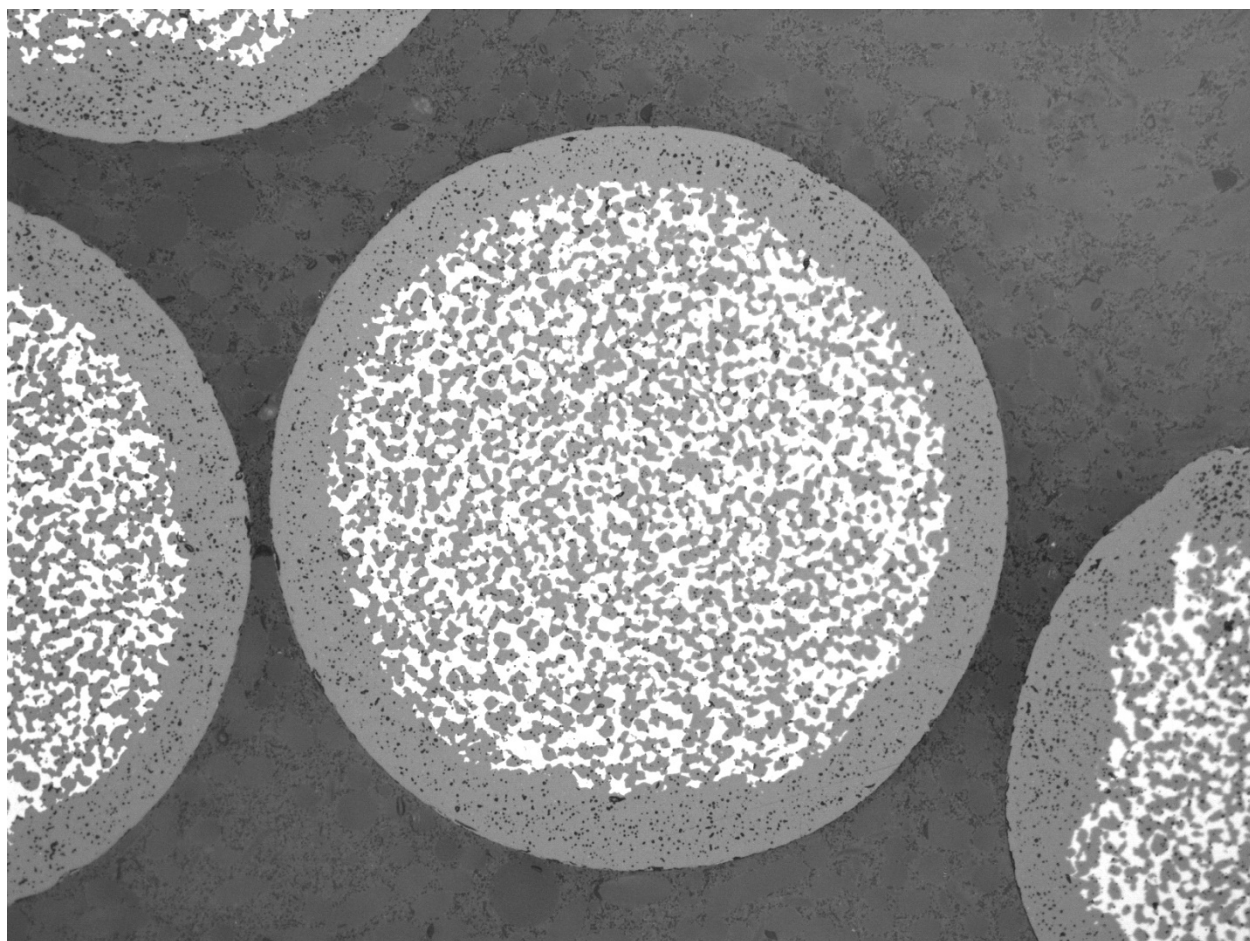
P17030905N145 segmented



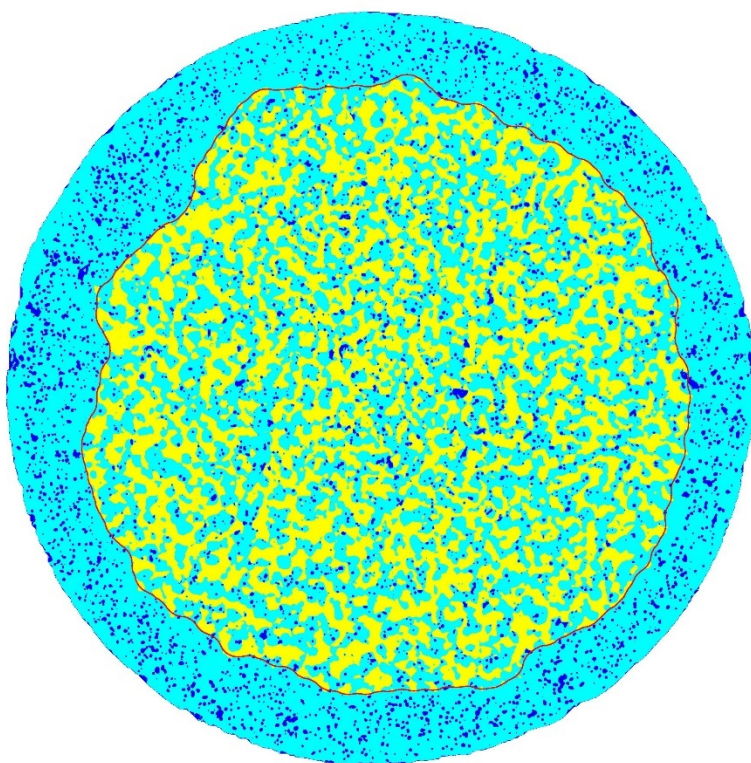
P17030905N145



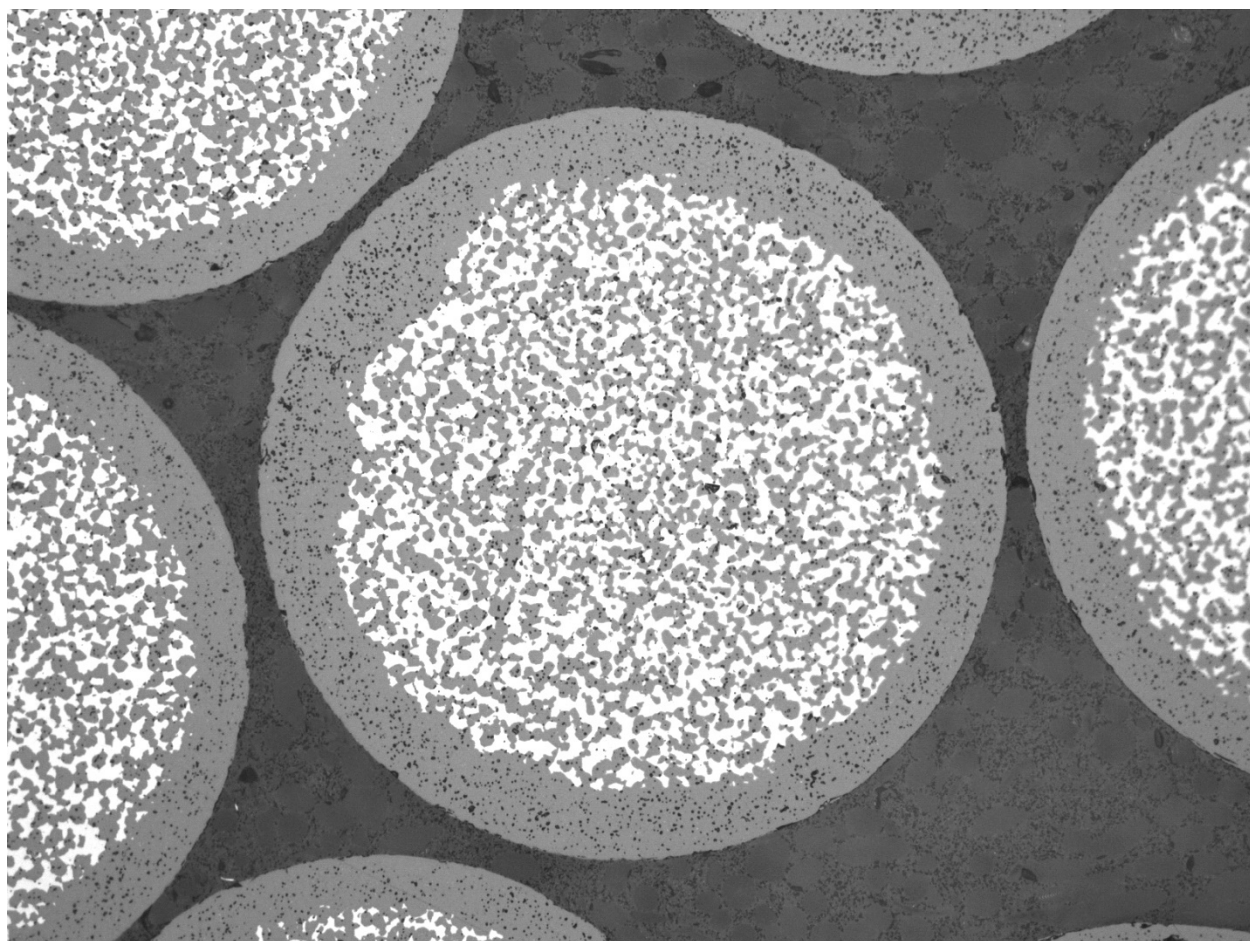
P17030905N146 segmented



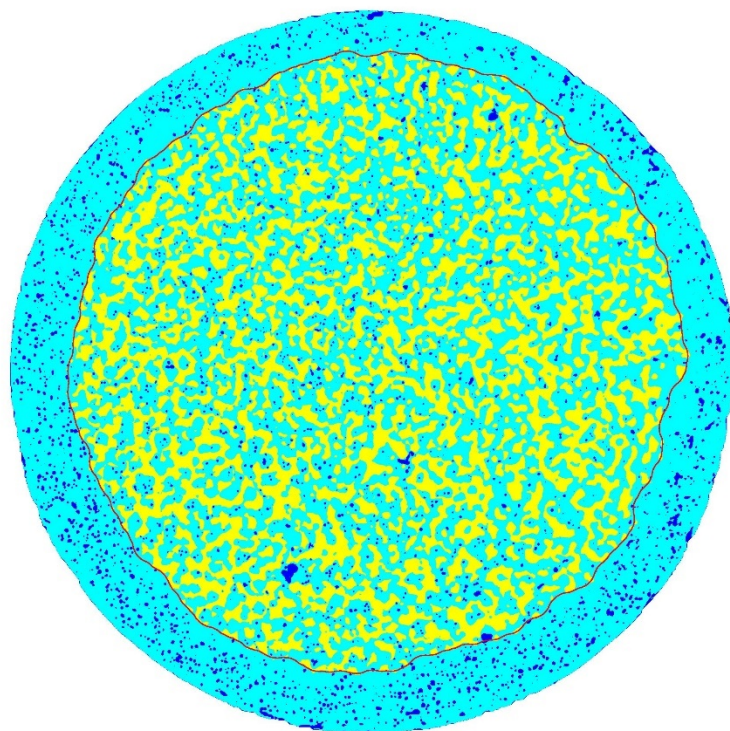
P17030905N146



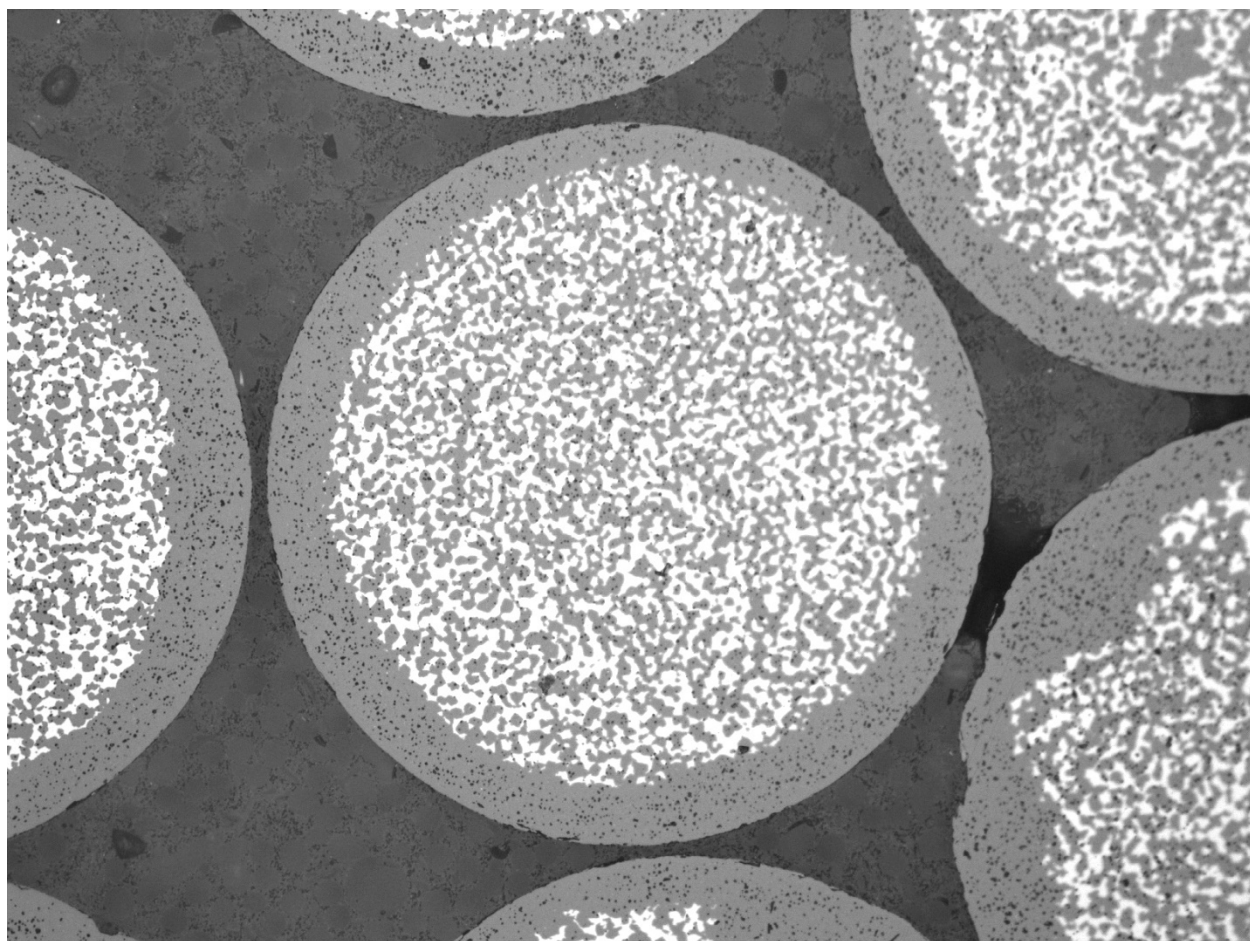
P17030905N147 segmented



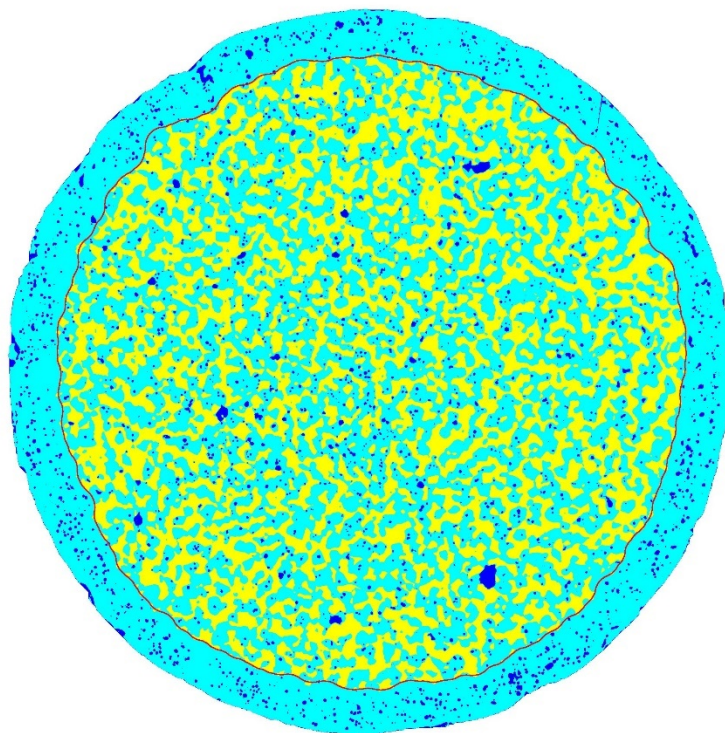
P17030905N147



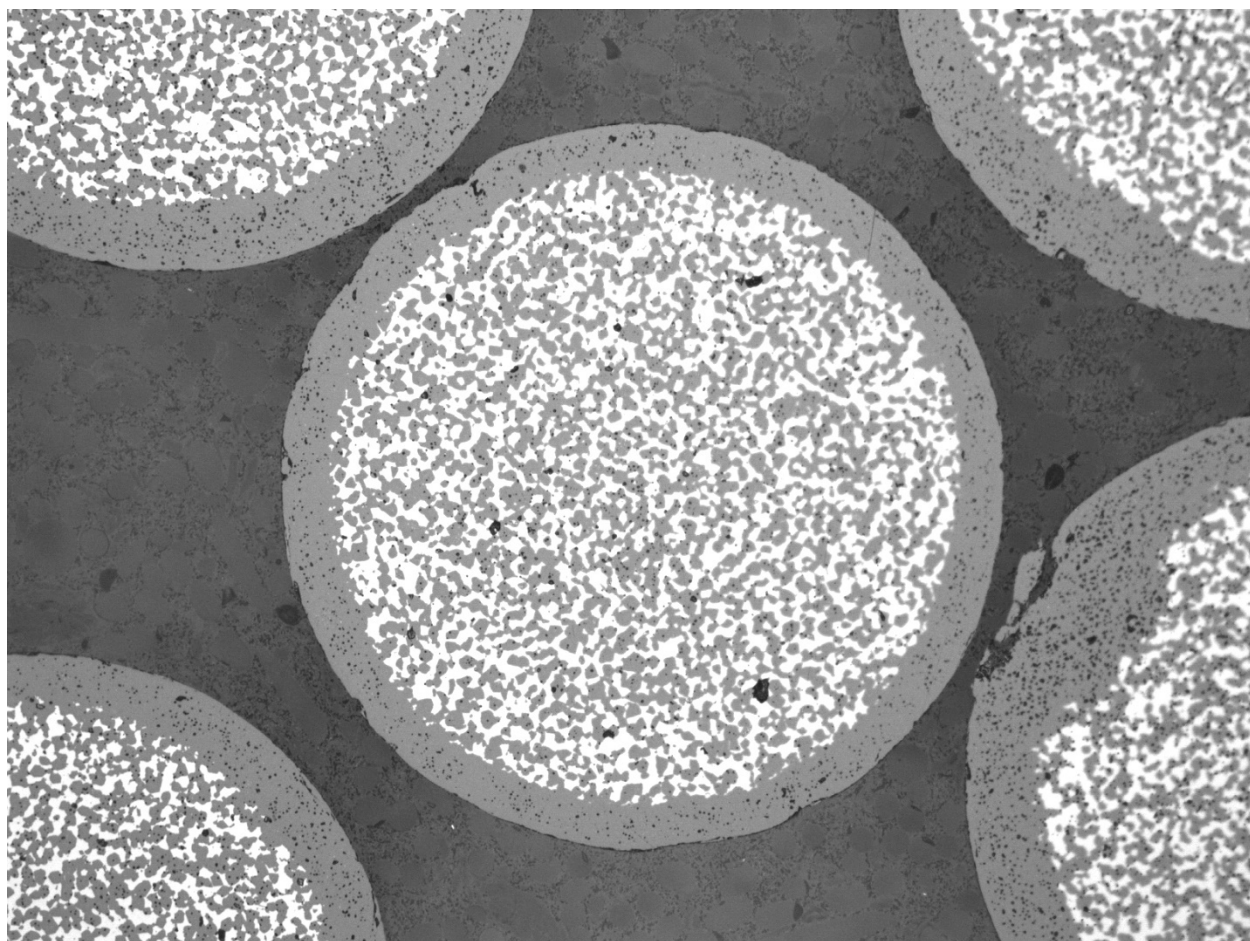
P17030905N148 segmented



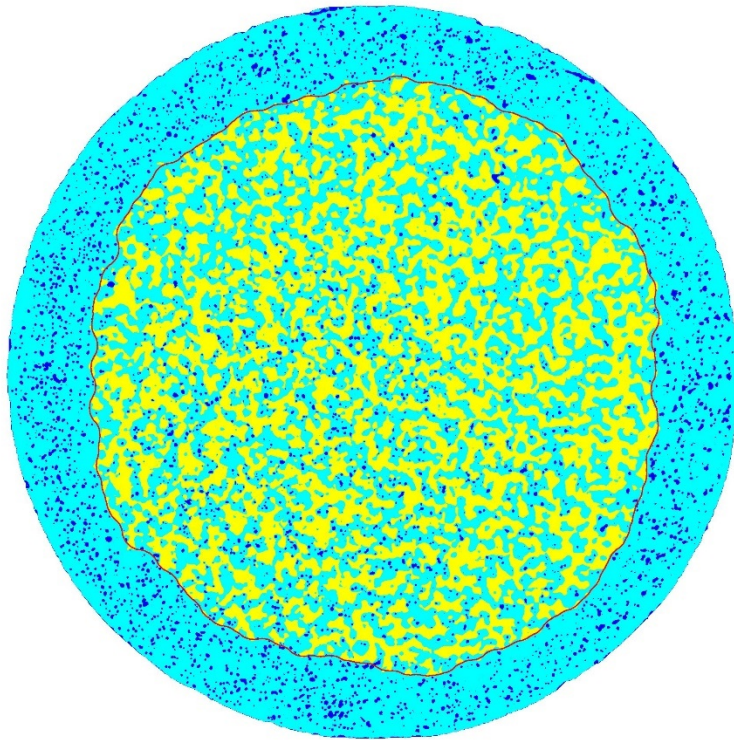
P17030905N148



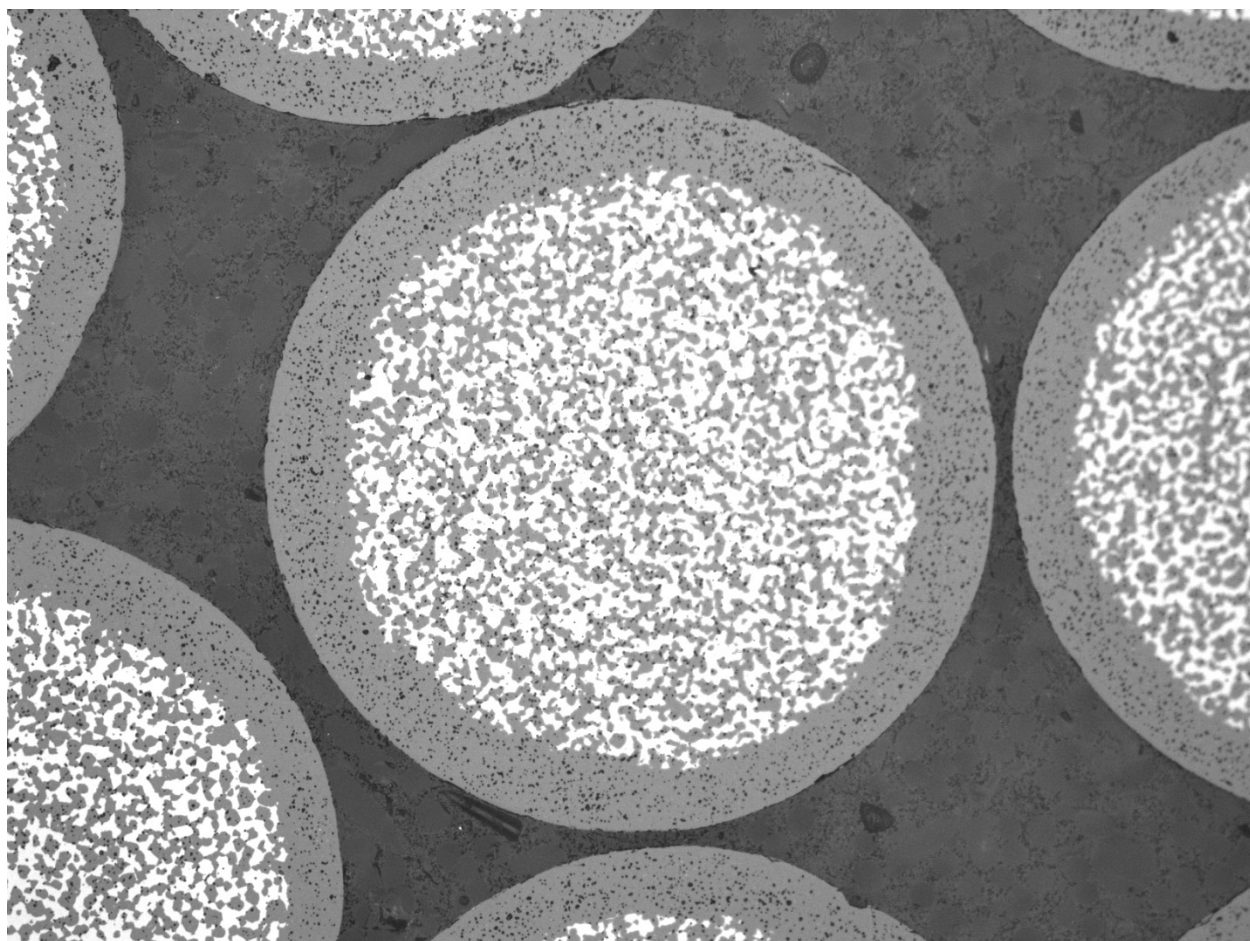
P17030905N149 segmented



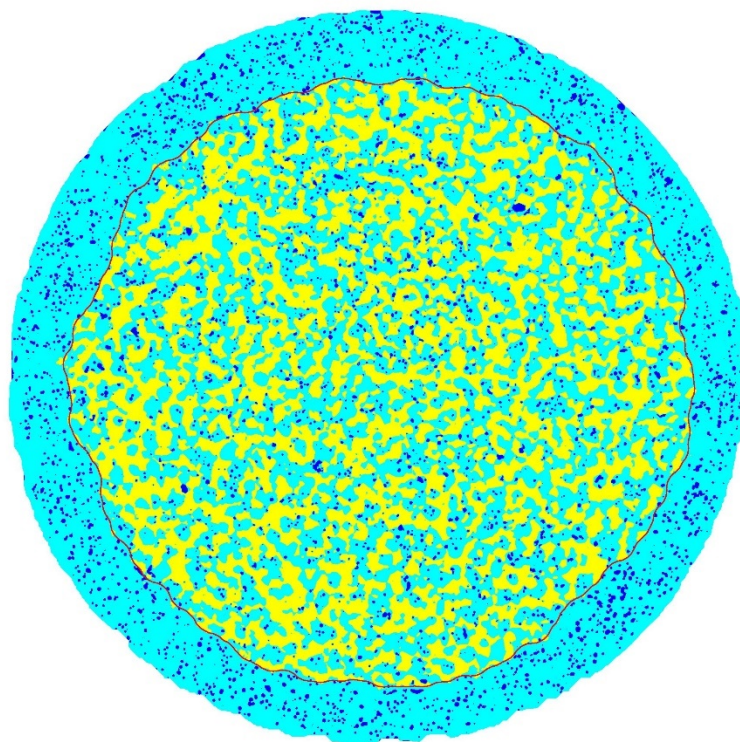
P17030905N149



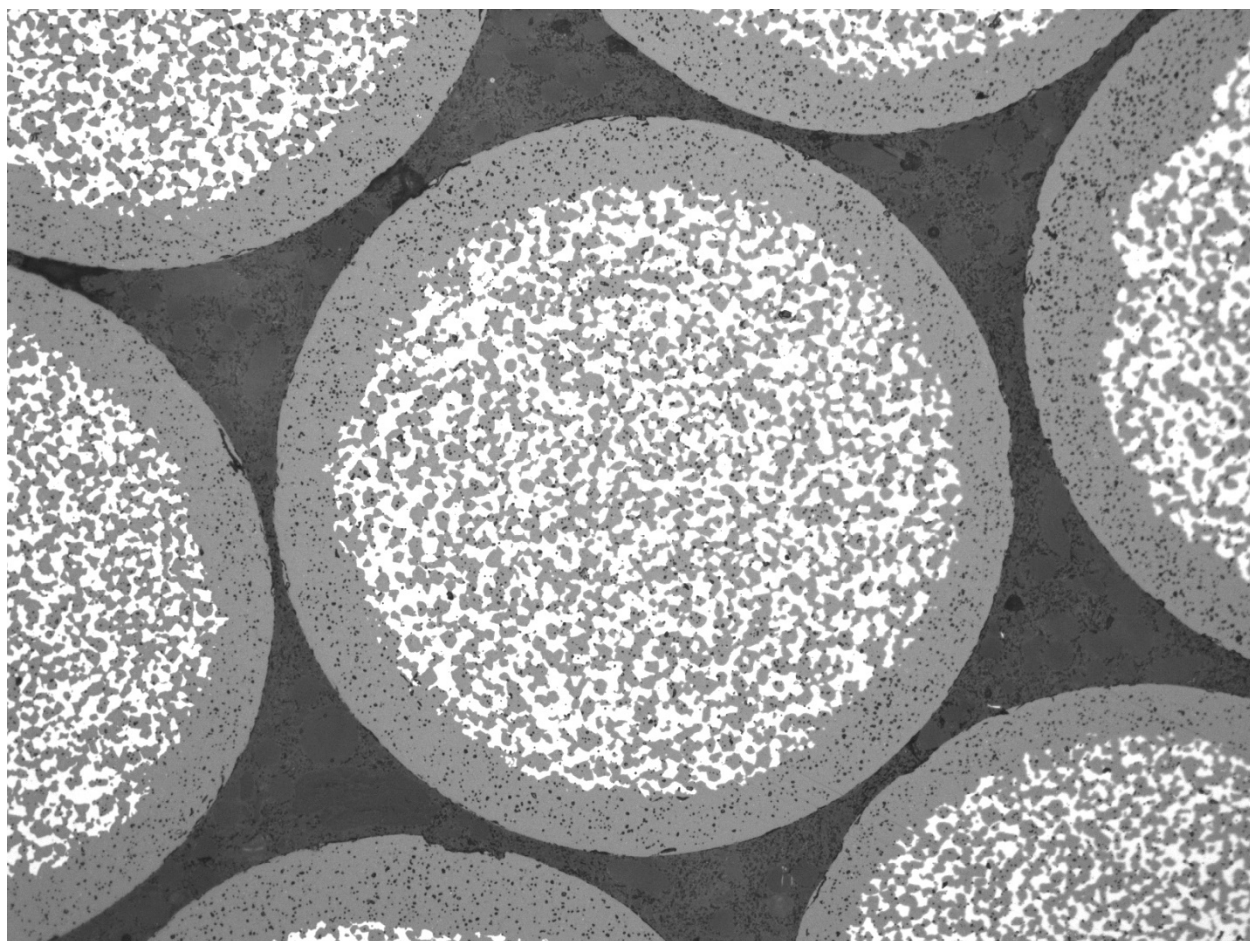
P17030905N151 segmented



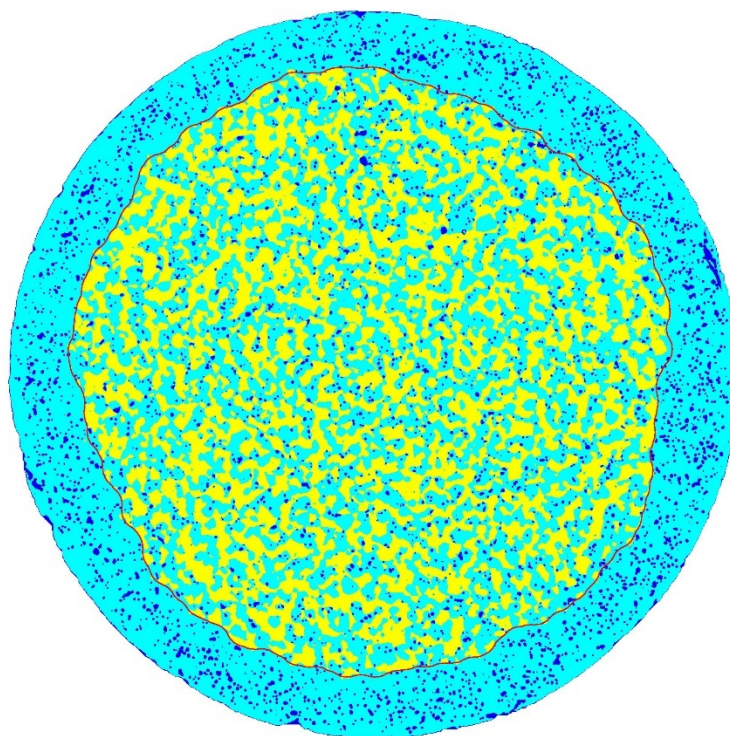
P17030905N151



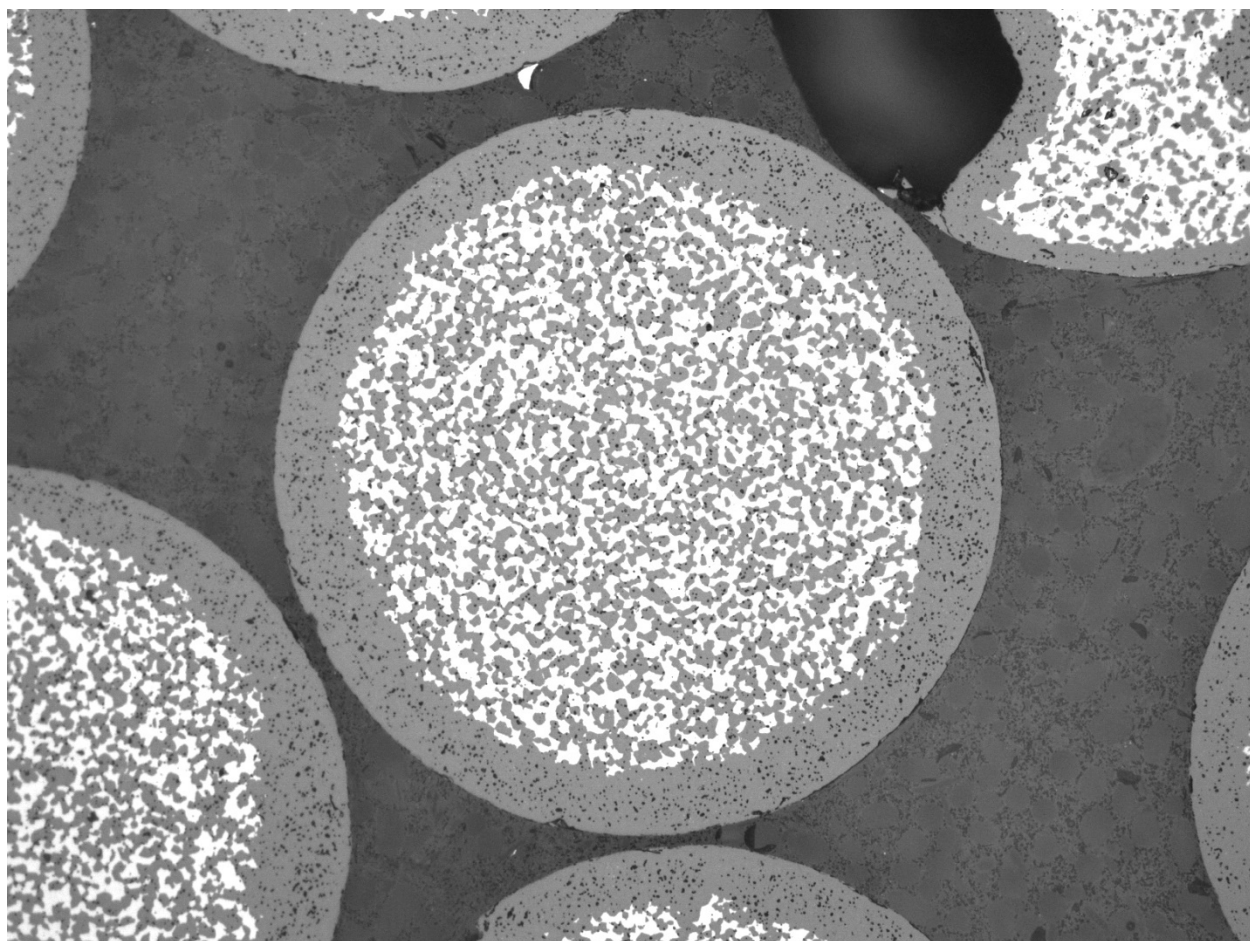
P17030905N152 segmented



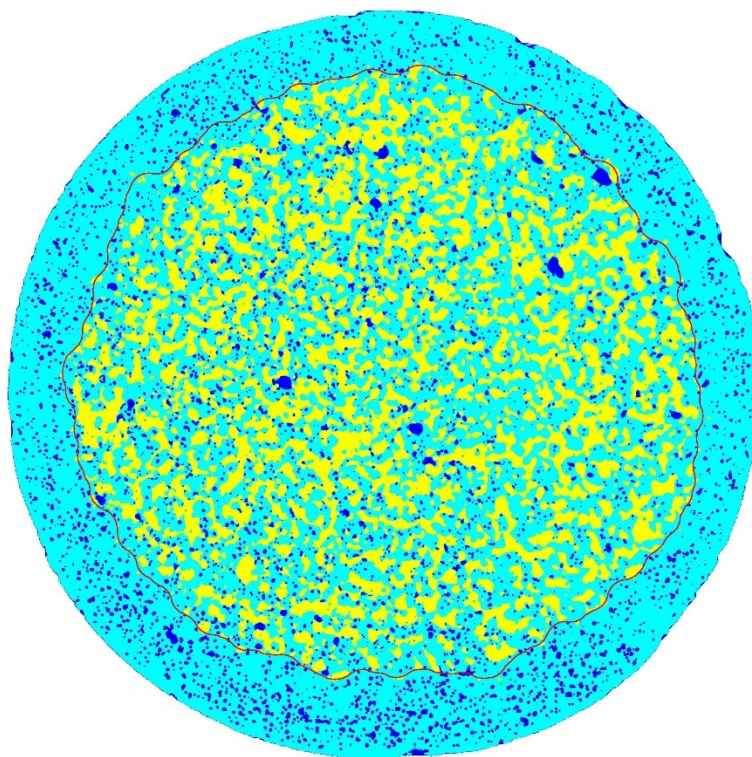
P17030905N152



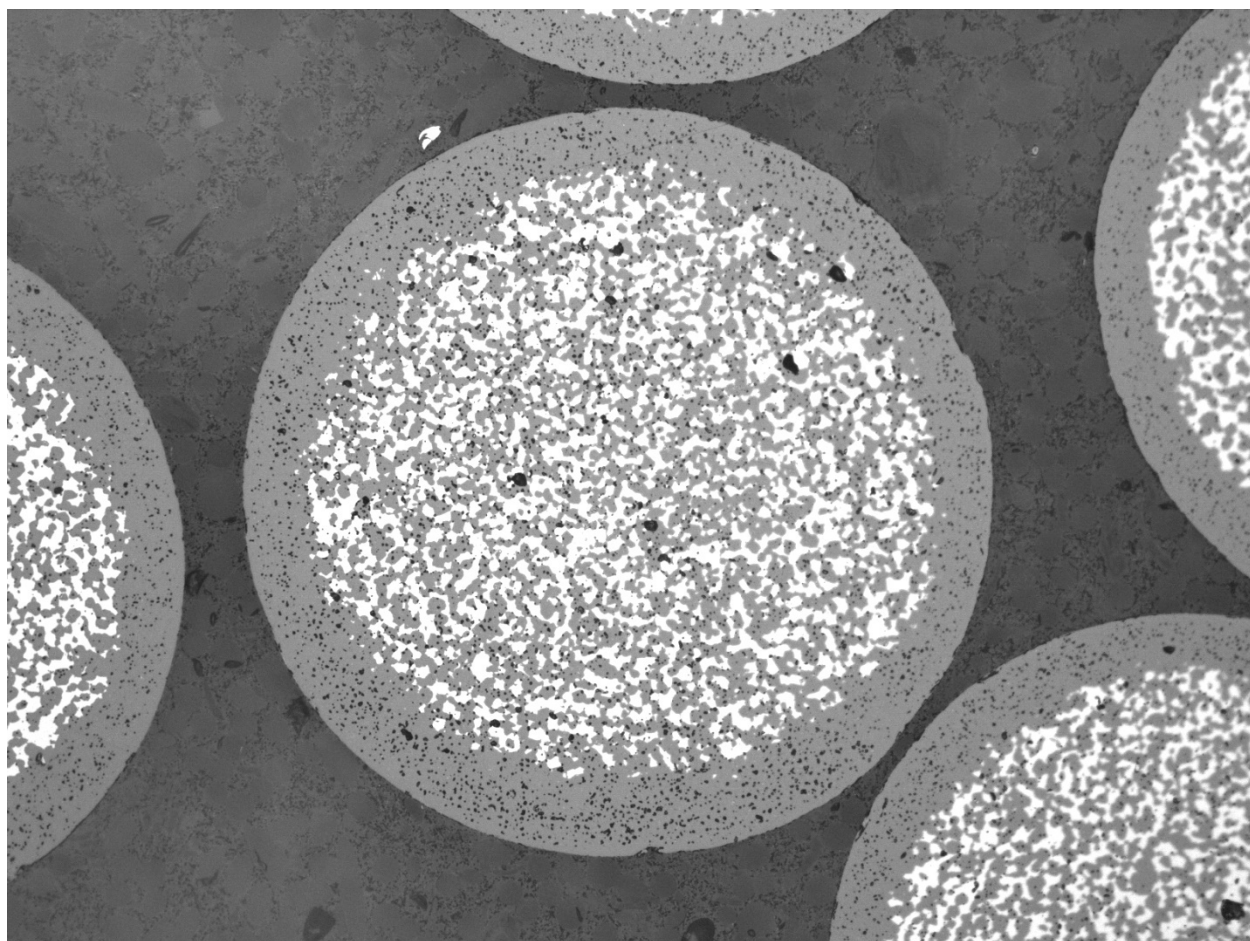
P17030905N153 segmented



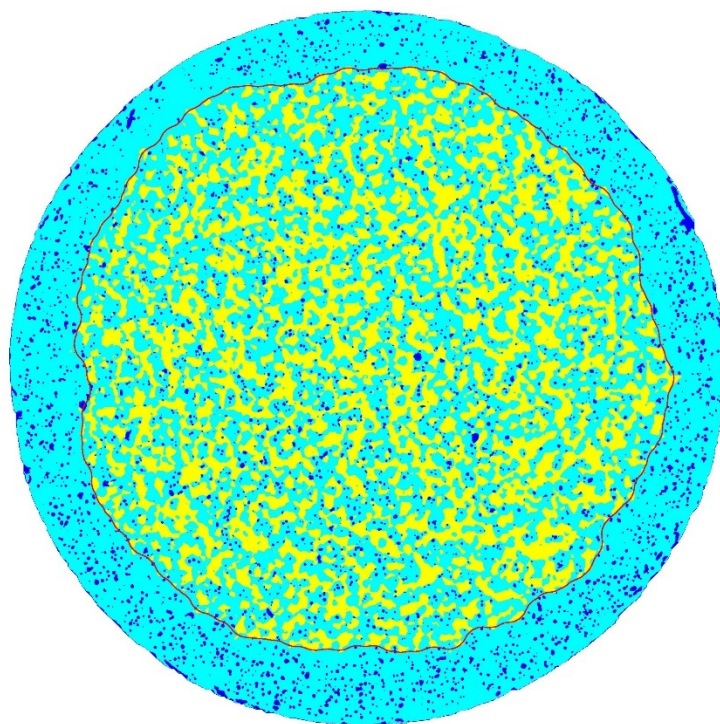
P17030905N153



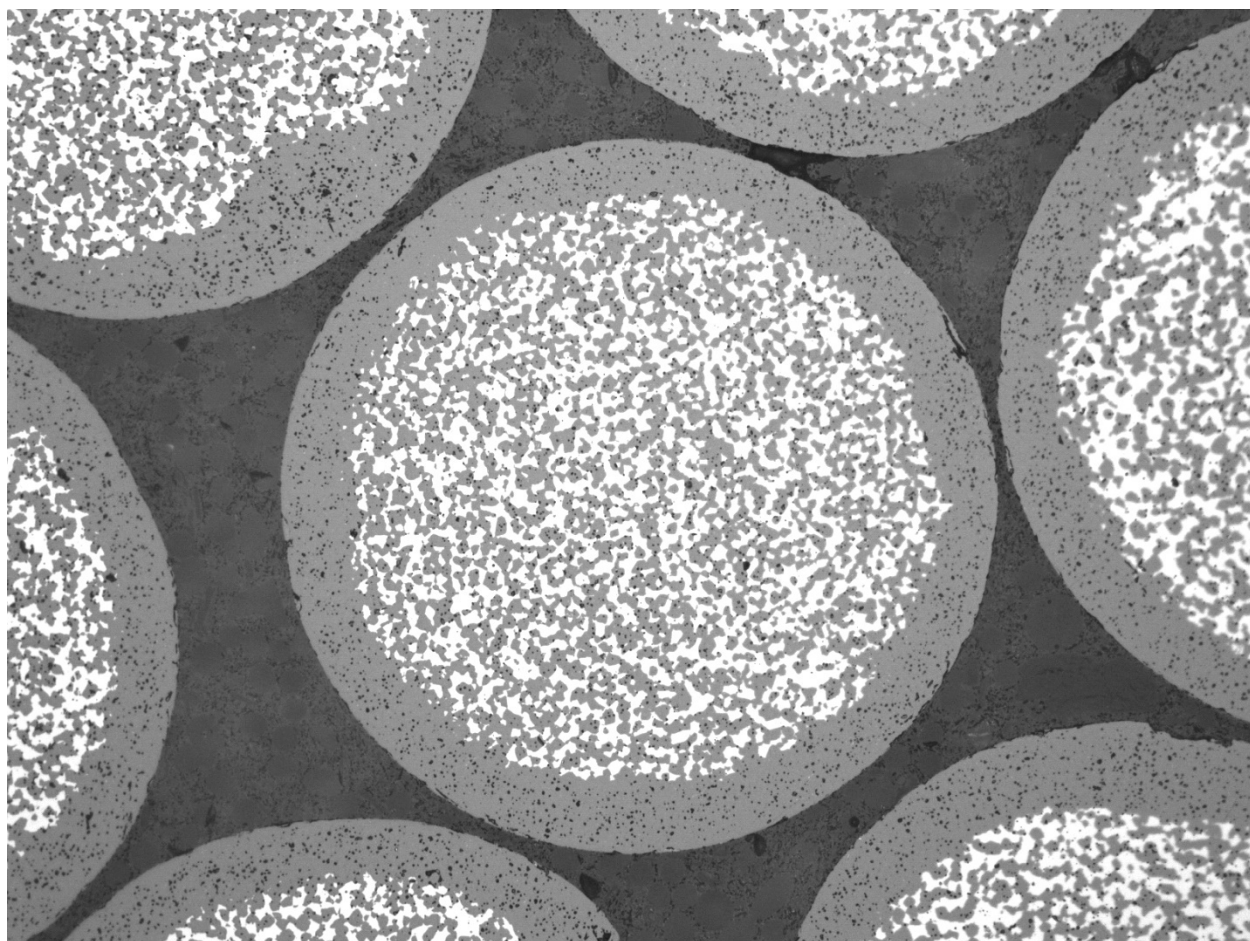
P17030905N154 segmented



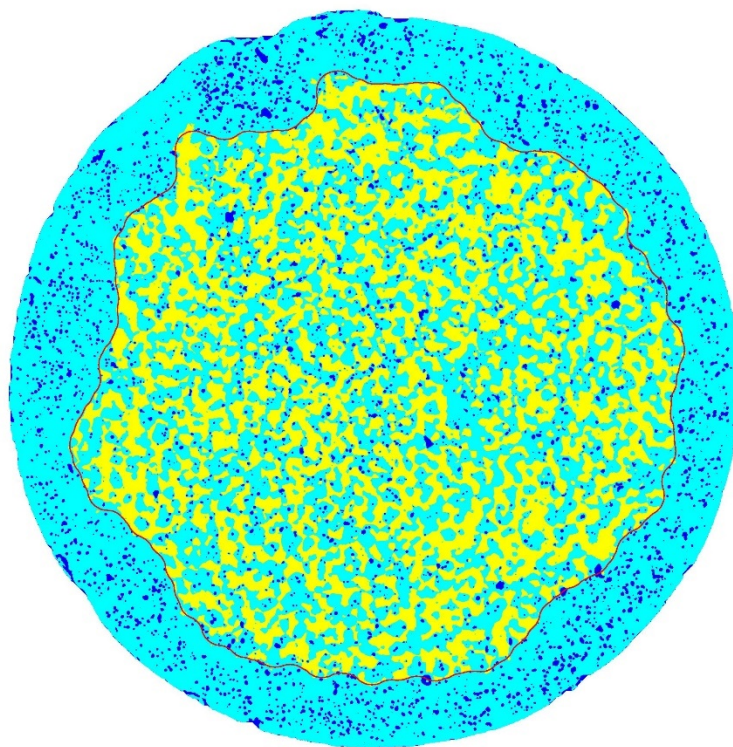
P17030905N154



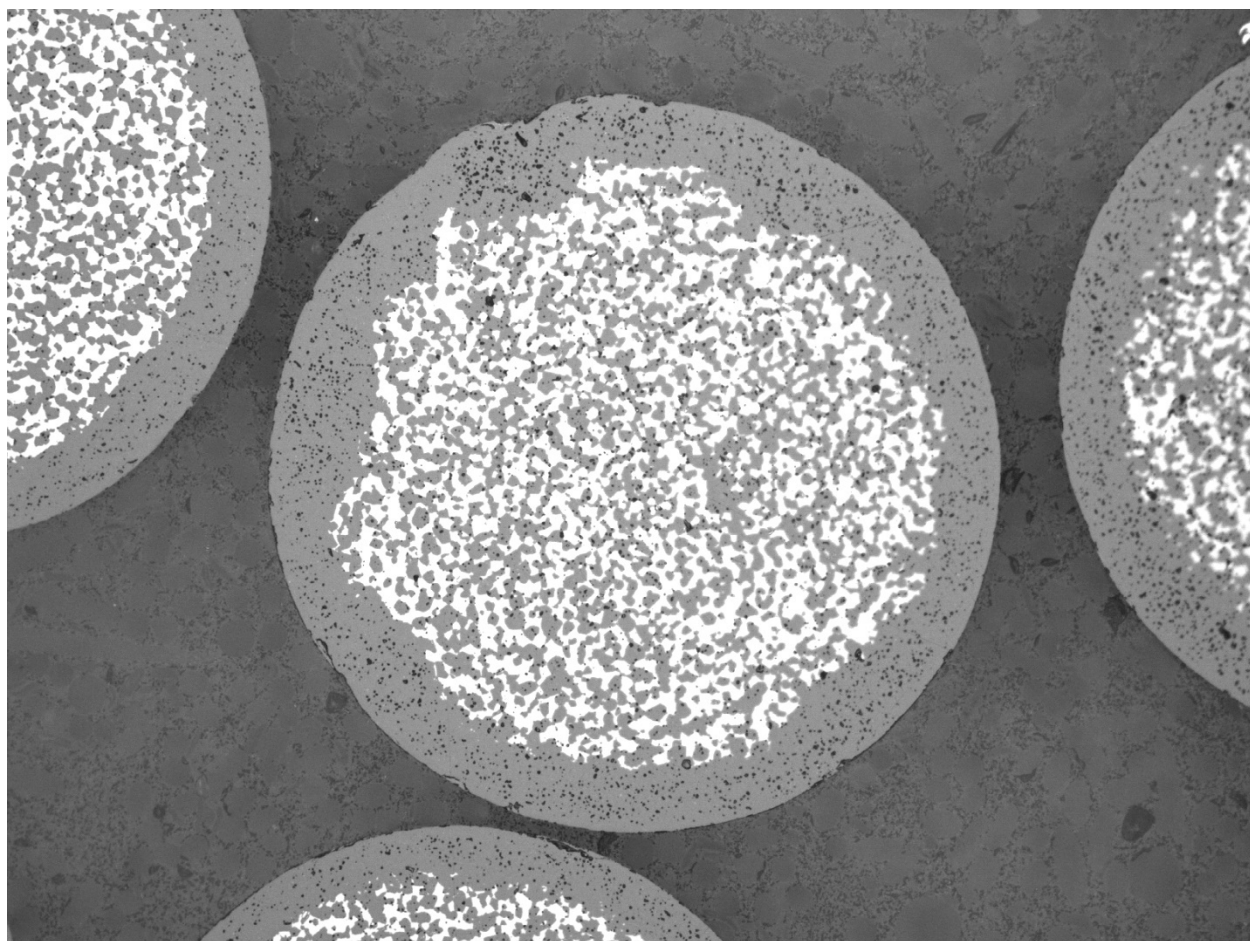
P17030905N155 segmented



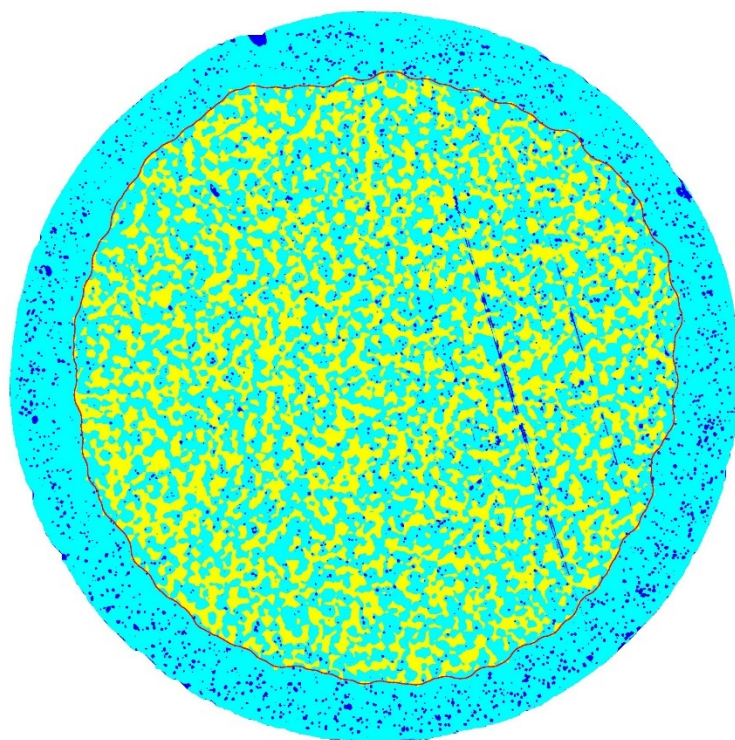
P17030905N155



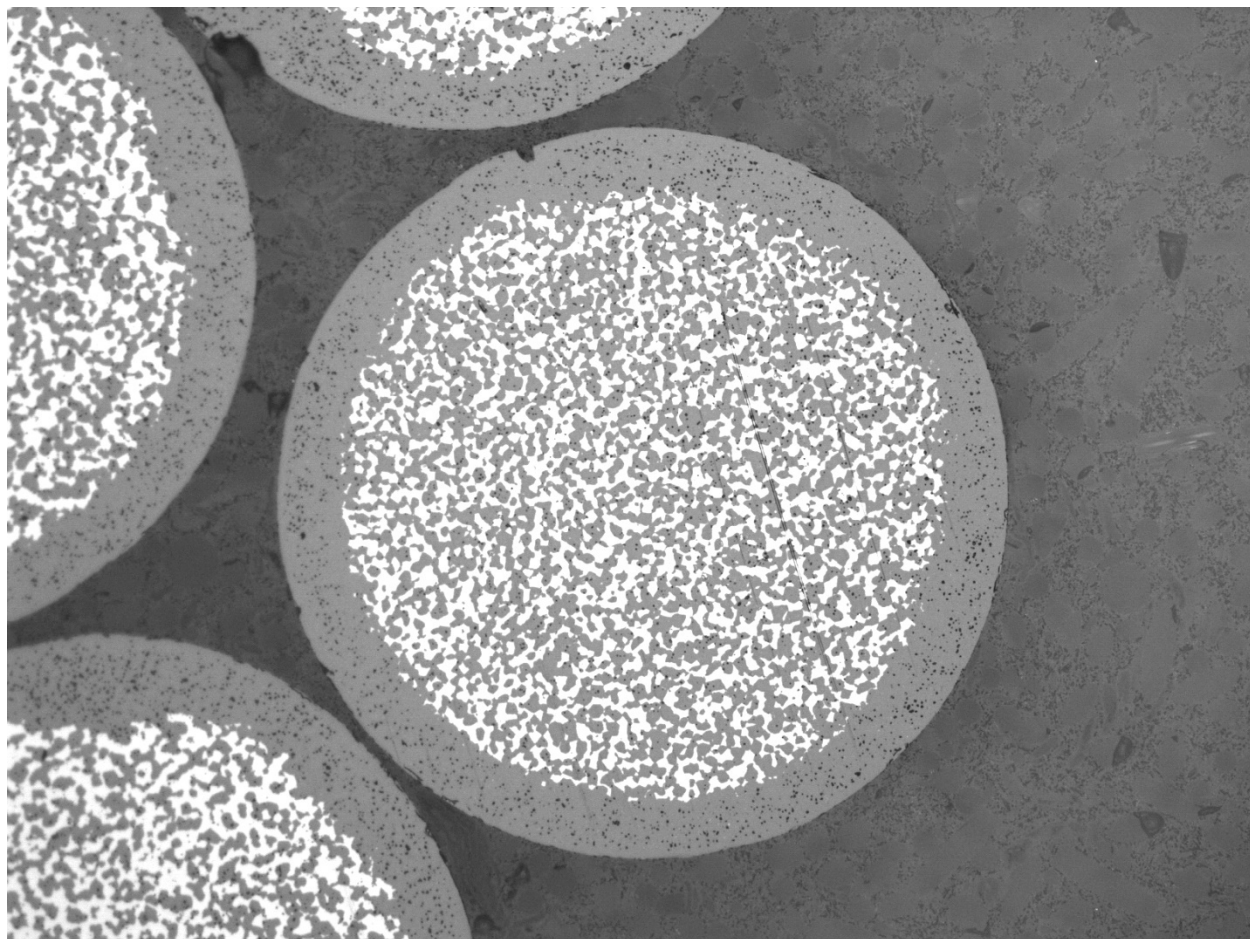
P17030905N156 segmented



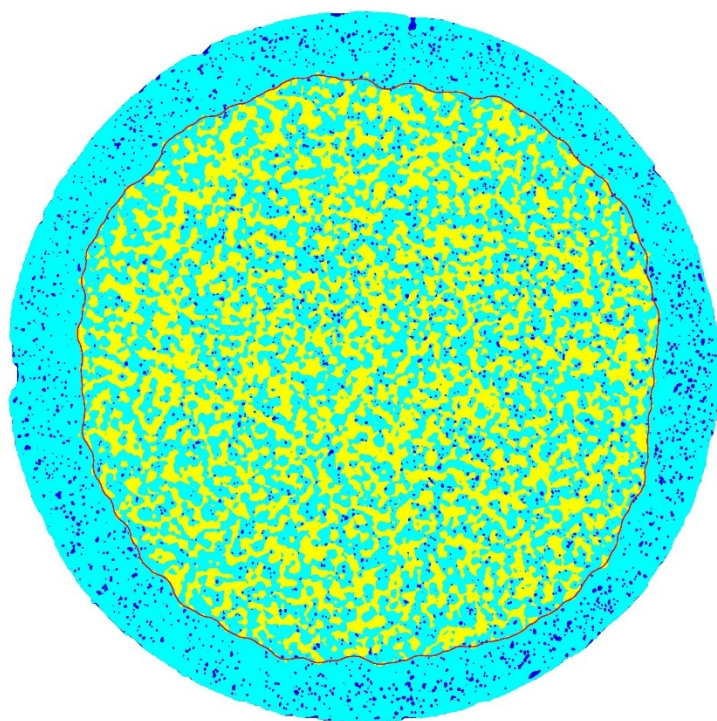
P17030905N156



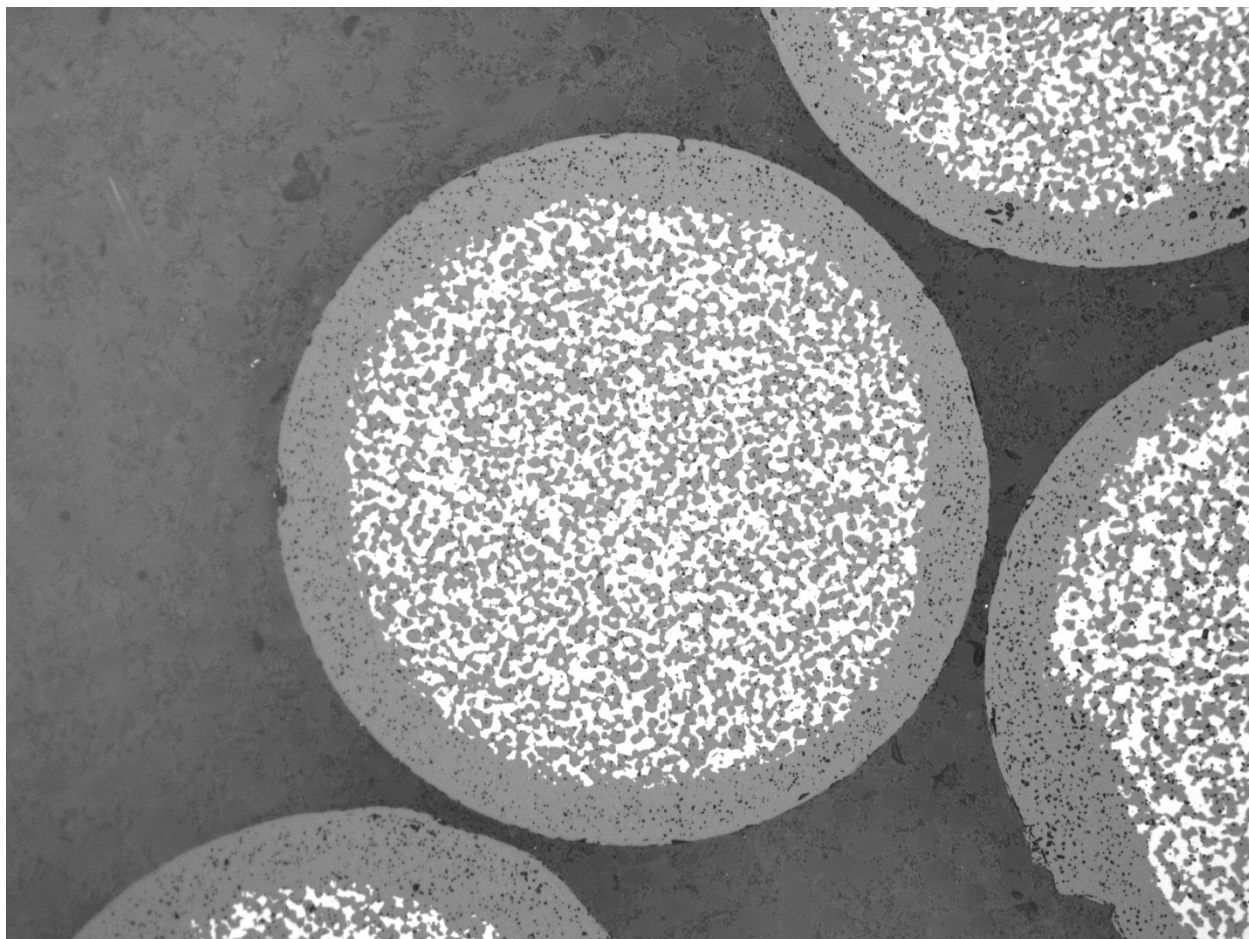
P17030905N157 segmented



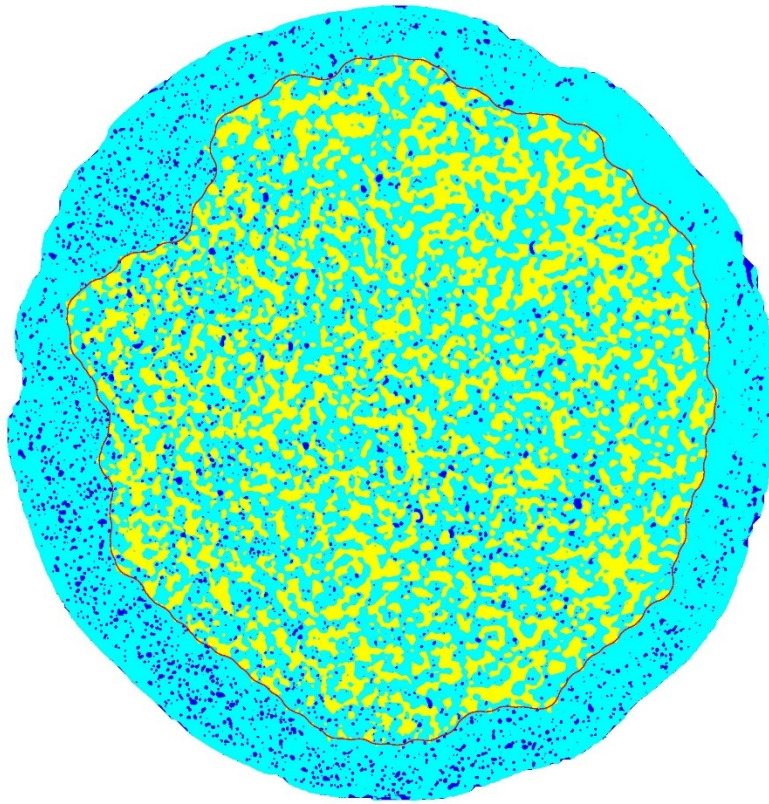
P17030905N157



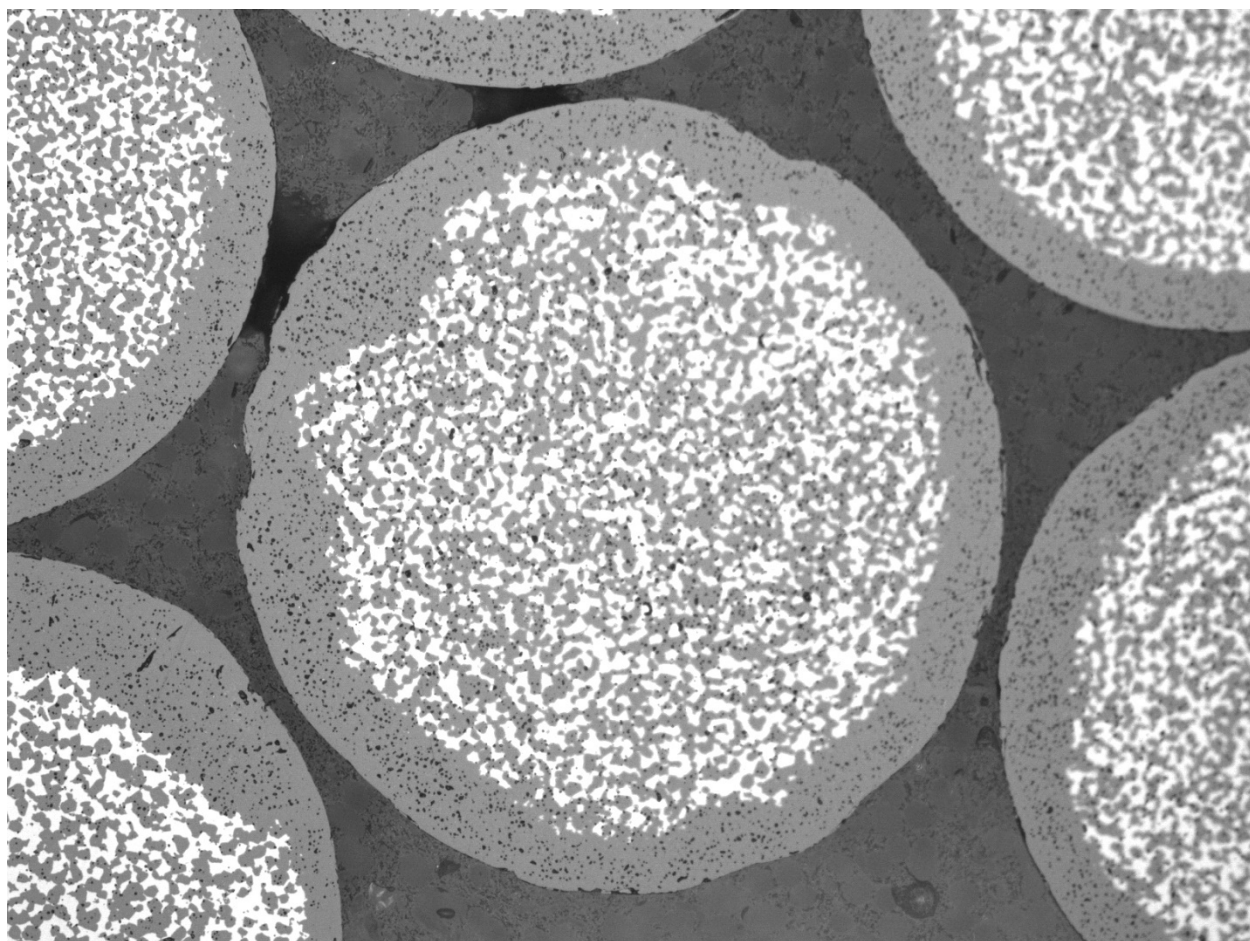
P17030905N158 segmented



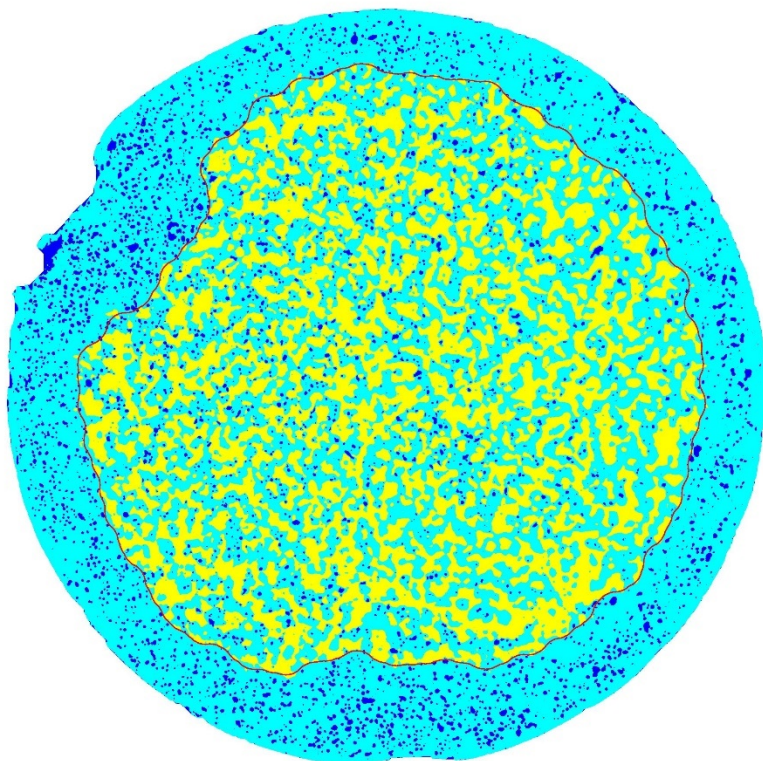
P17030905N158



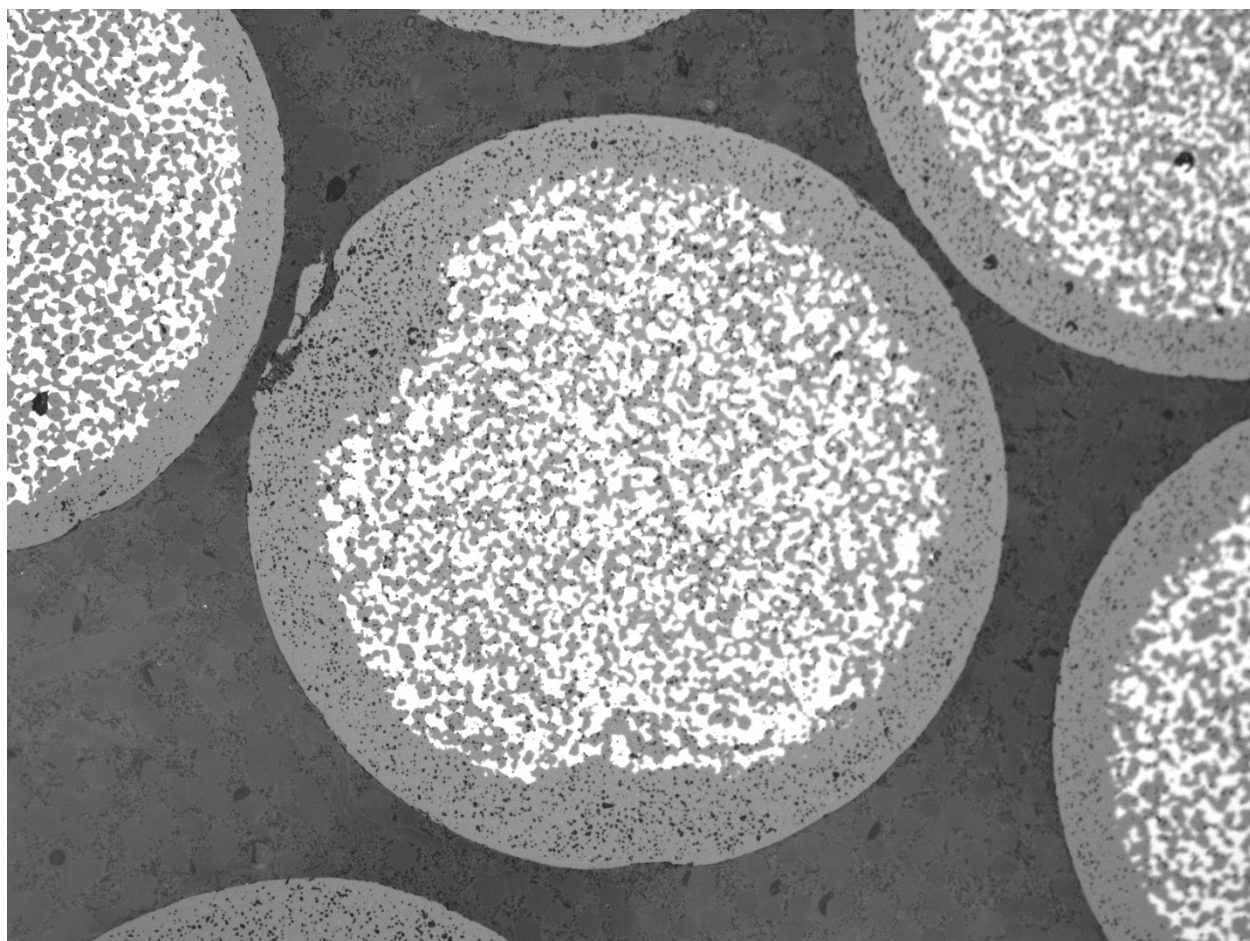
P17030905N159 segmented



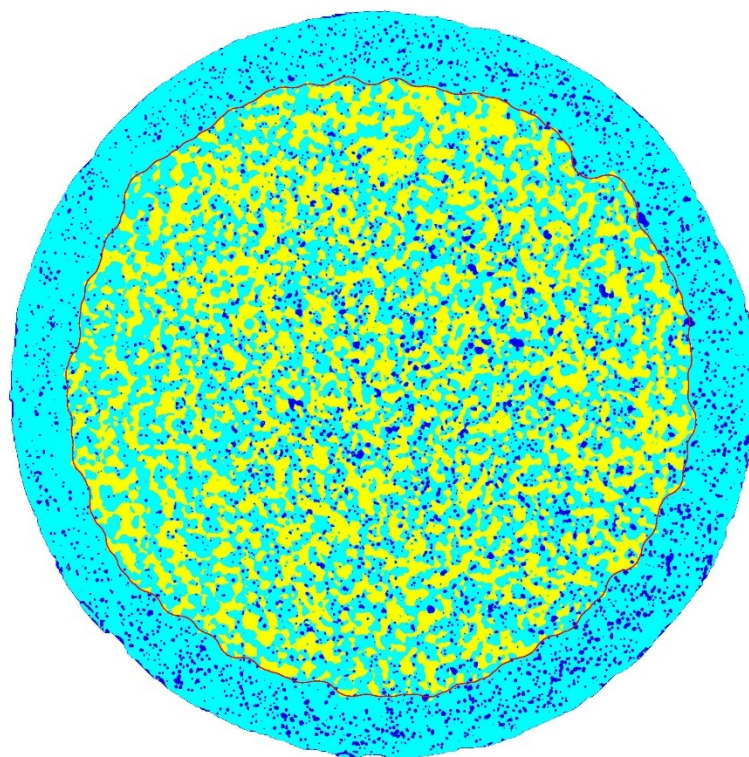
P17030905N159



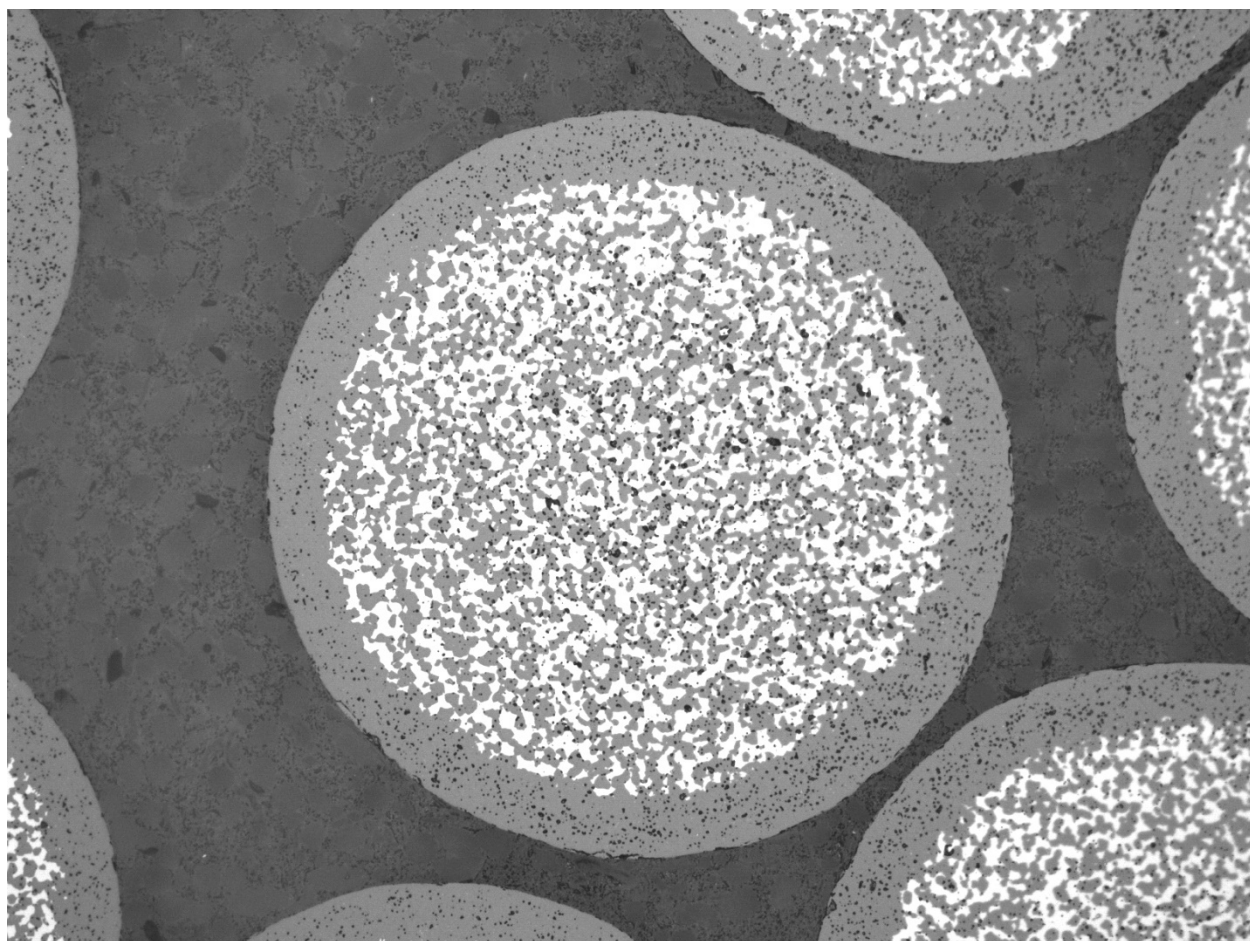
P17030905N160 segmented



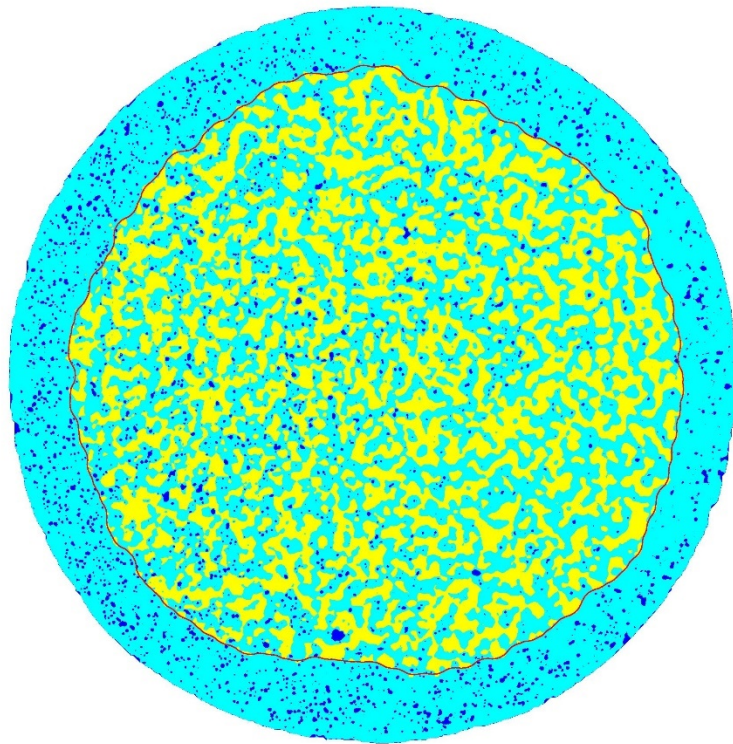
P17030905N160



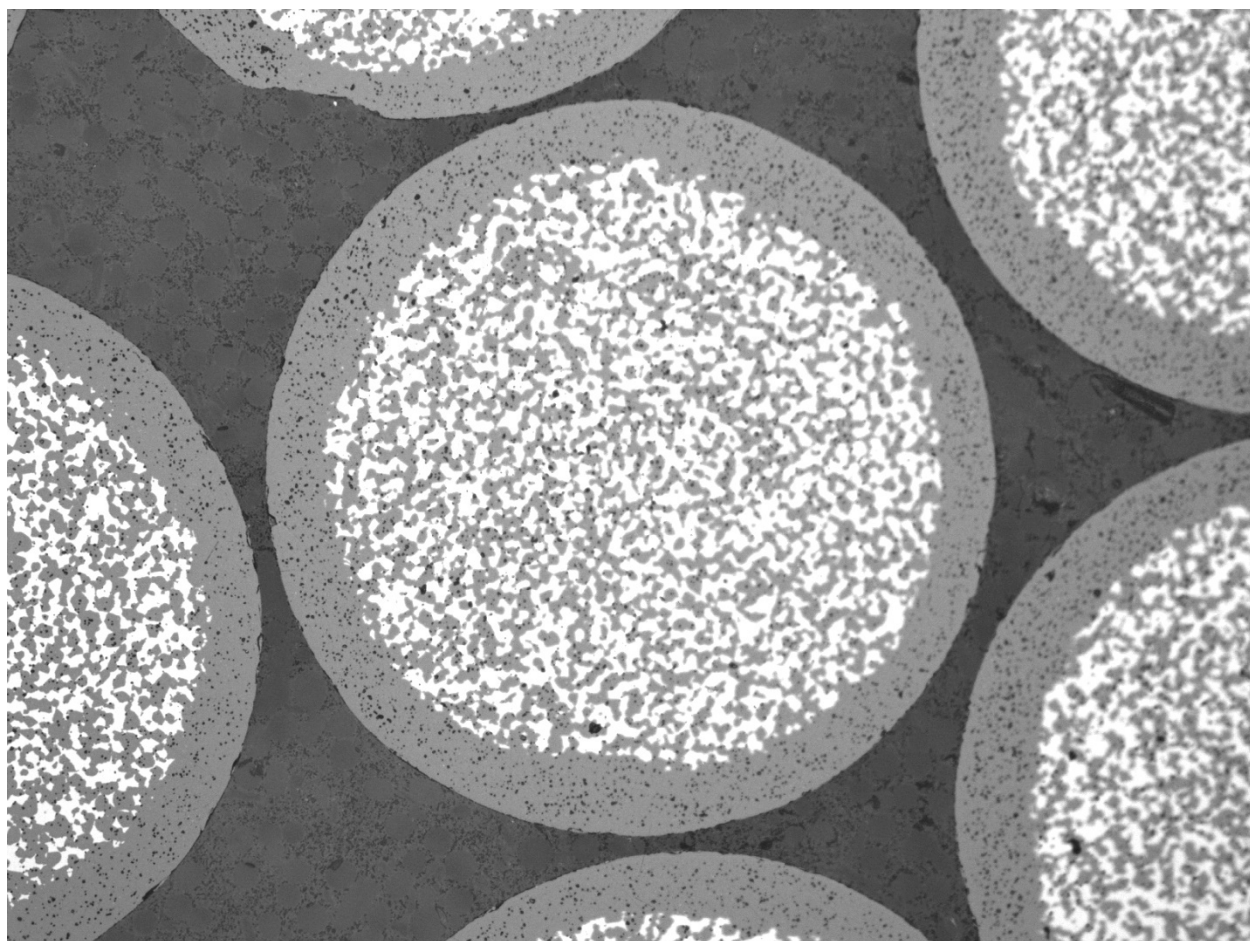
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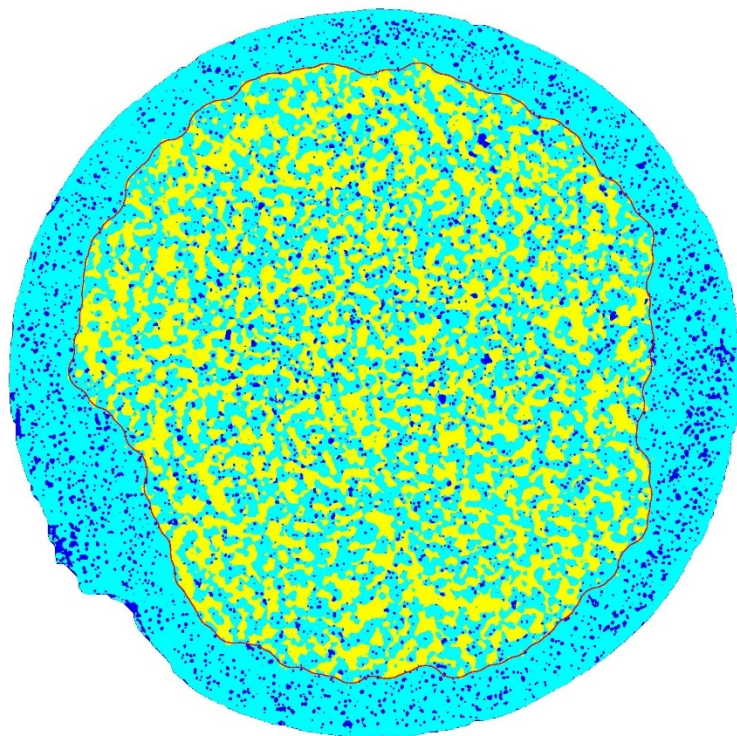
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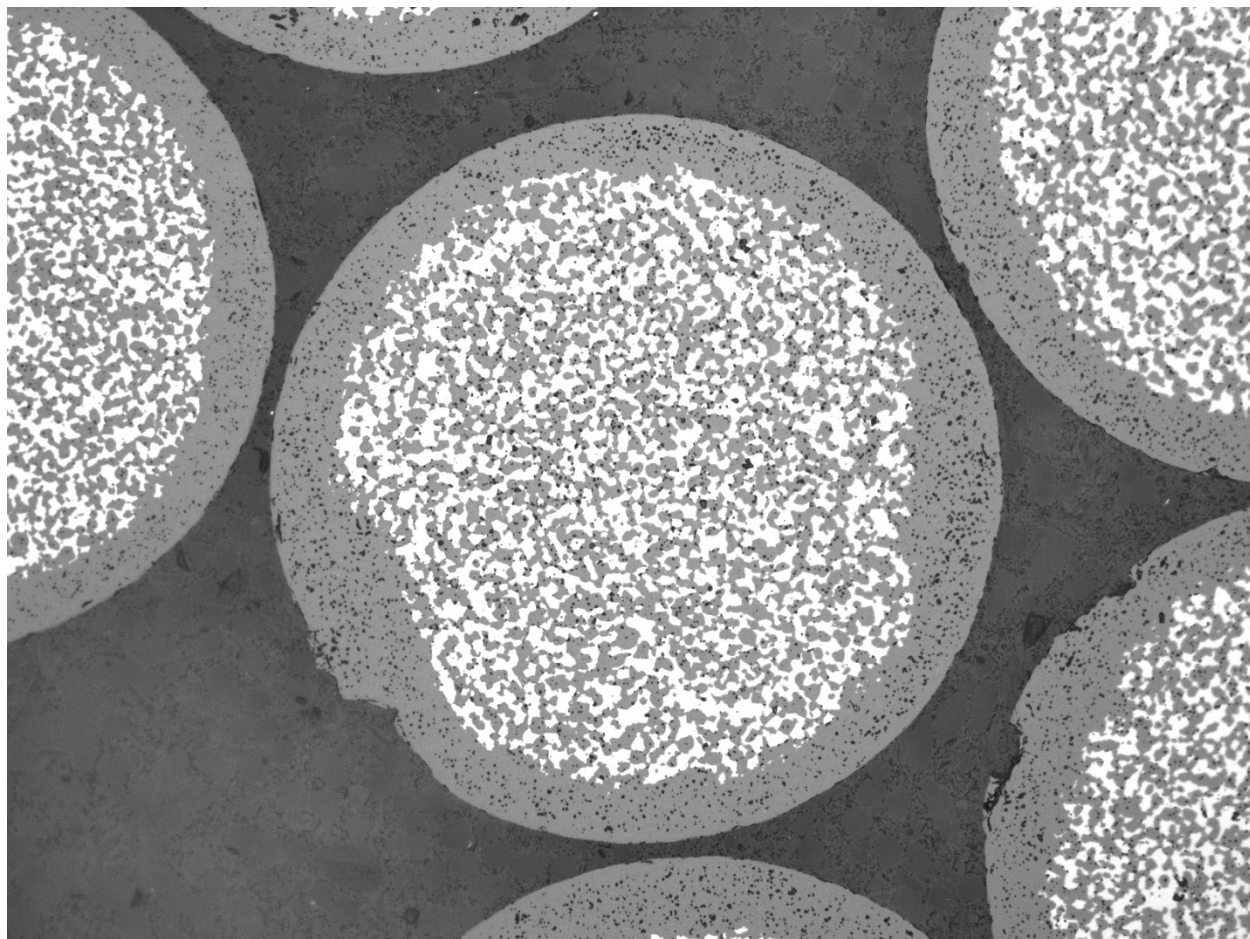
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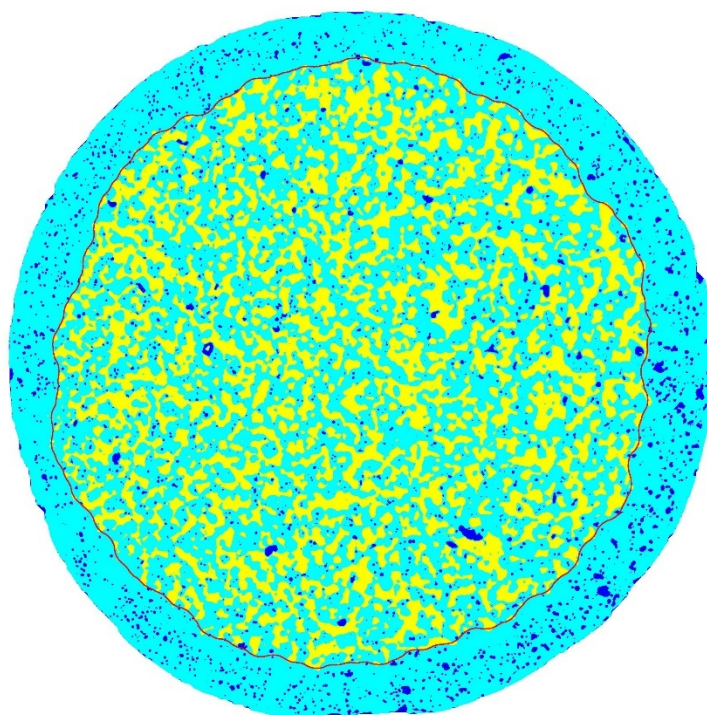
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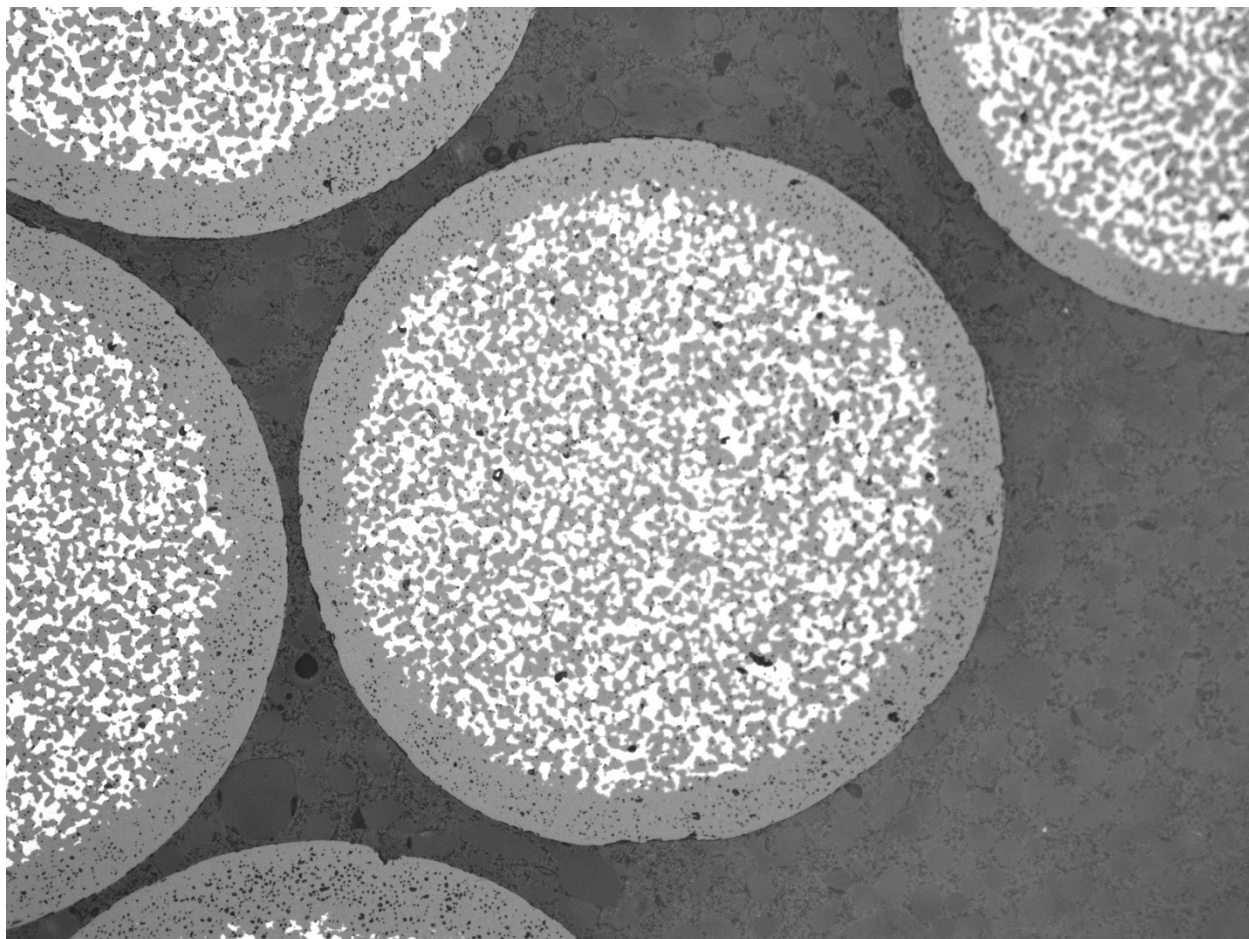
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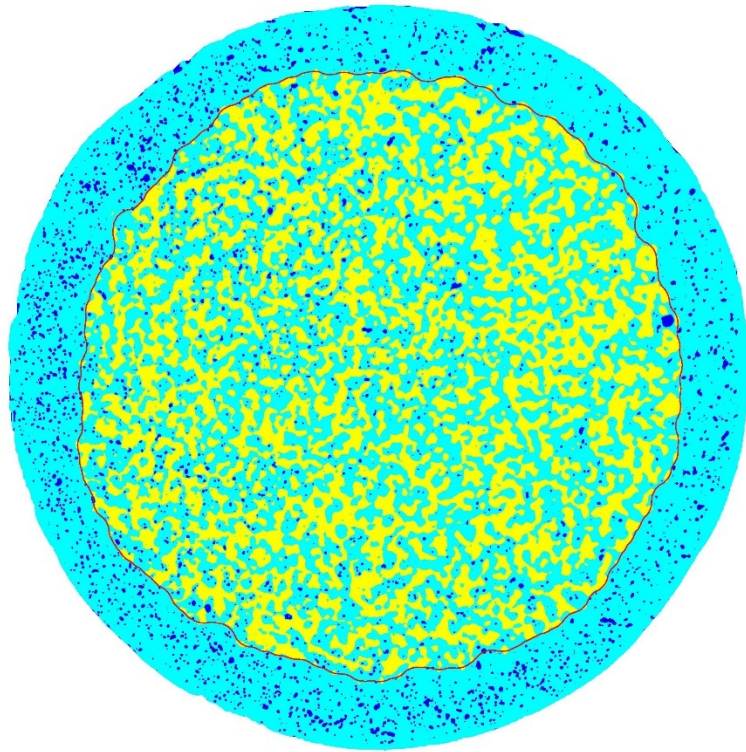
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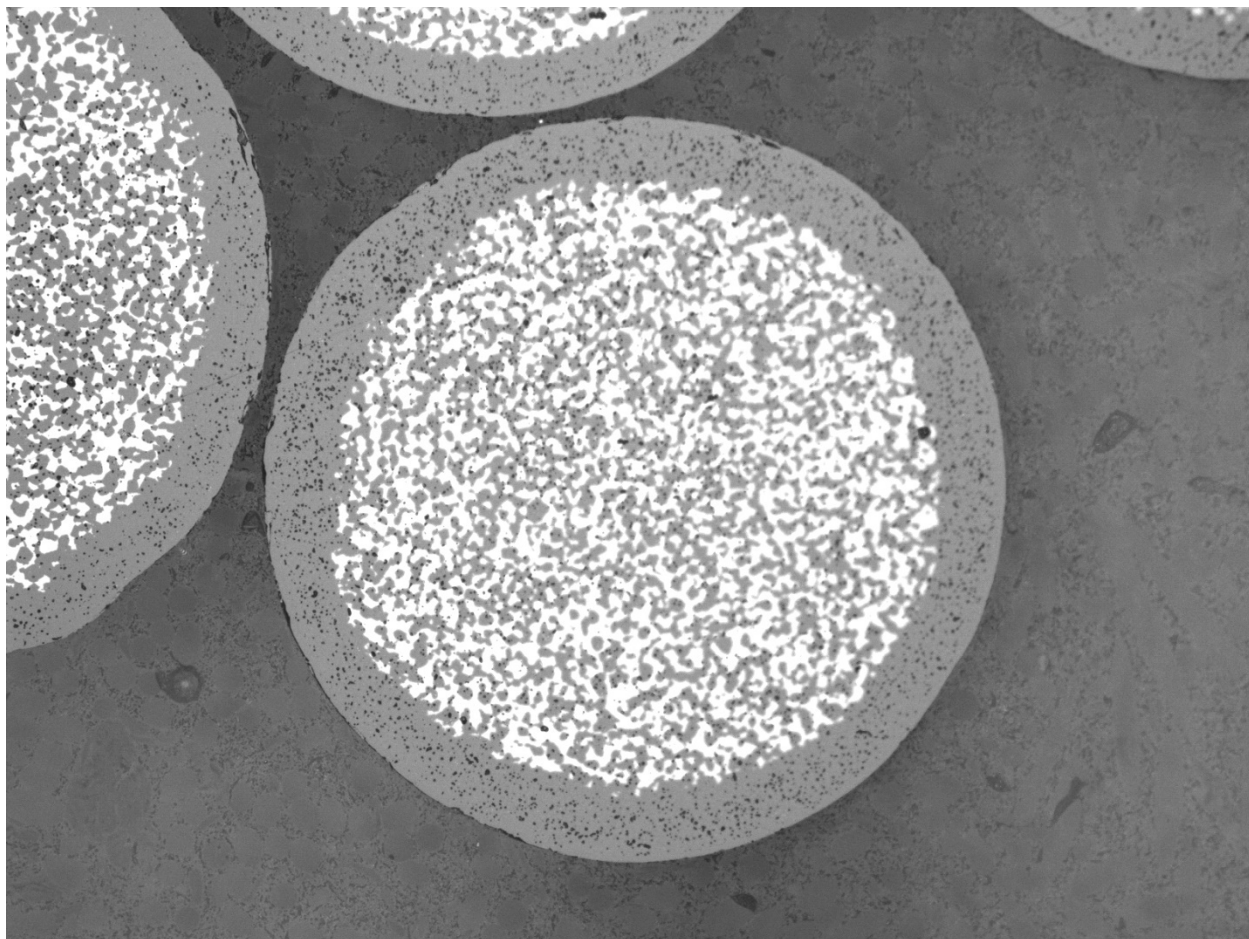
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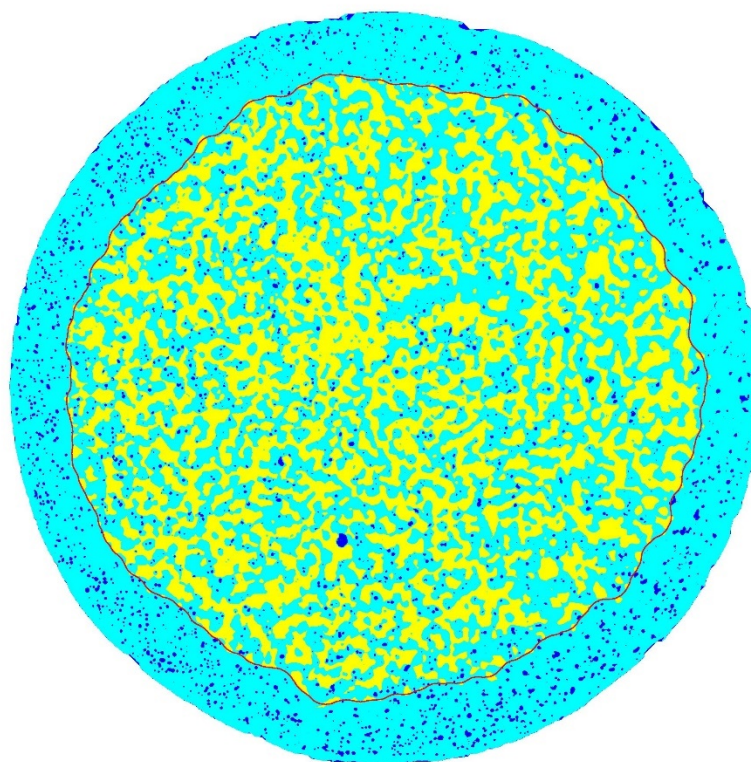
P17030905N164



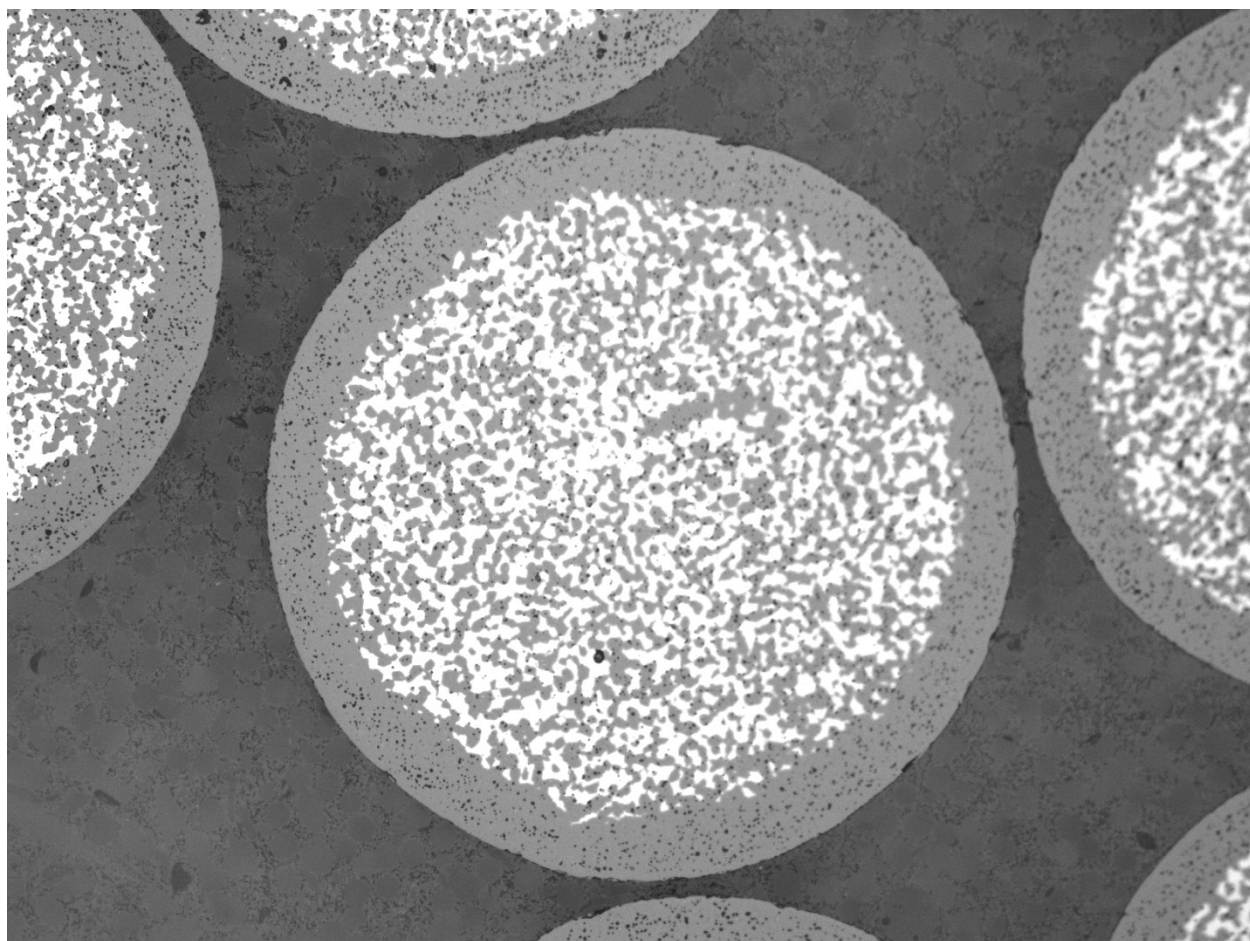
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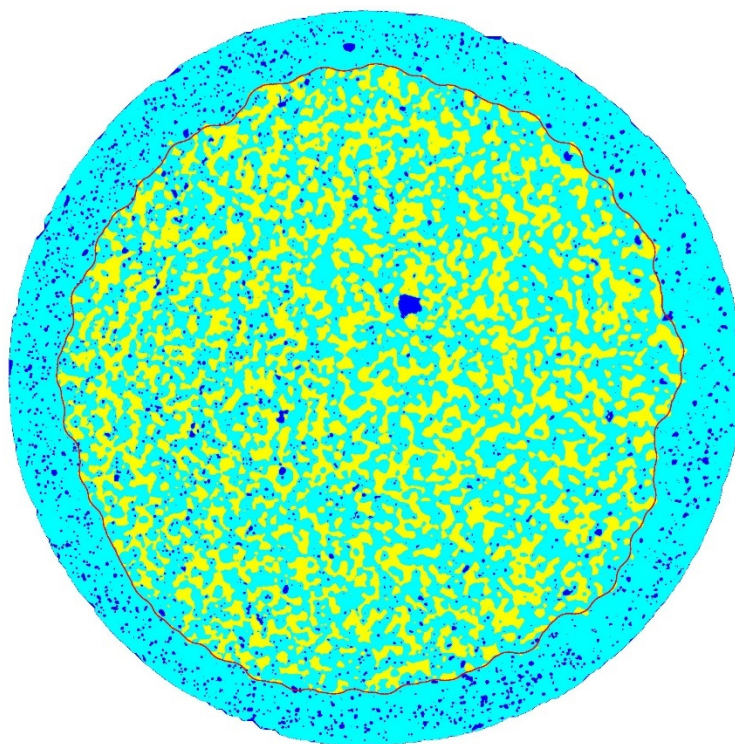
P17030905N165



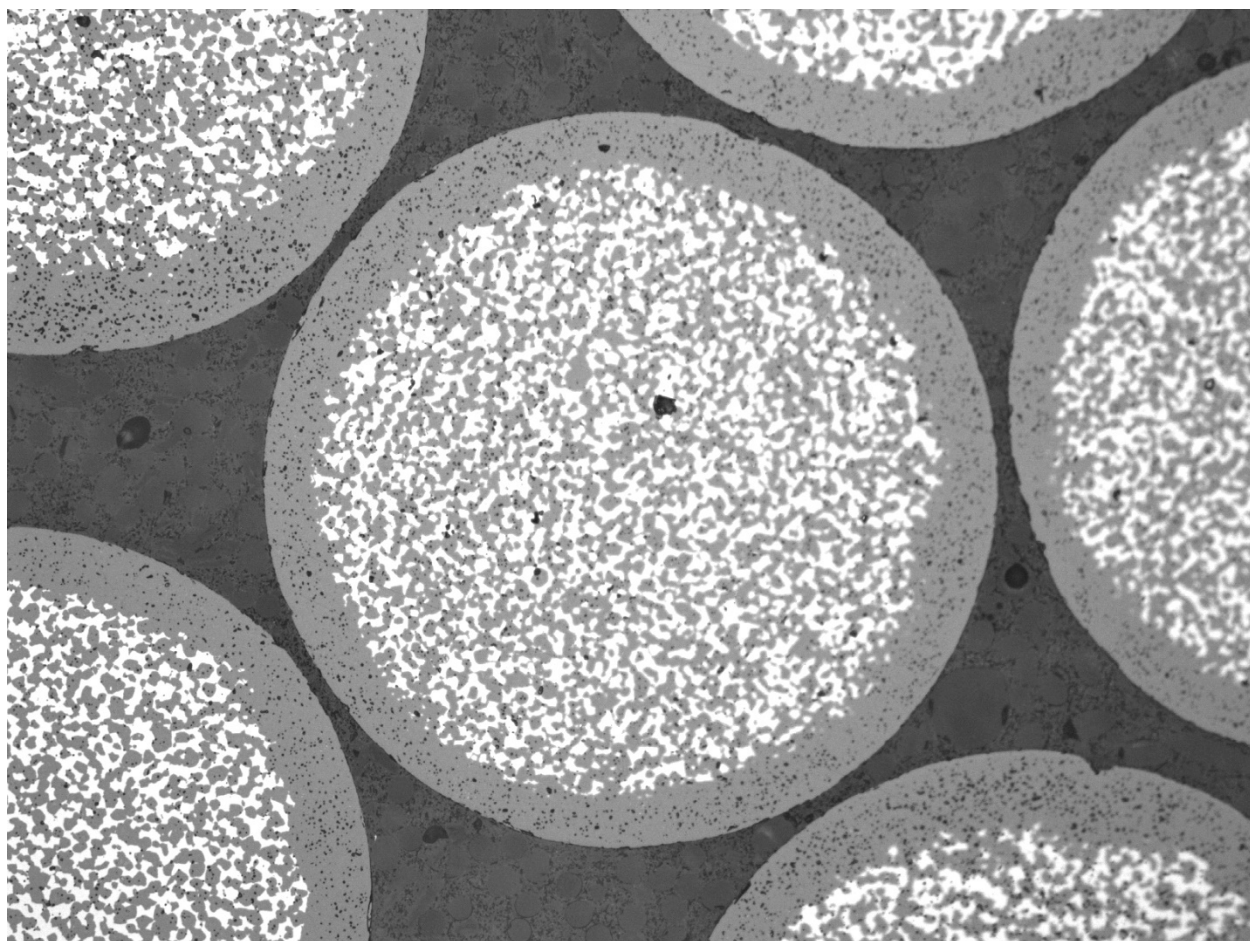
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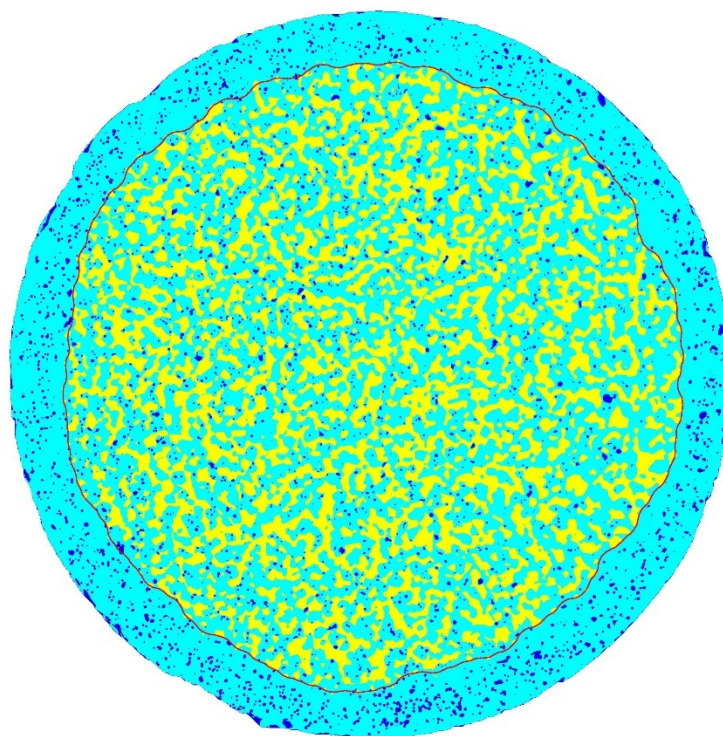
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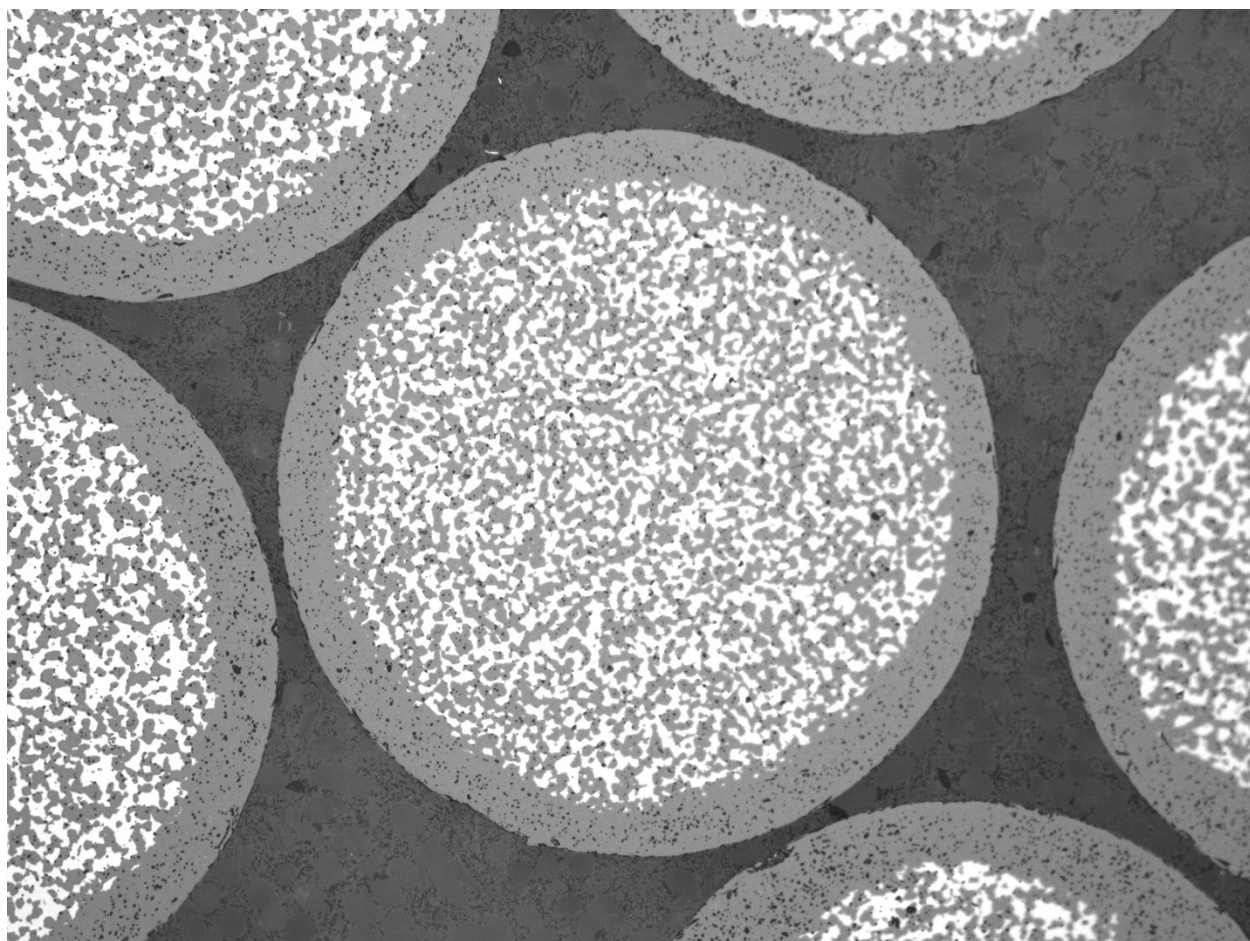
P17030905N167 segmented



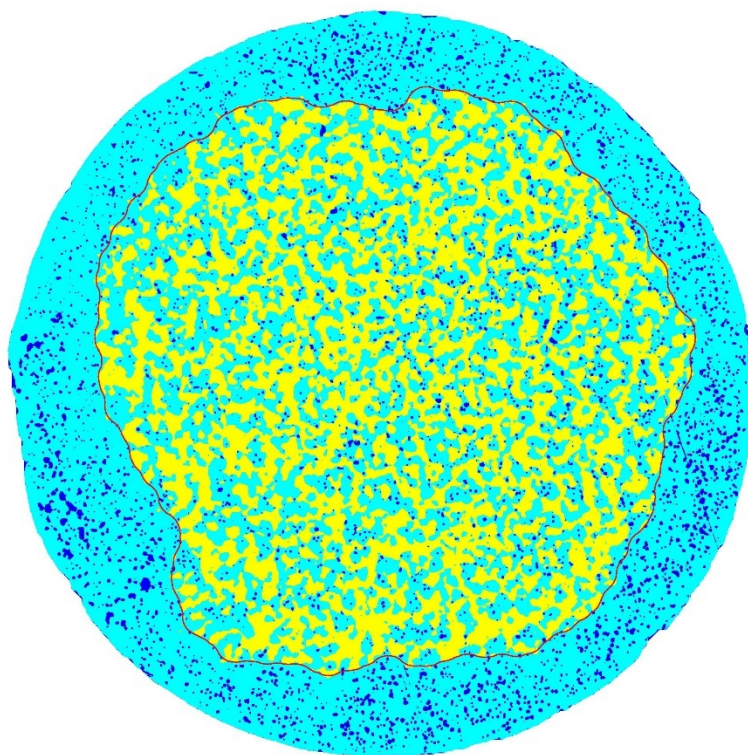
P17030905N167



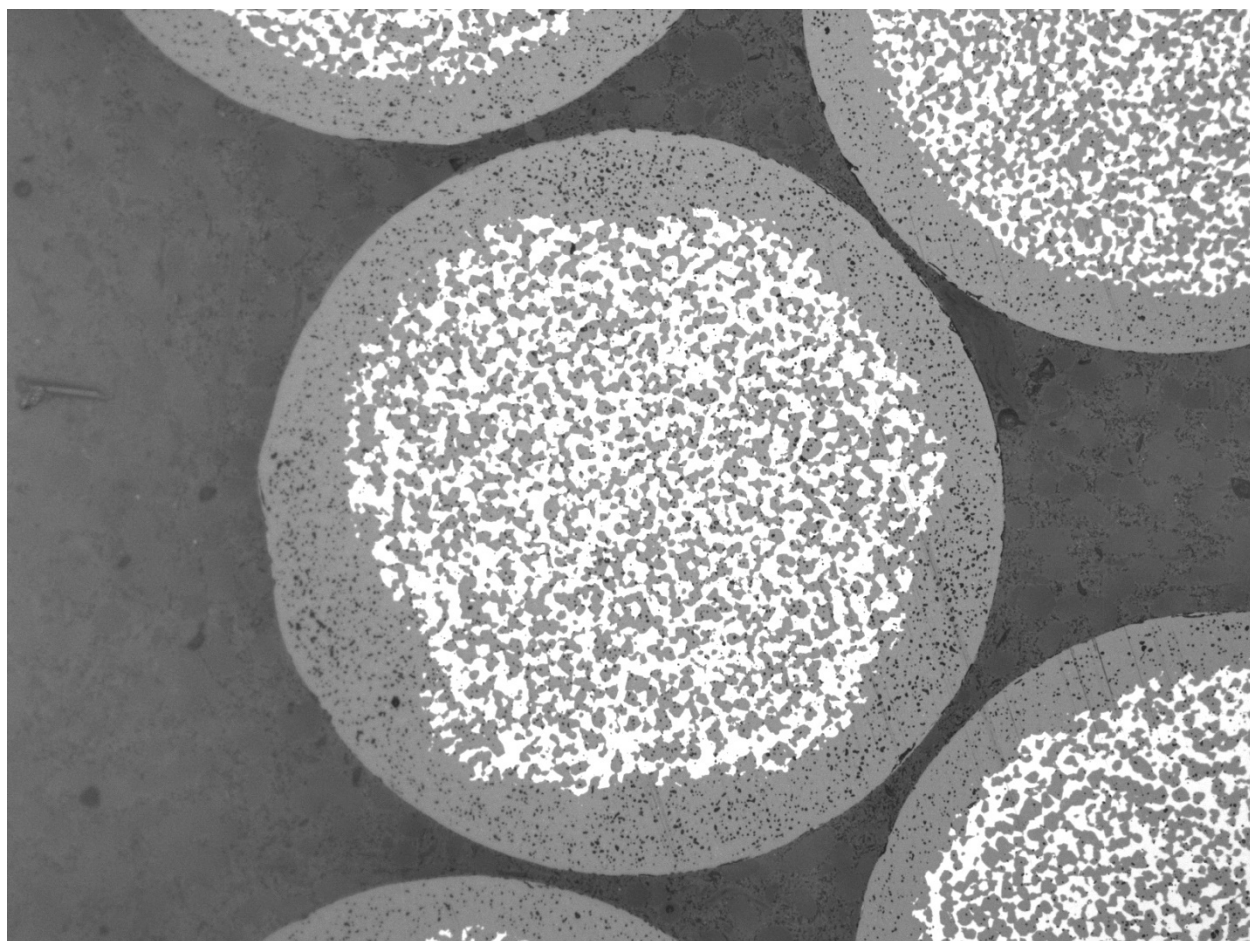
P17030905N168 segmented



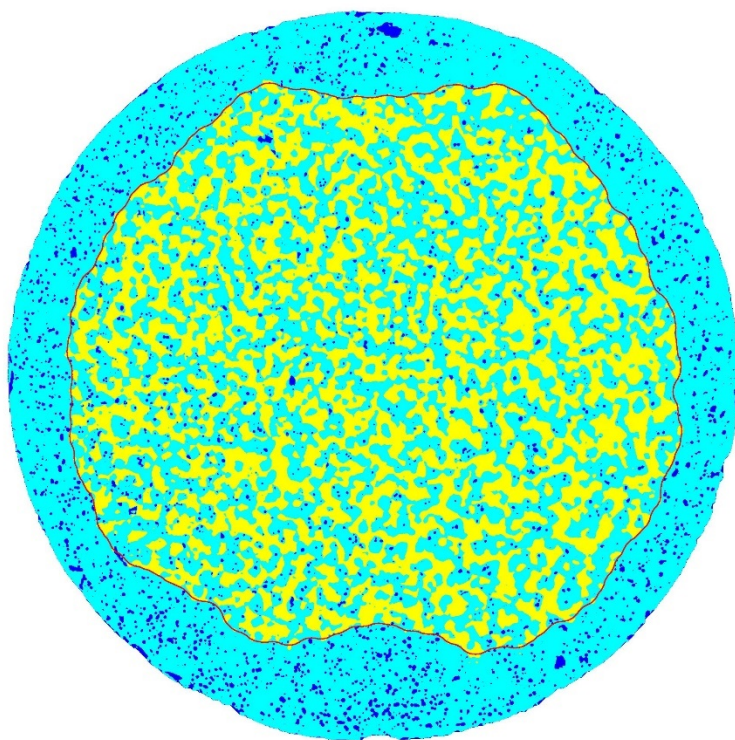
P17030905N168



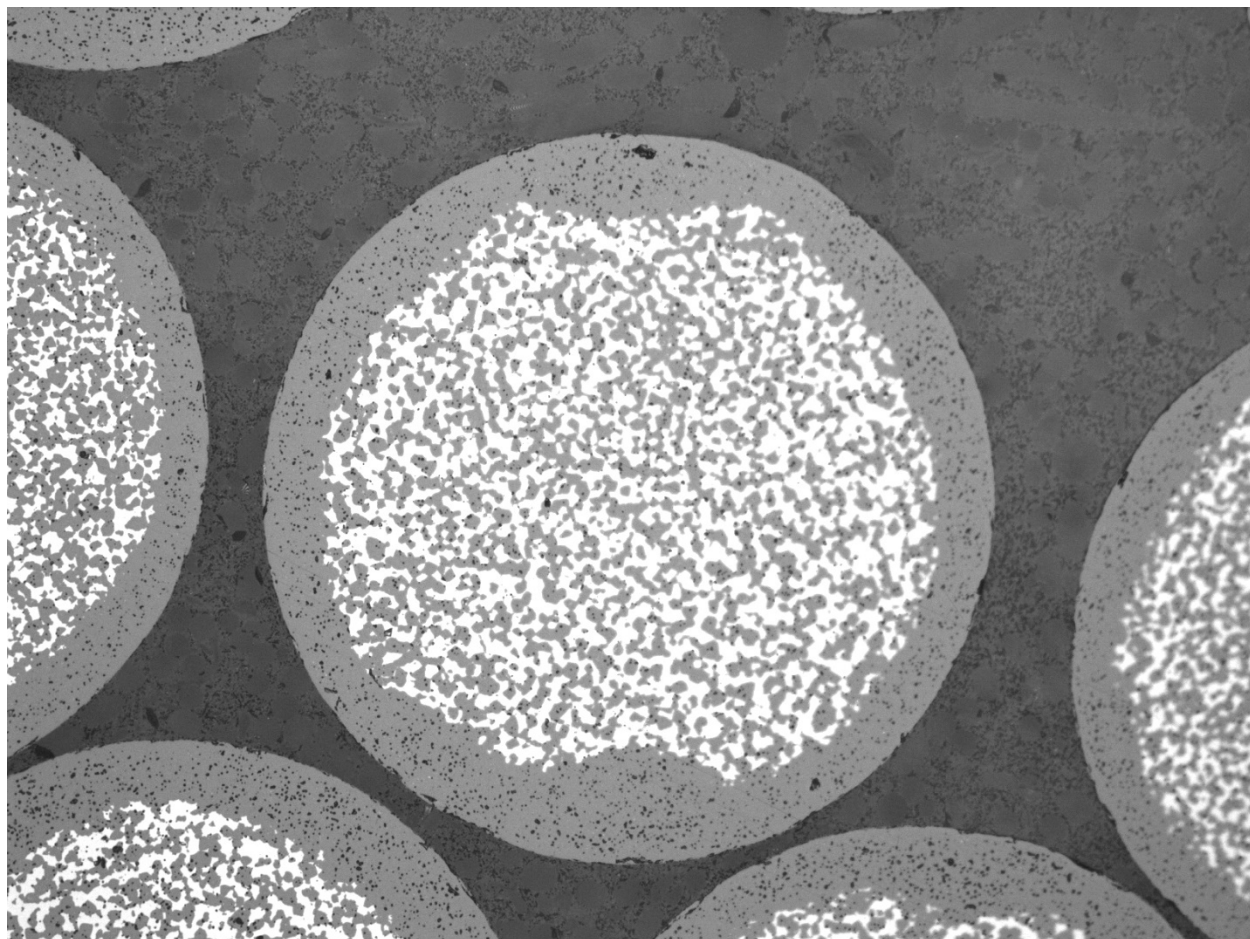
P17030905N170 segmented



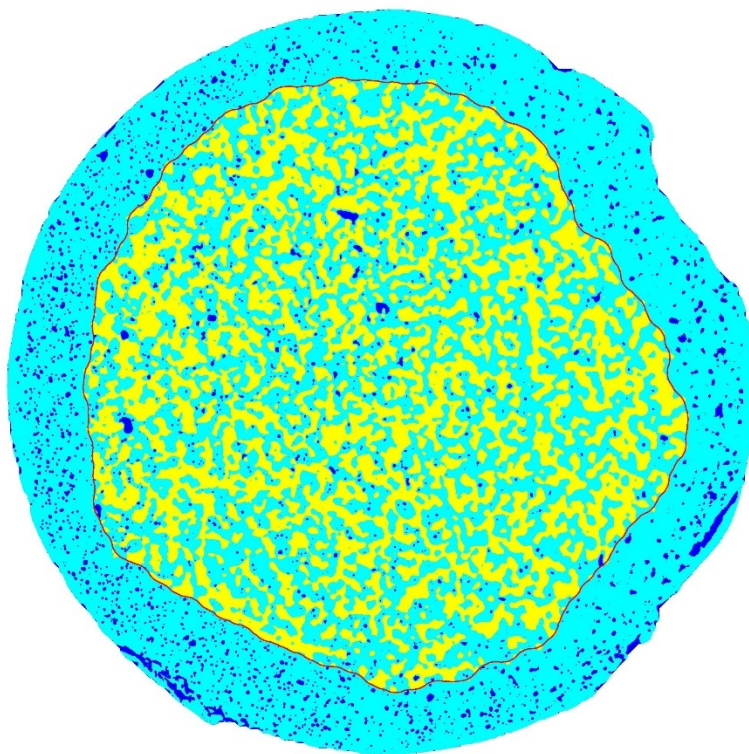
P17030905N170



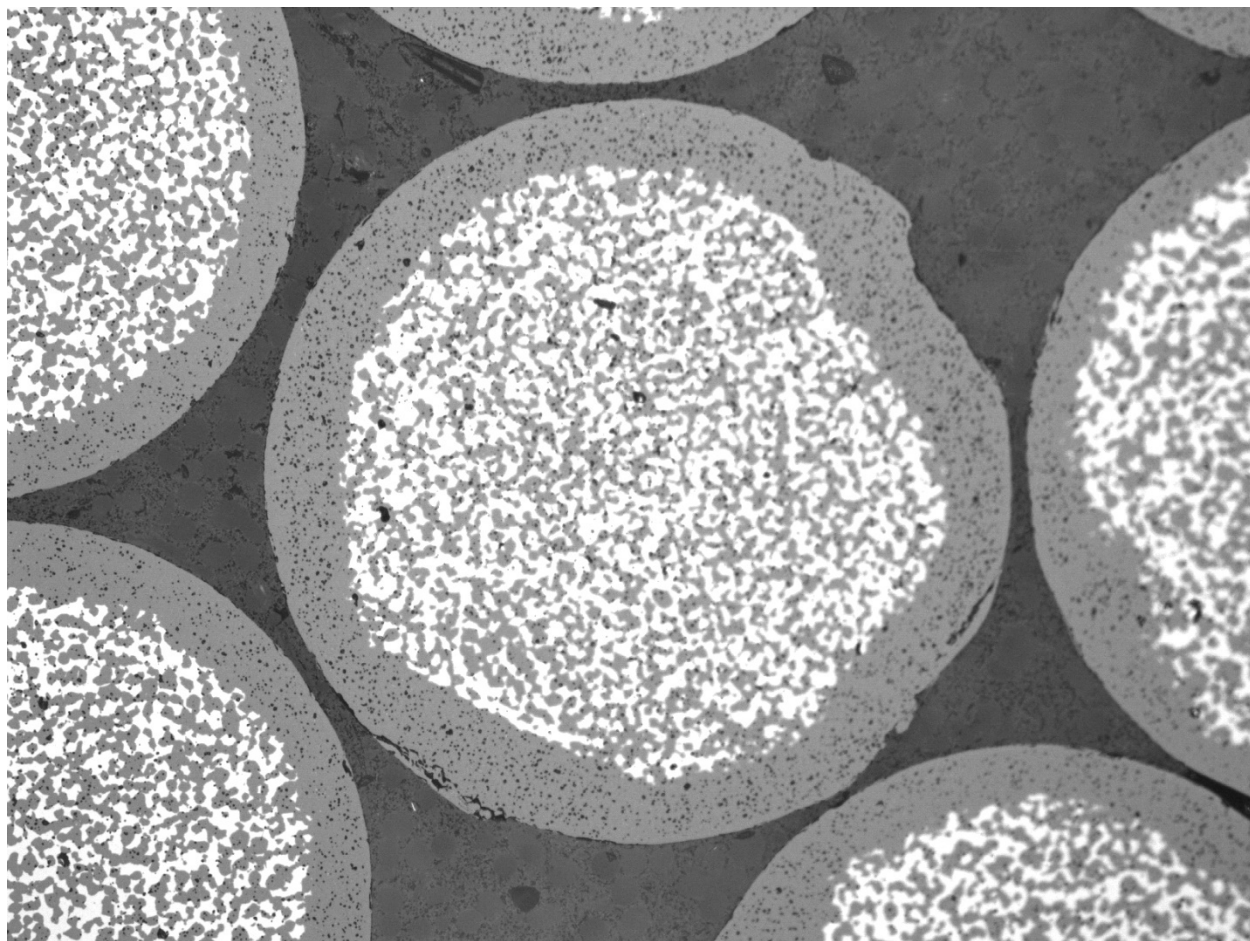
P17030905N171 segmented



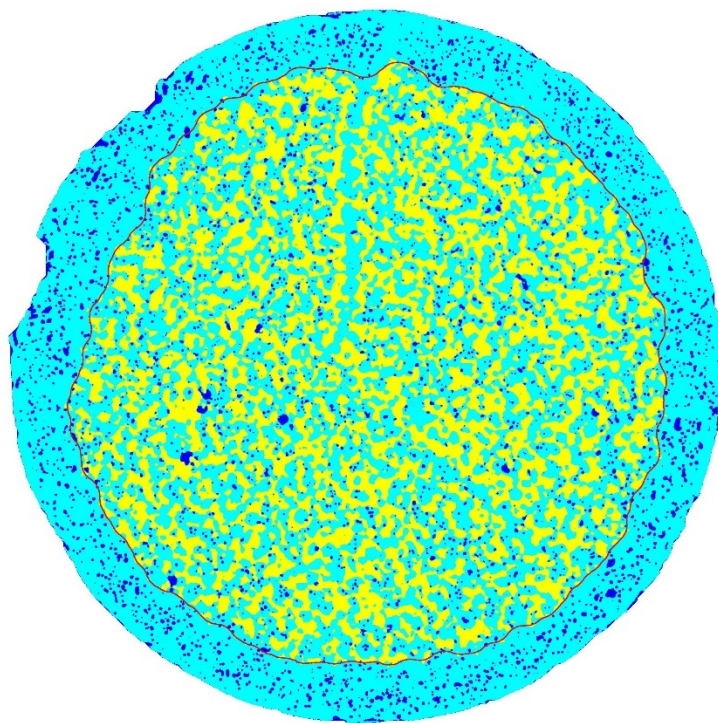
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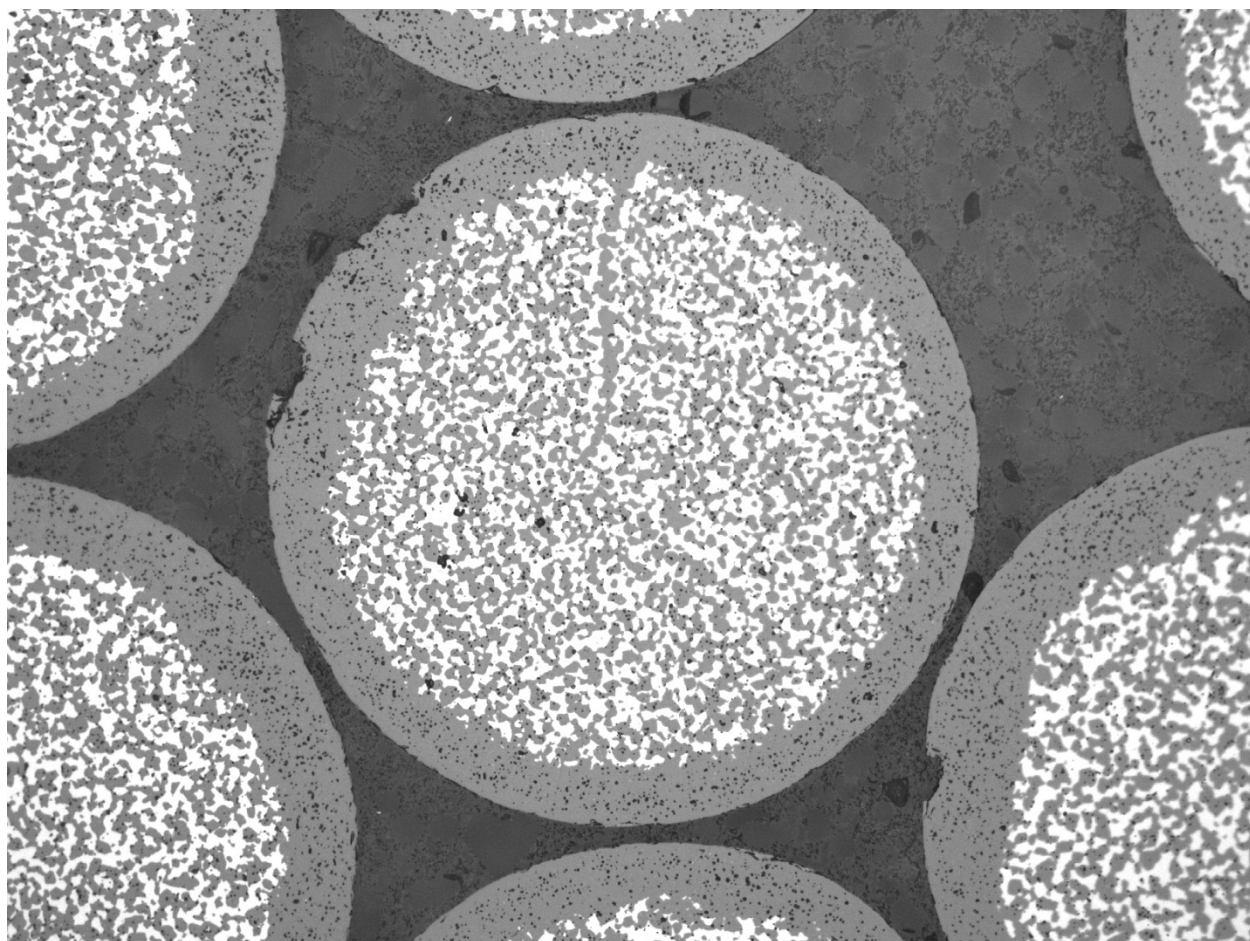
P17030905N172 segmented



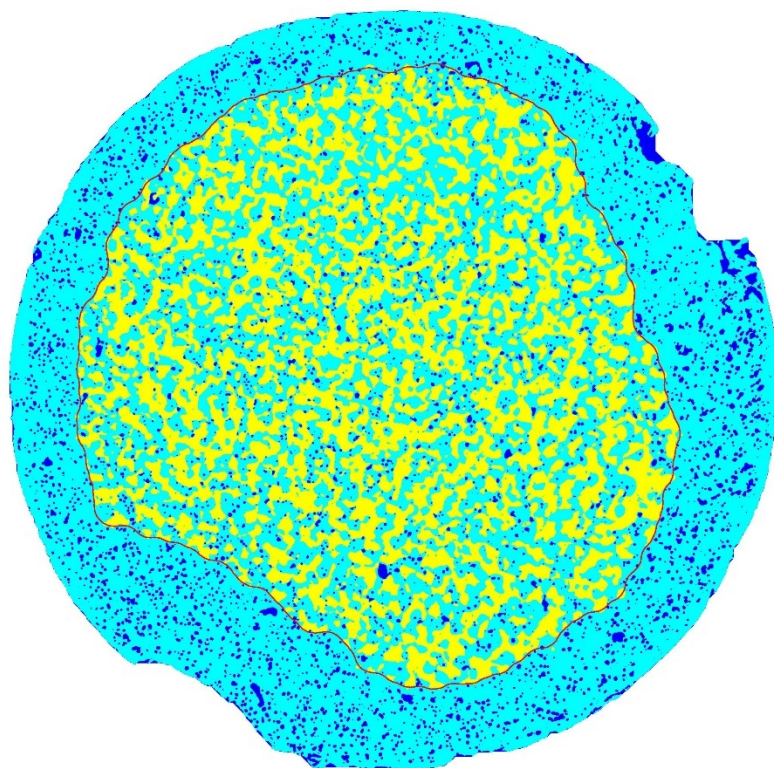
P17030905N172



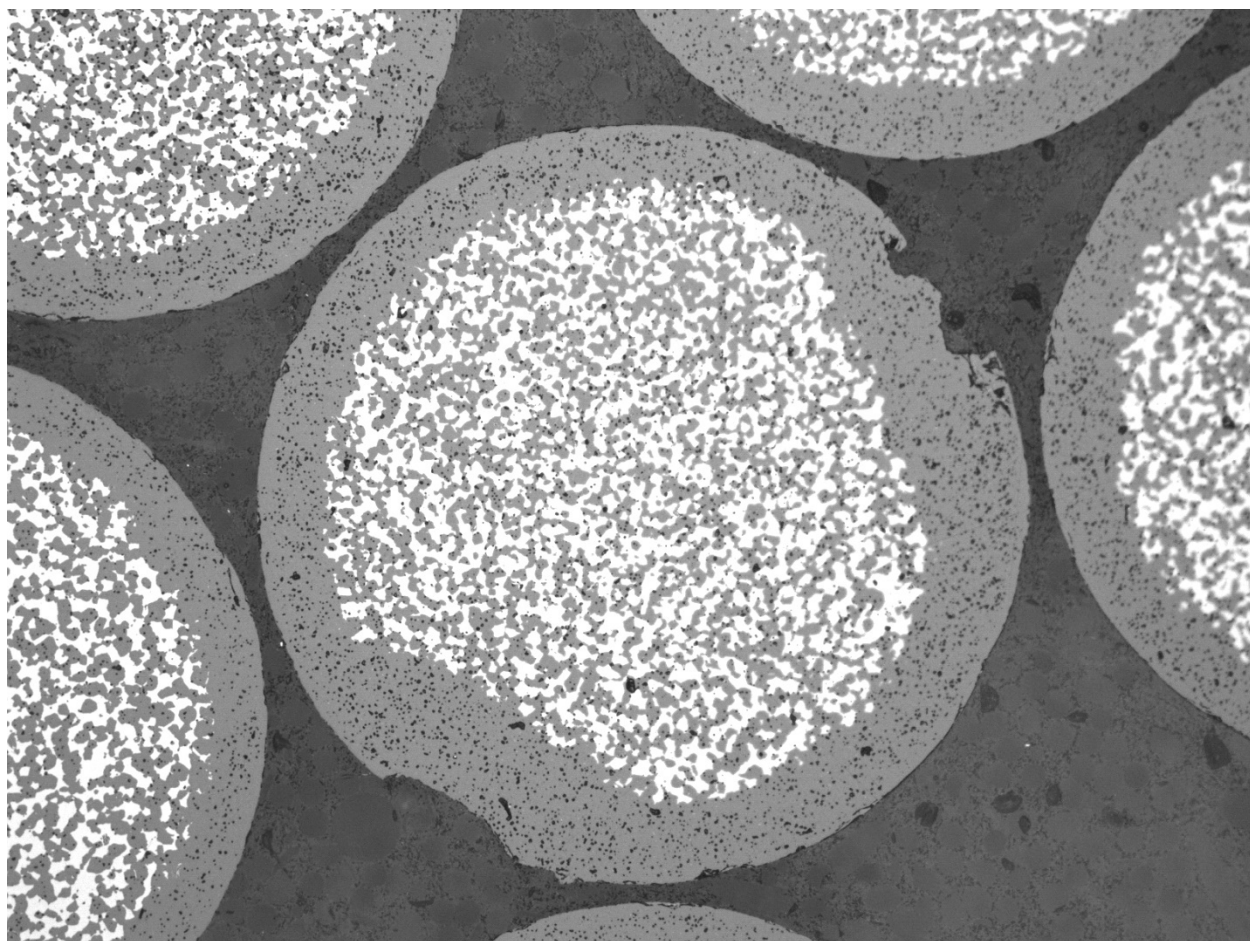
P17030905N173 segmented



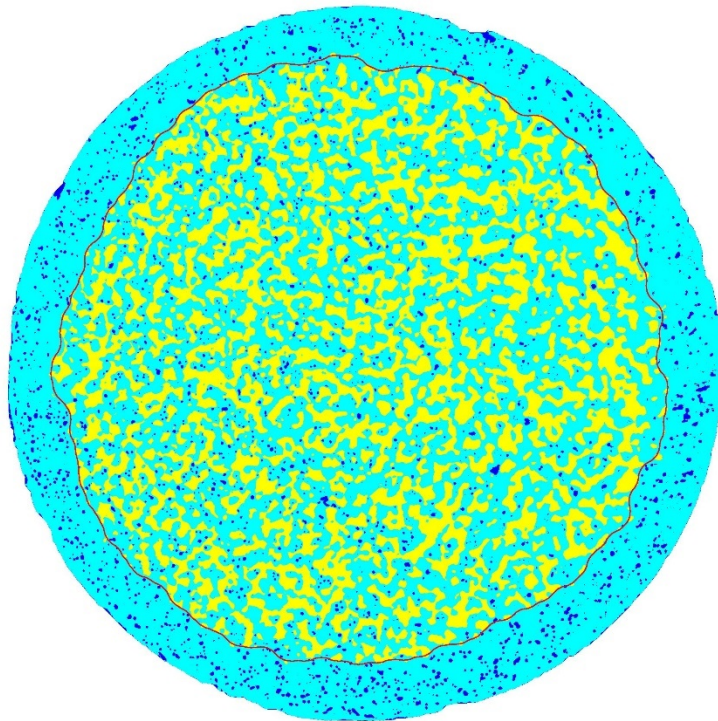
P17030905N173



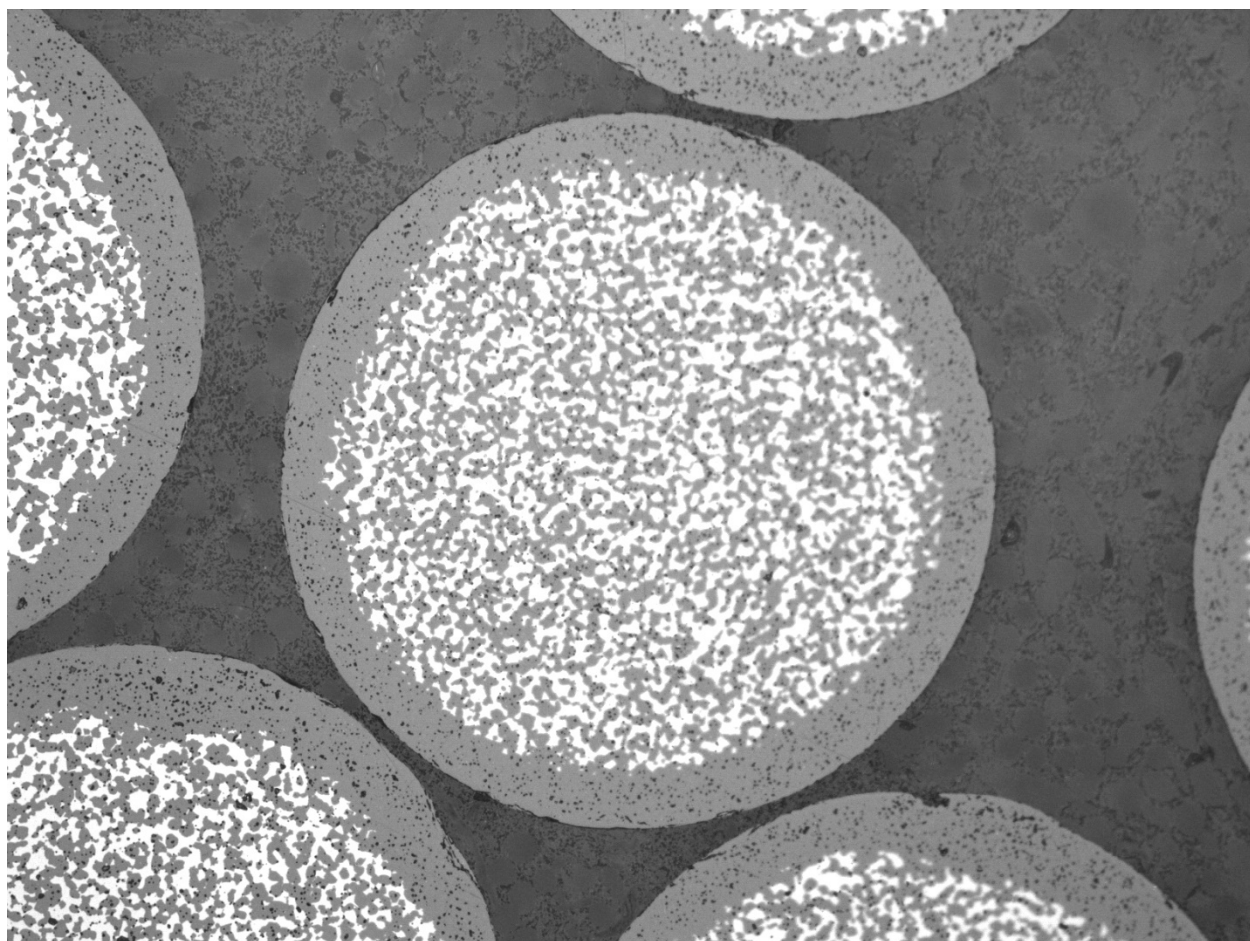
P17030905N175 segmented



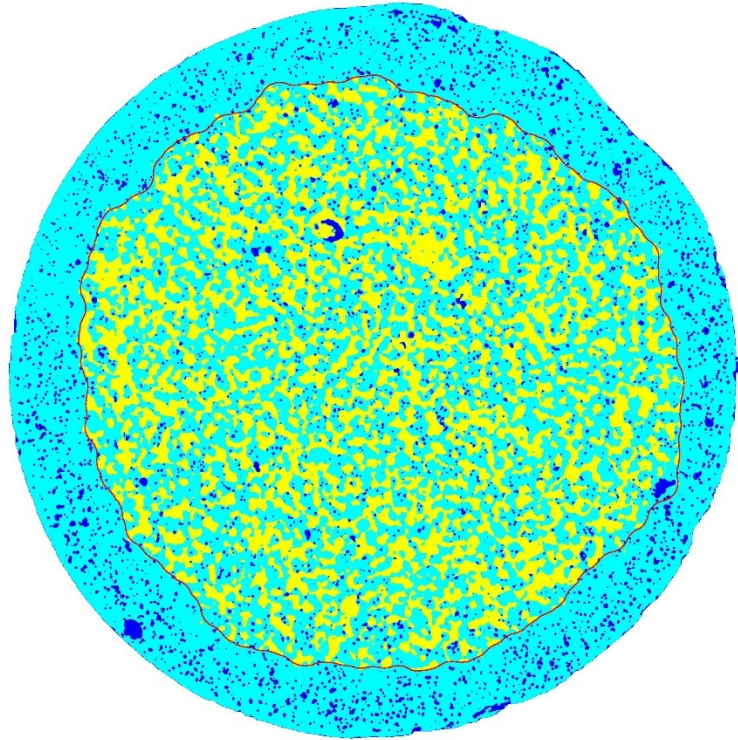
P17030905N175



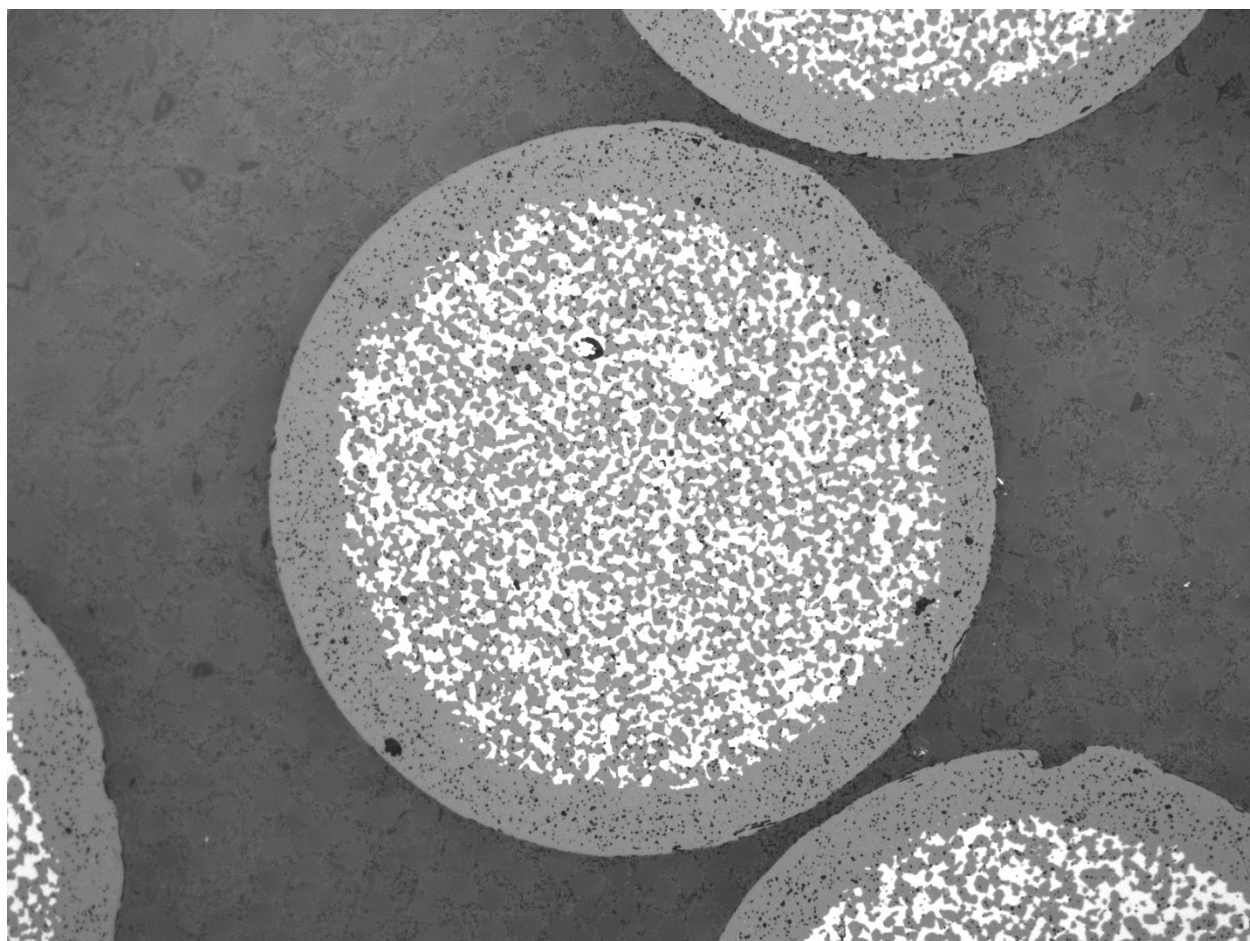
P17030905N176 segmented



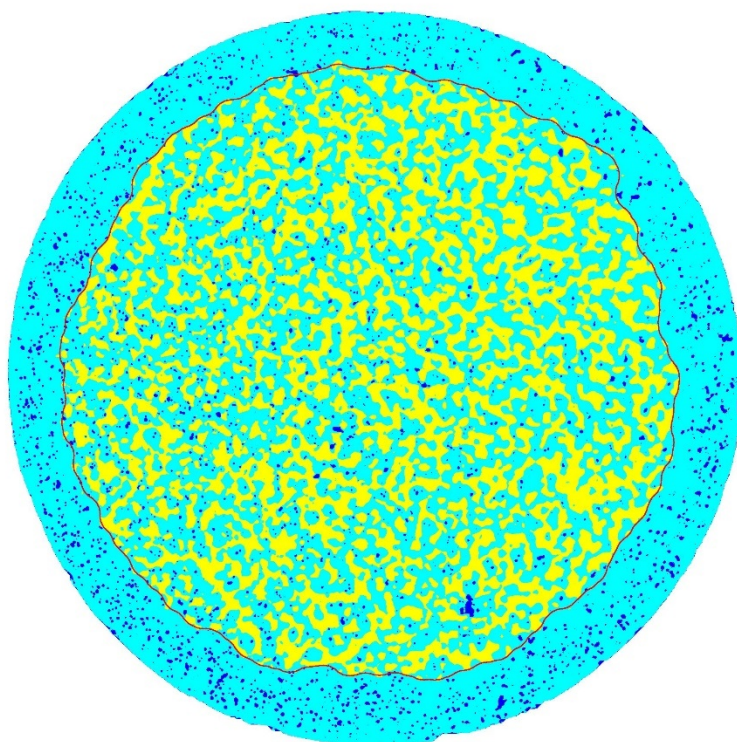
P17030905N176



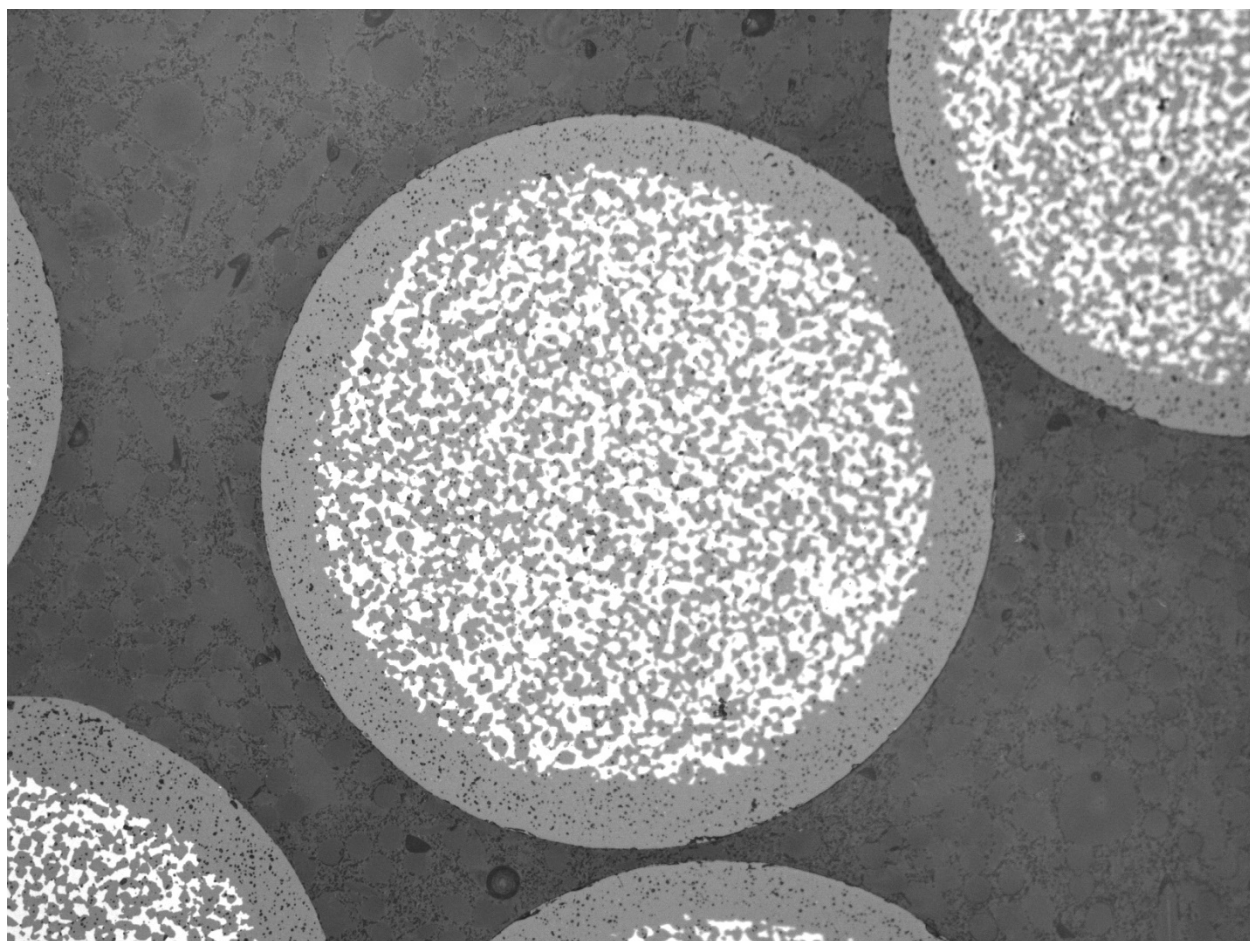
P17030905N177 segmented



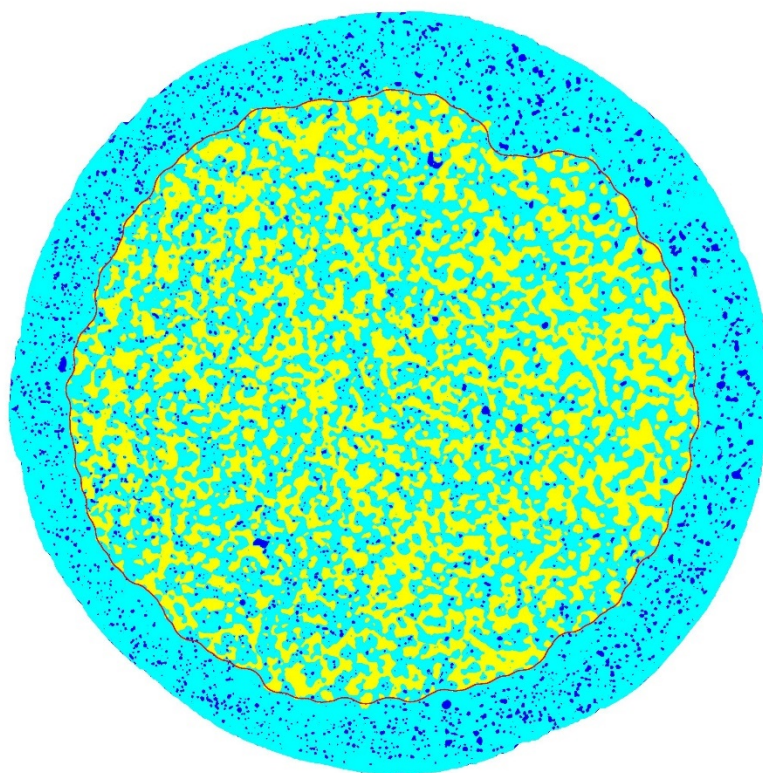
P17030905N177



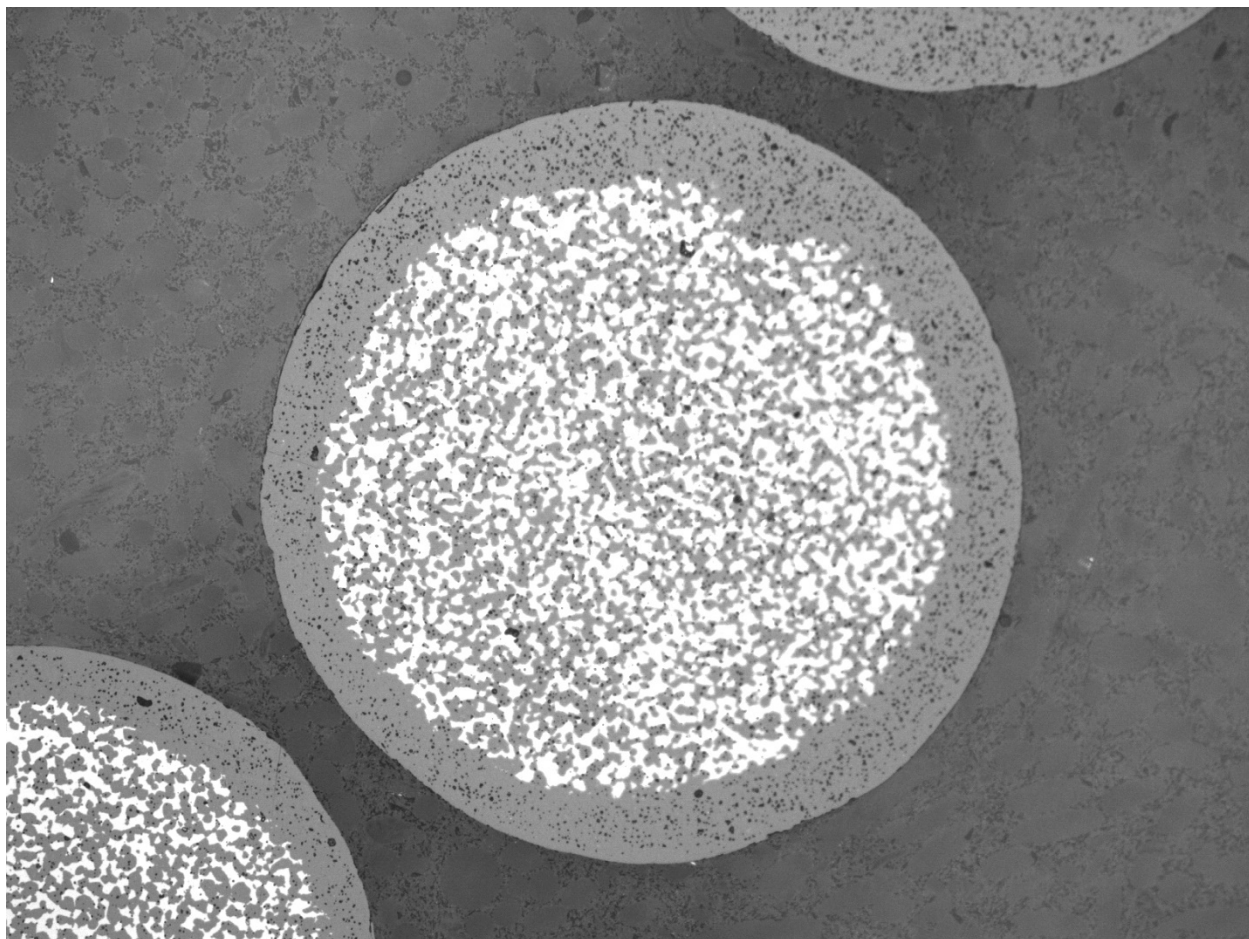
P17030905N178 segmented



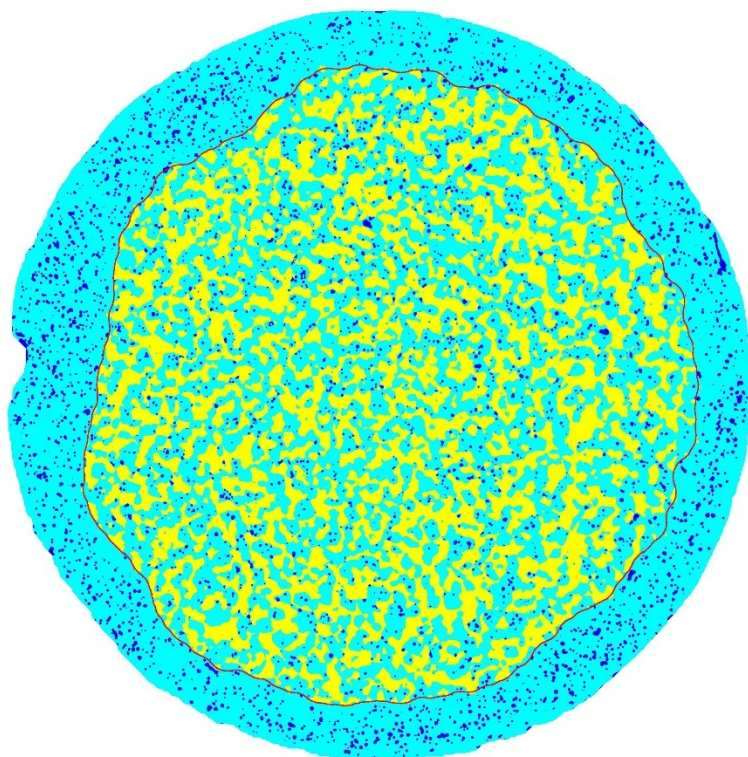
P17030905N178



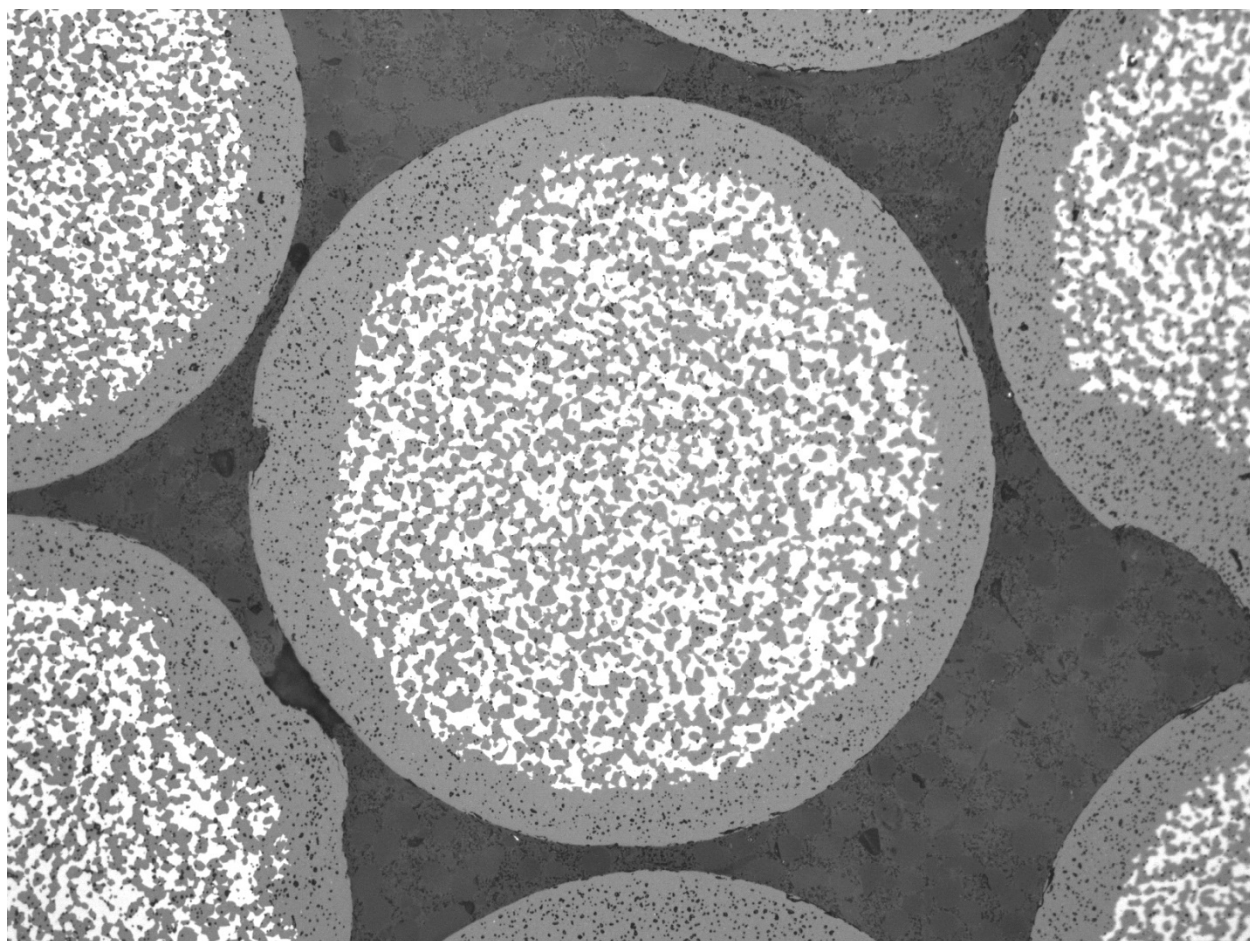
P17030905N179 segmented



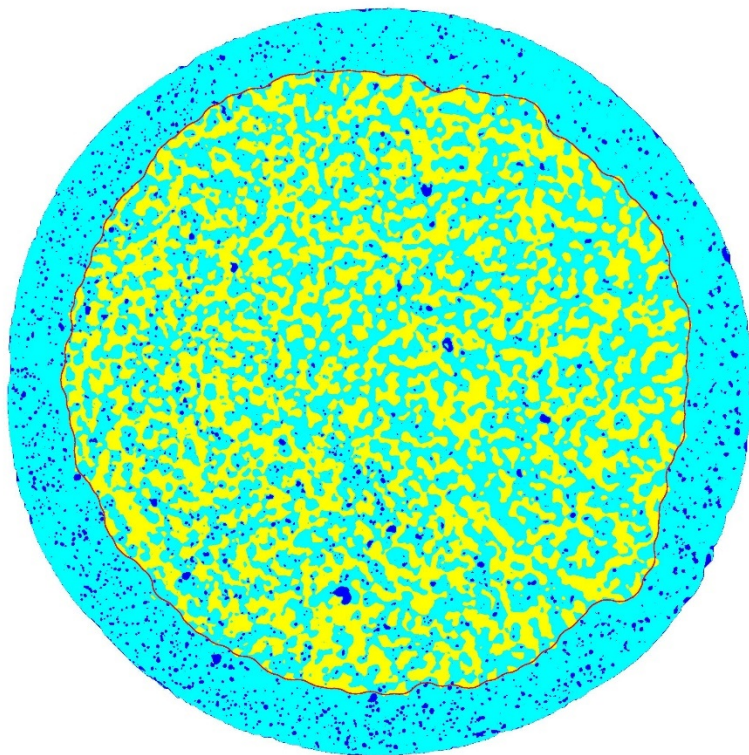
P17030905N179



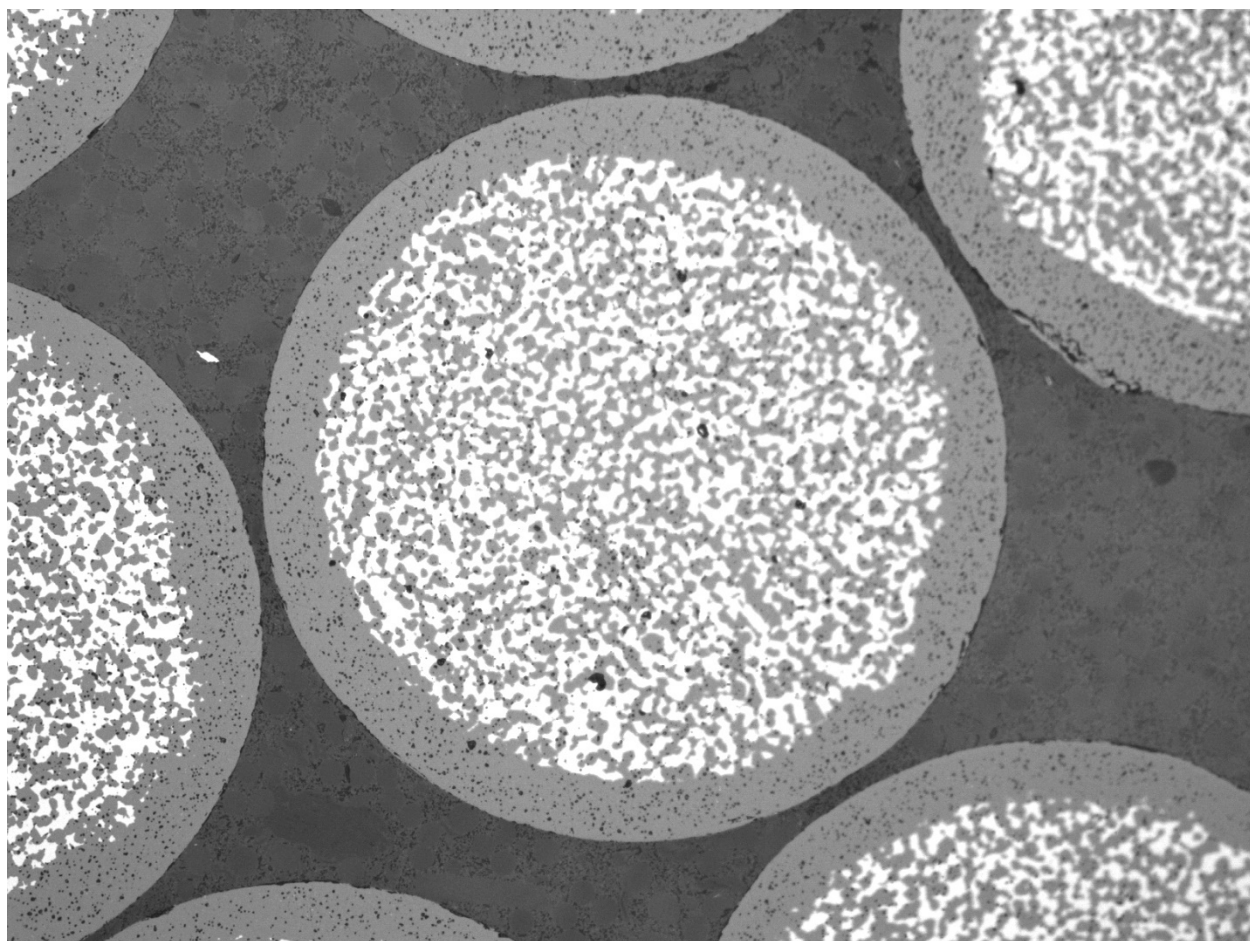
P17030905N180 segmented



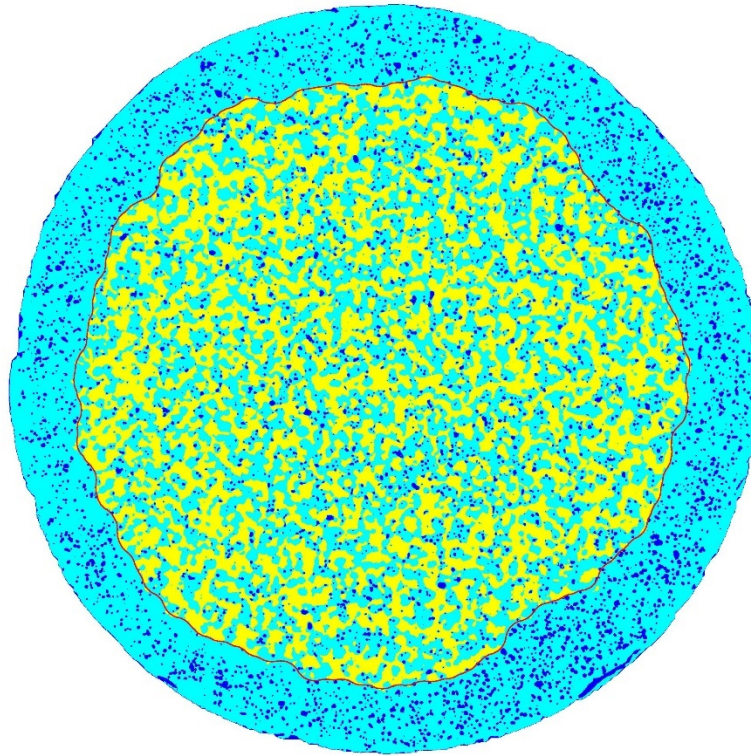
P17030905N180



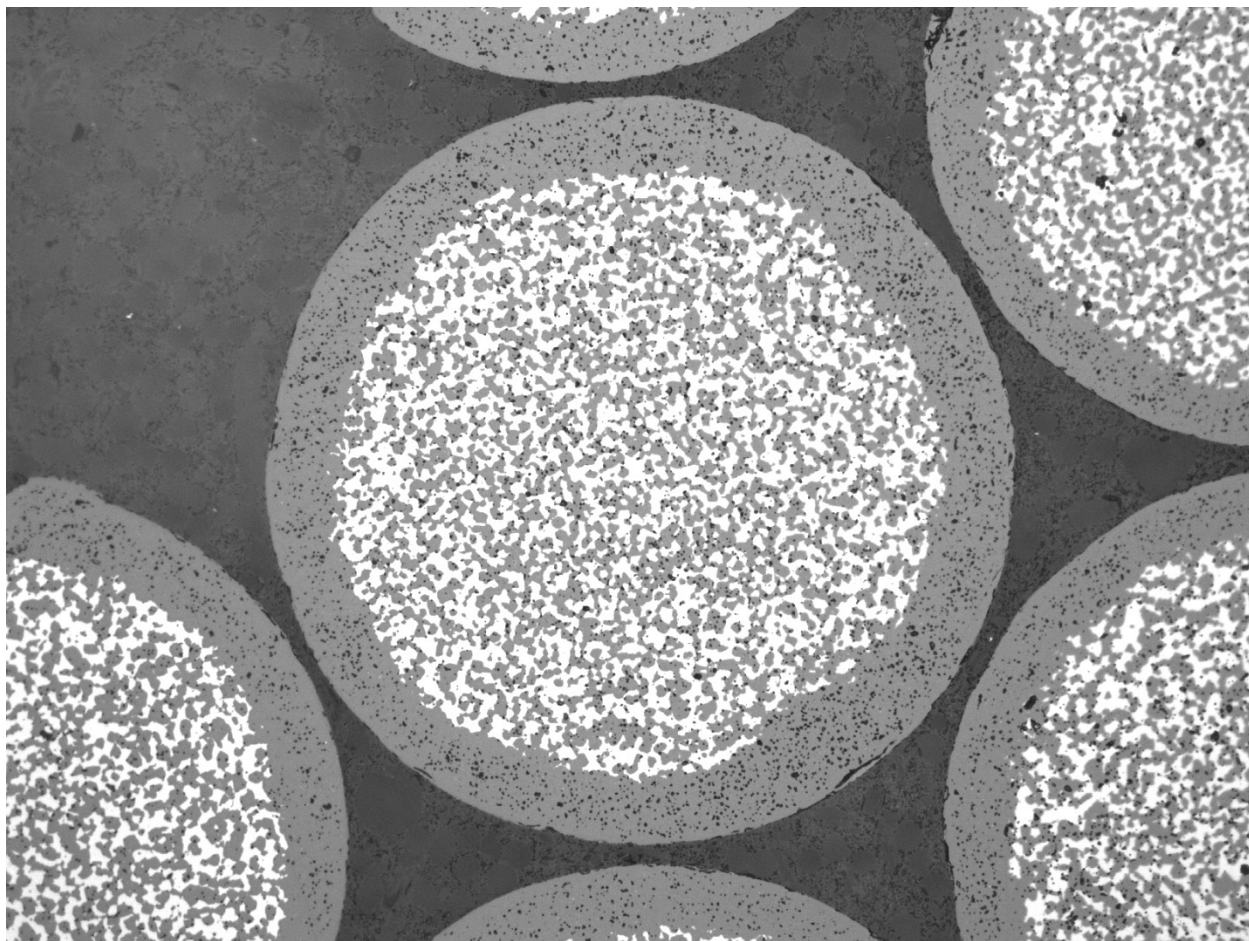
P17030905N181 segmented



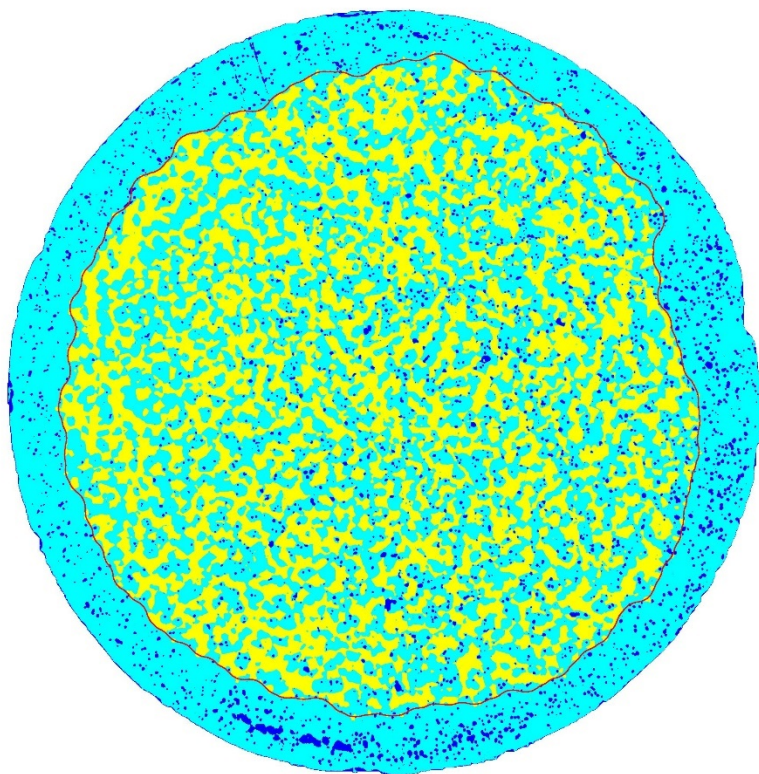
P17030905N181



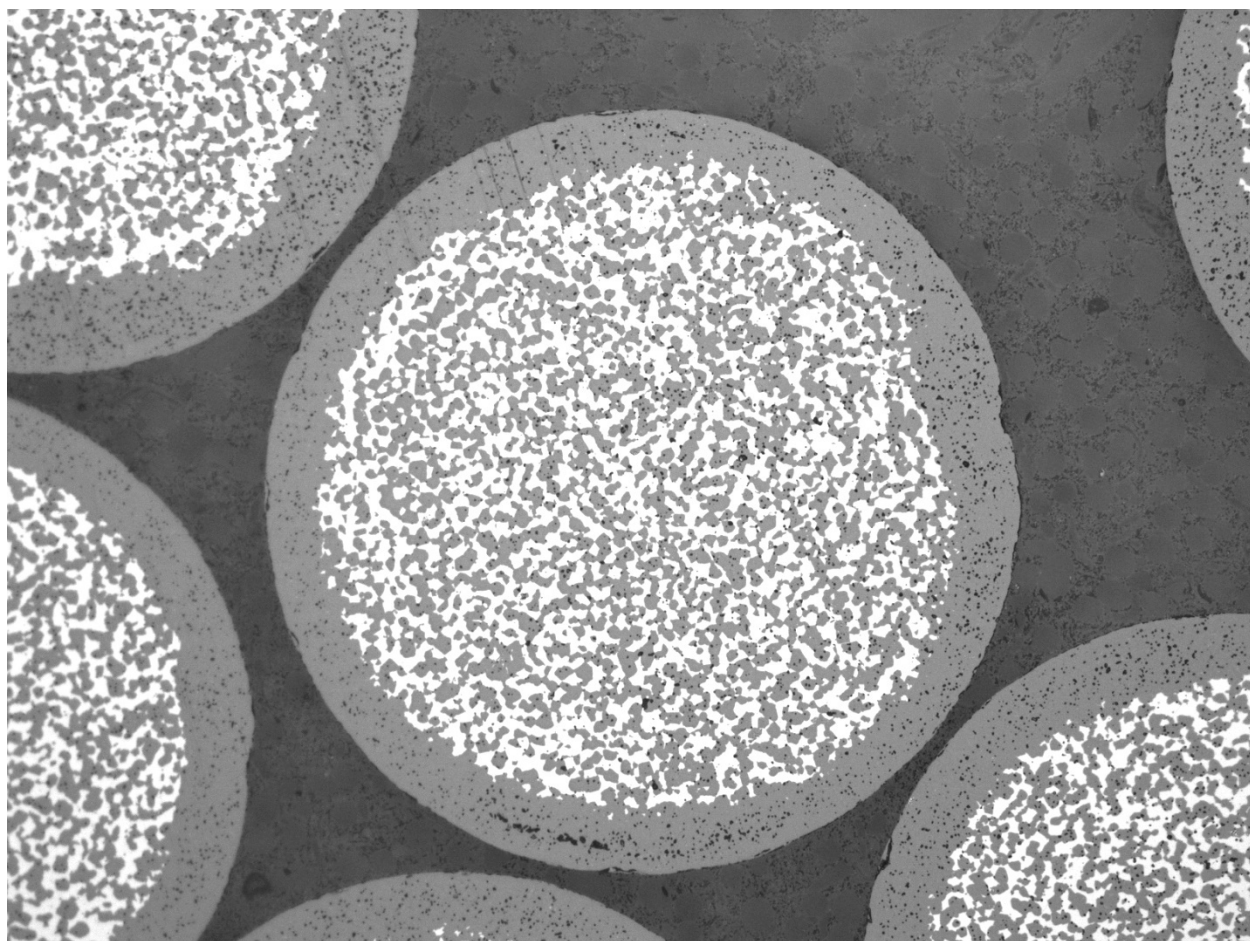
P17030905N182 segmented



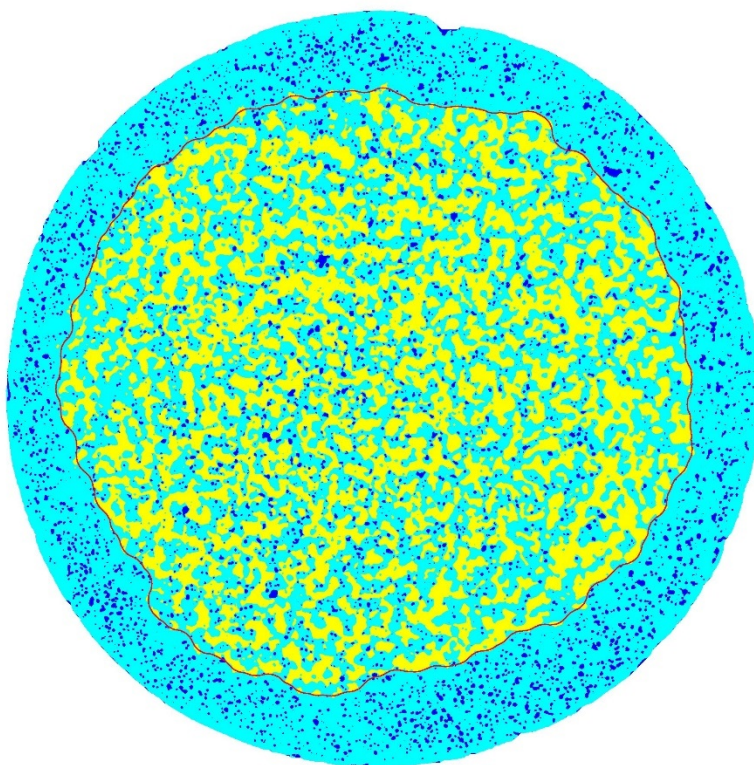
P17030905N182



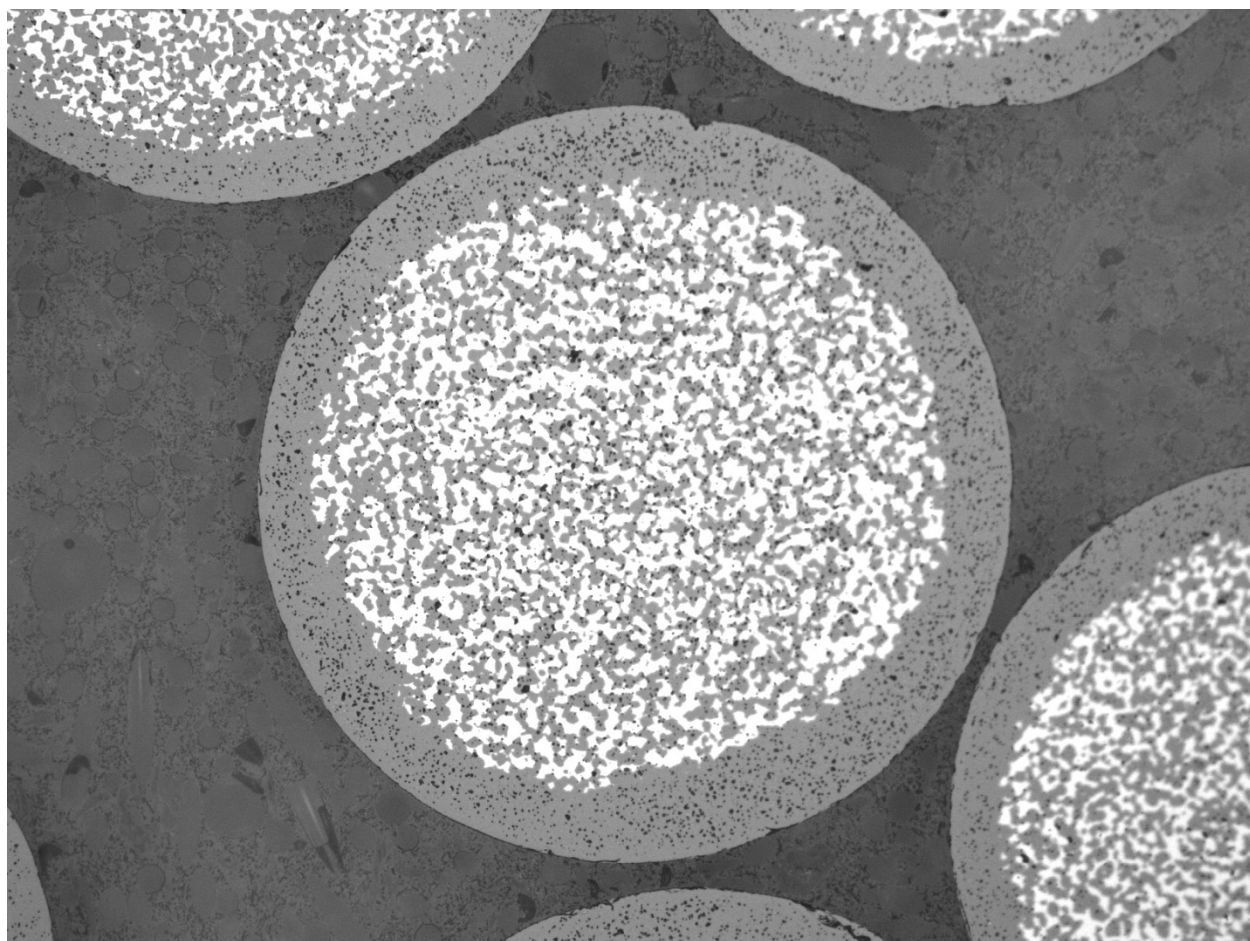
P17030905N183 segmented



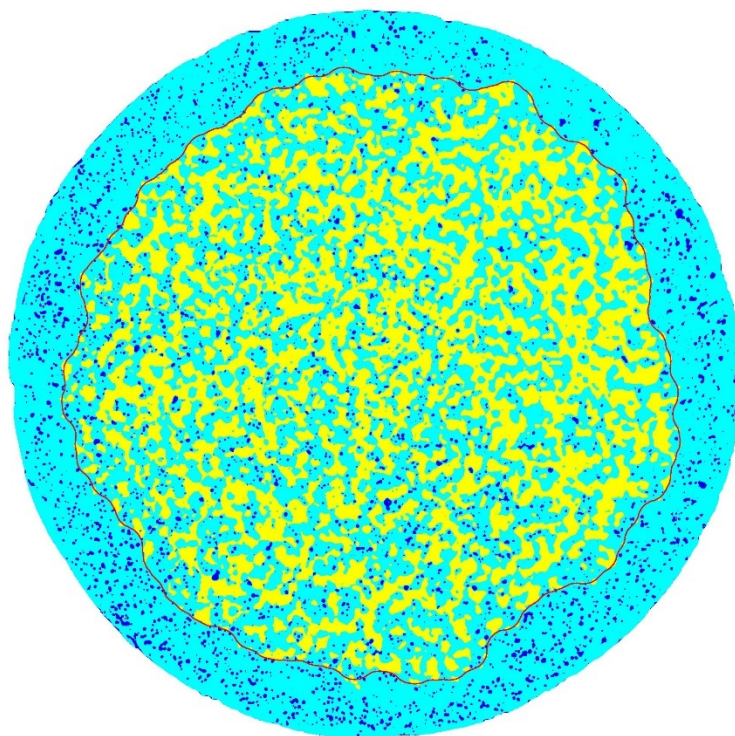
P17030905N183



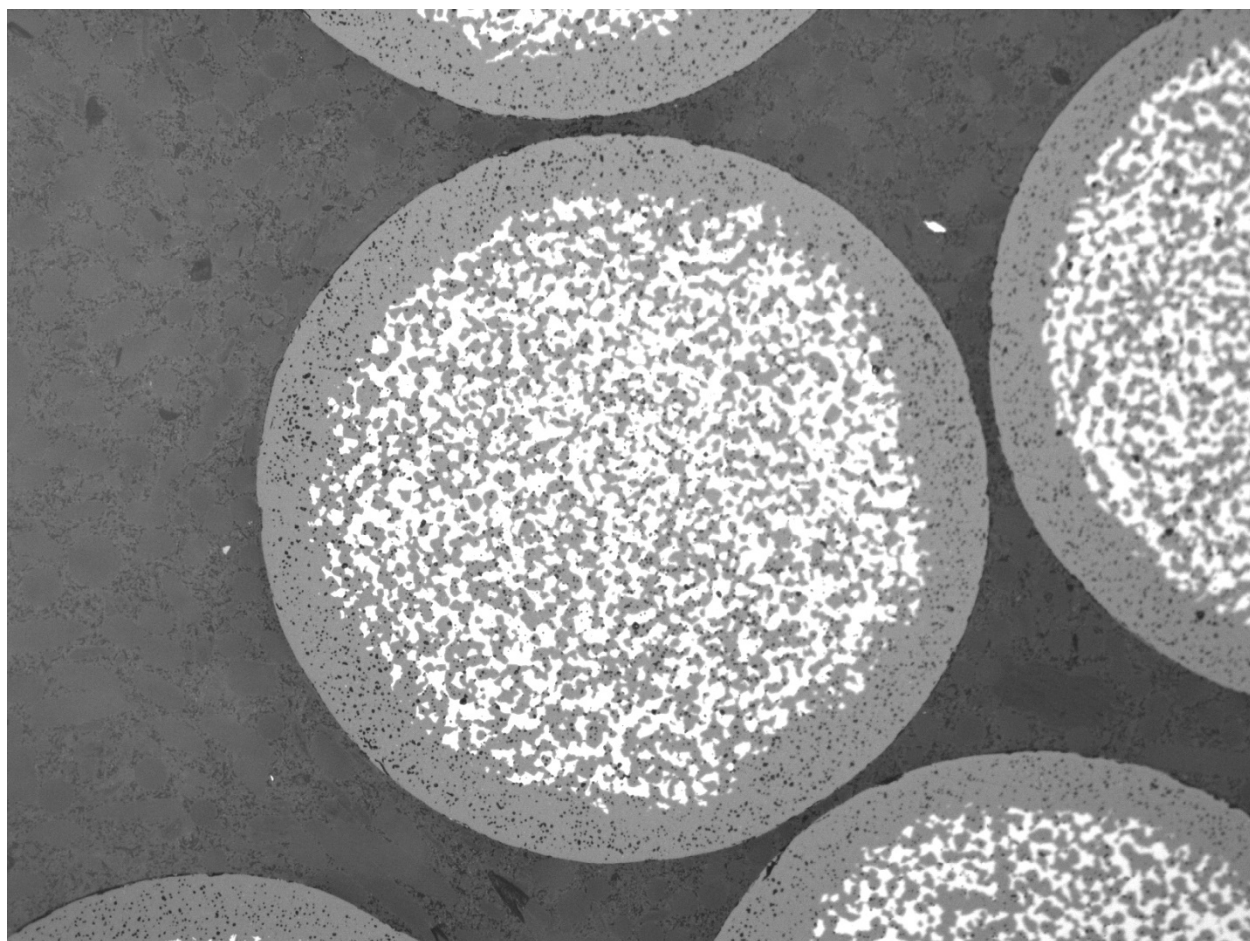
P17030905N184 segmented



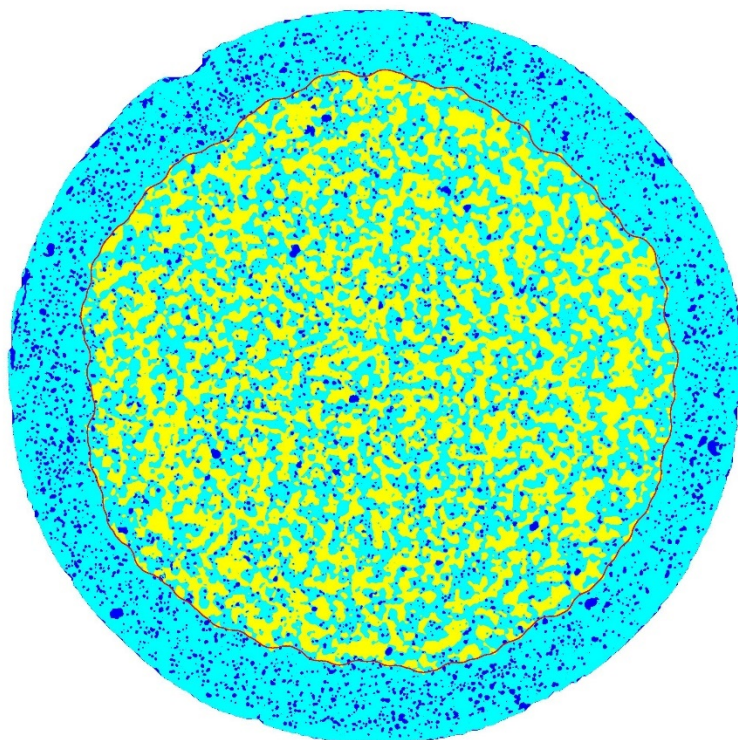
P17030905N184



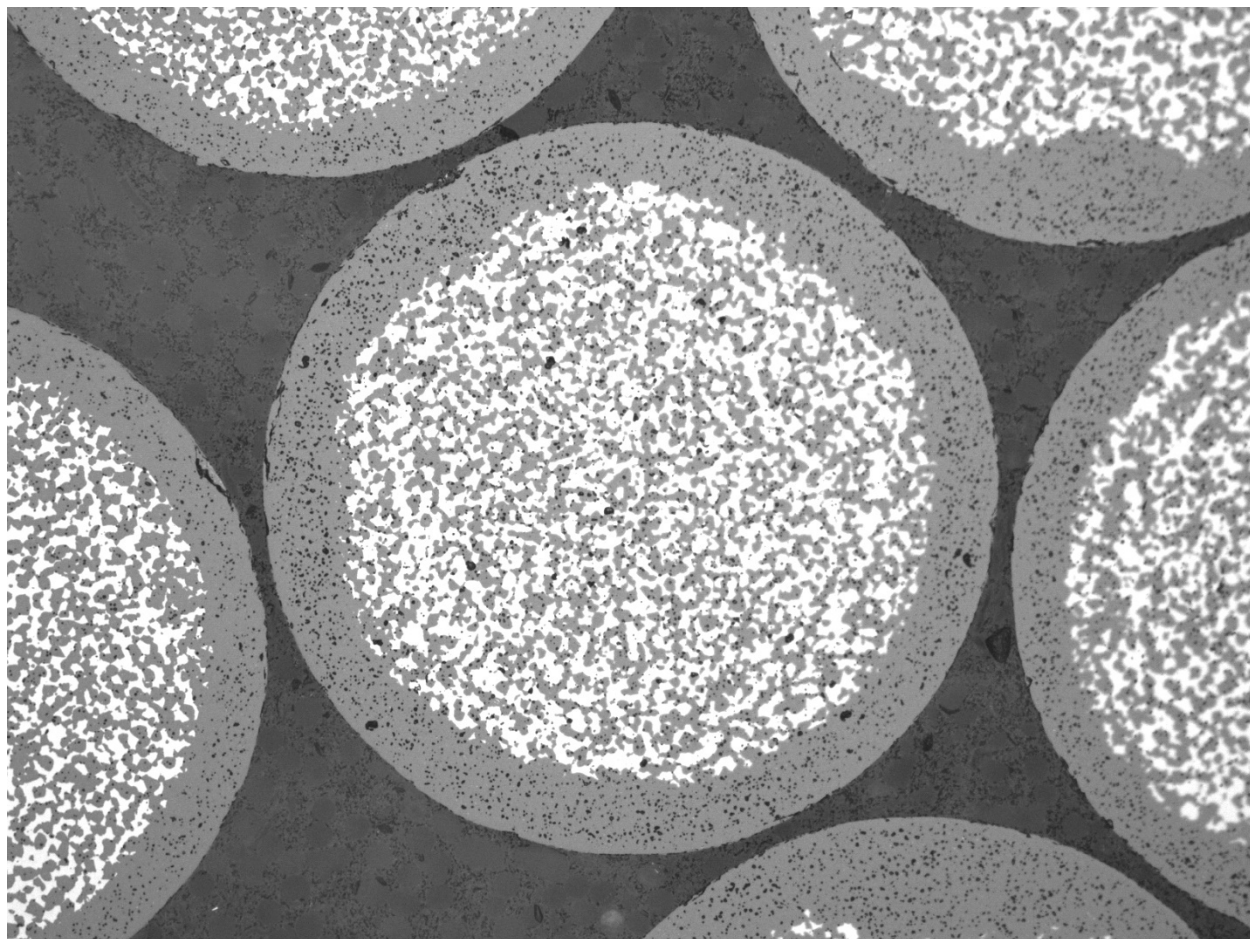
P17030905N185 segmented



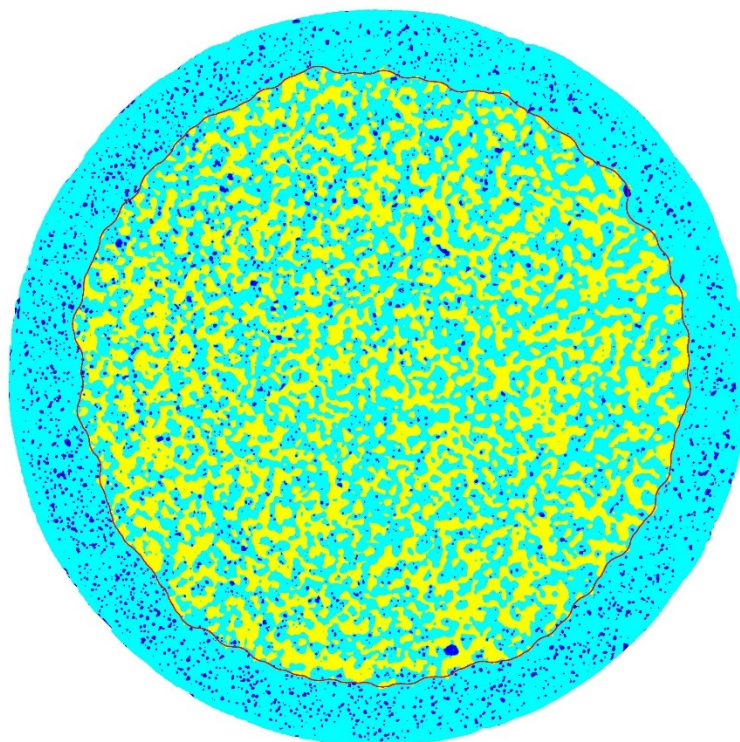
P17030905N185



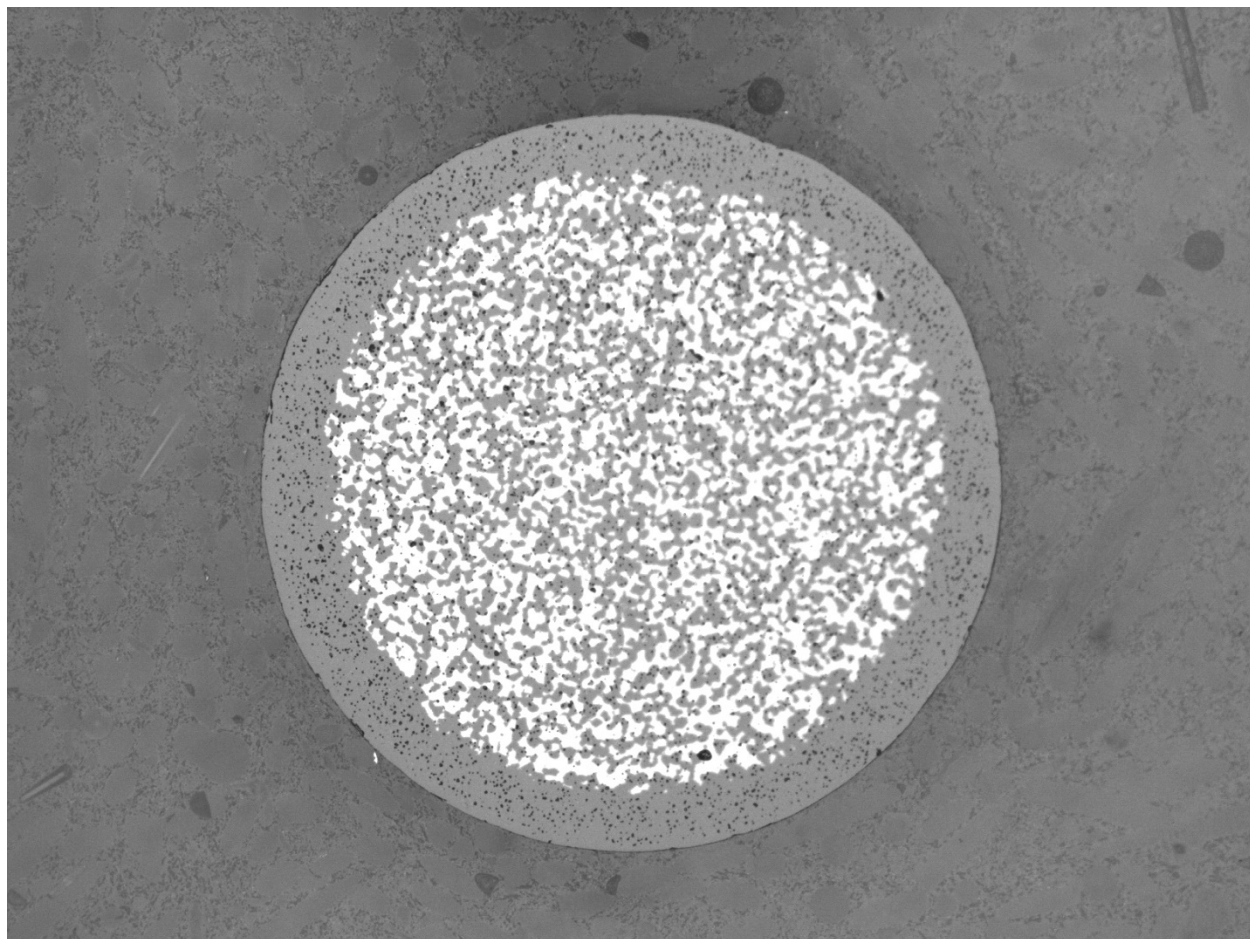
P17030905N186 segmented



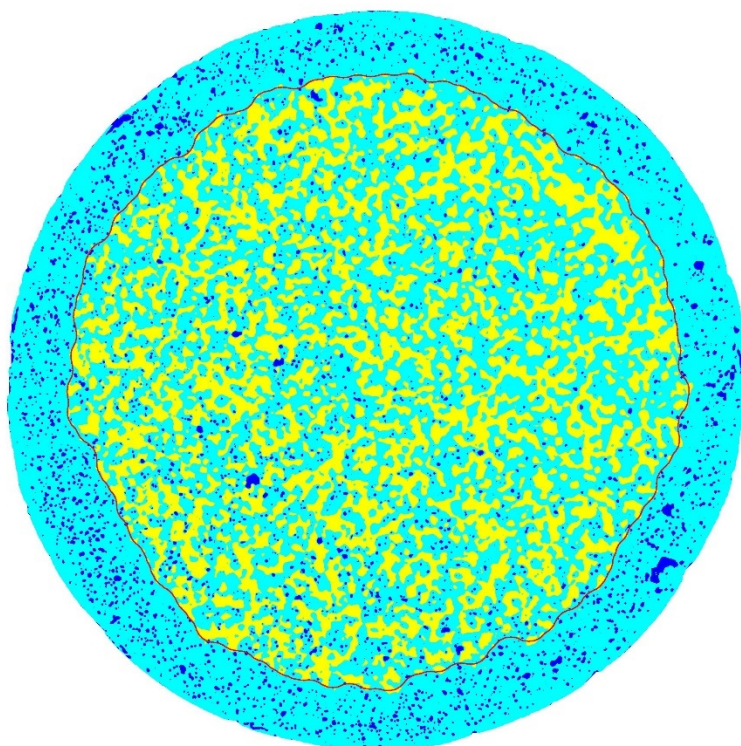
P17030905N186



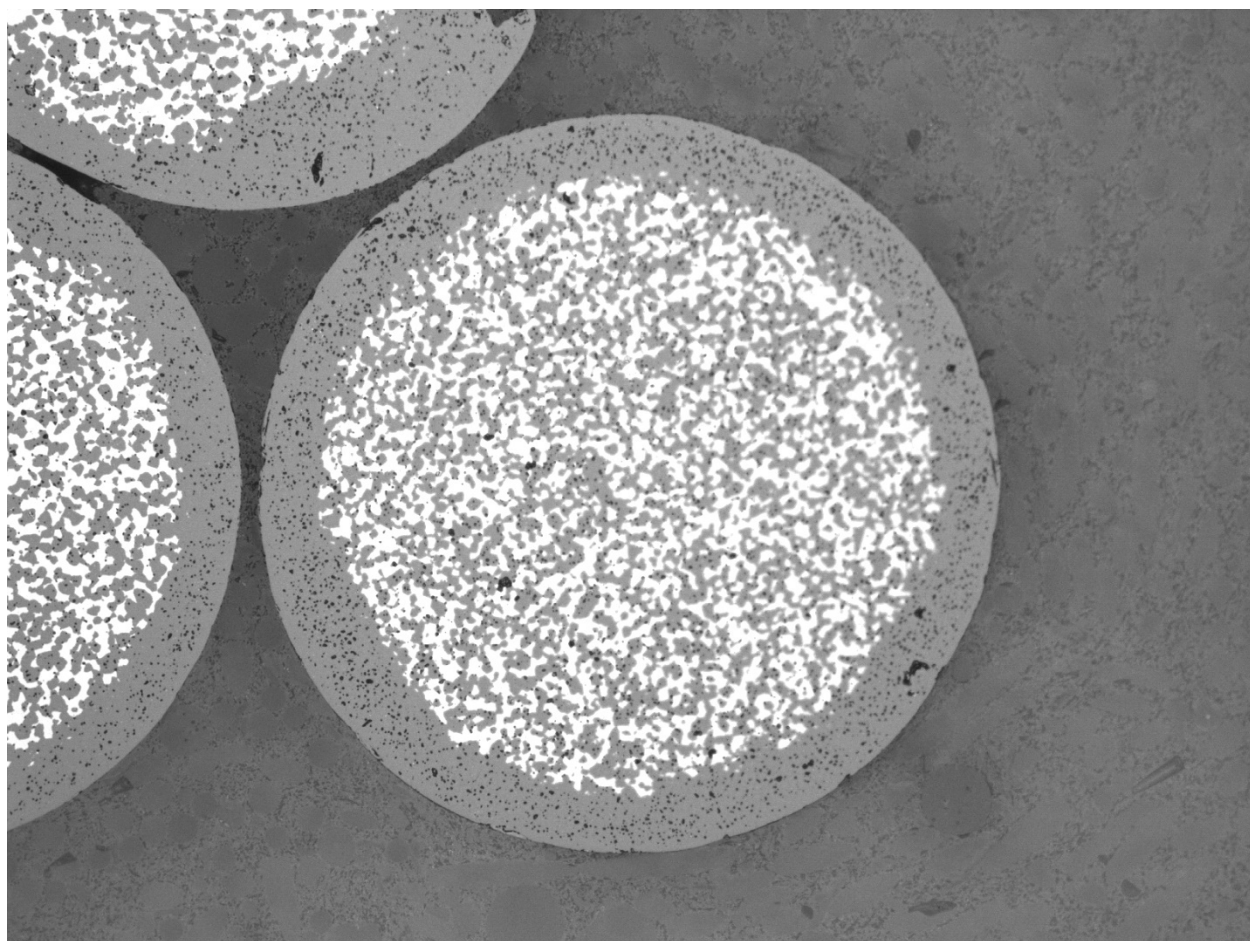
P17030905N187 segmented



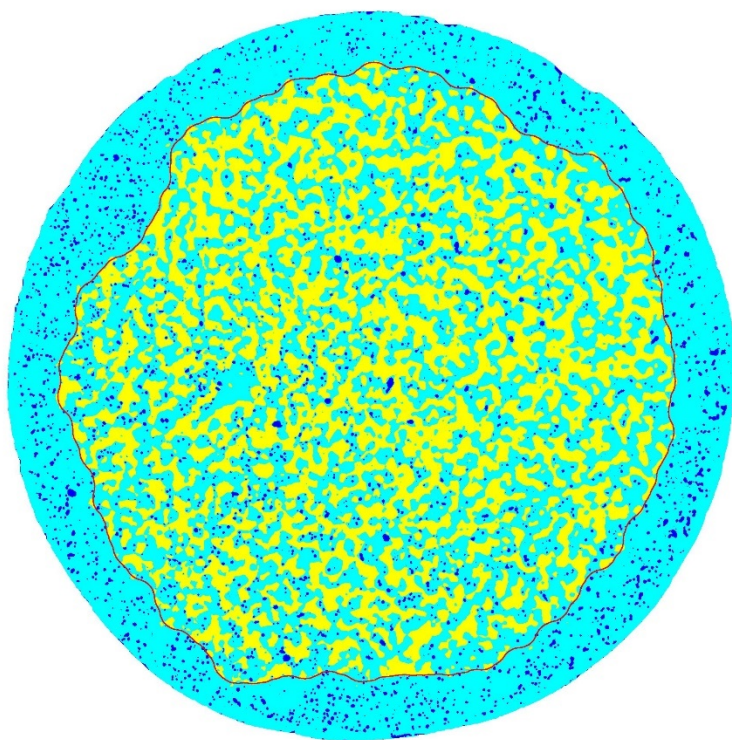
P17030905N187



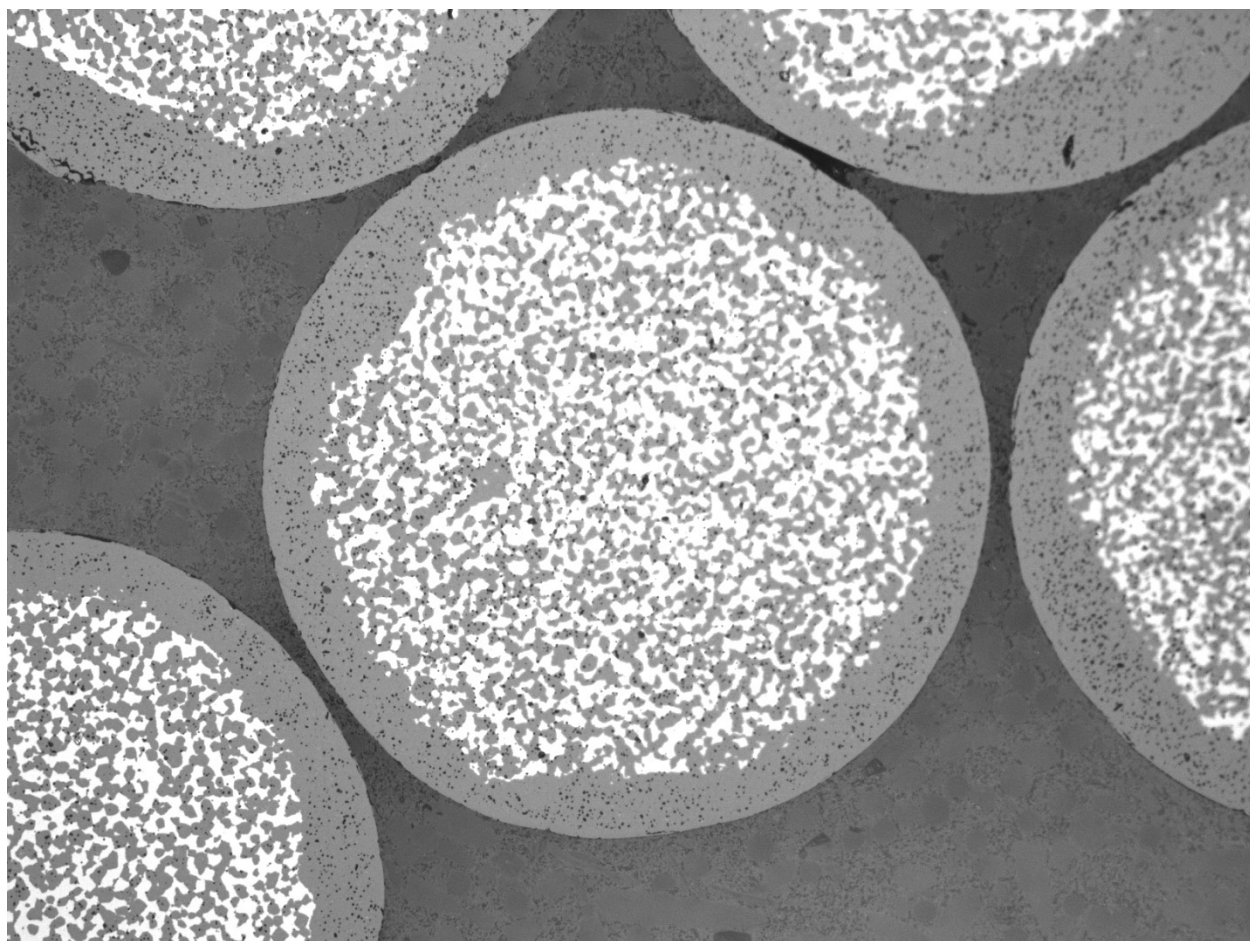
P17030905N188 segmented



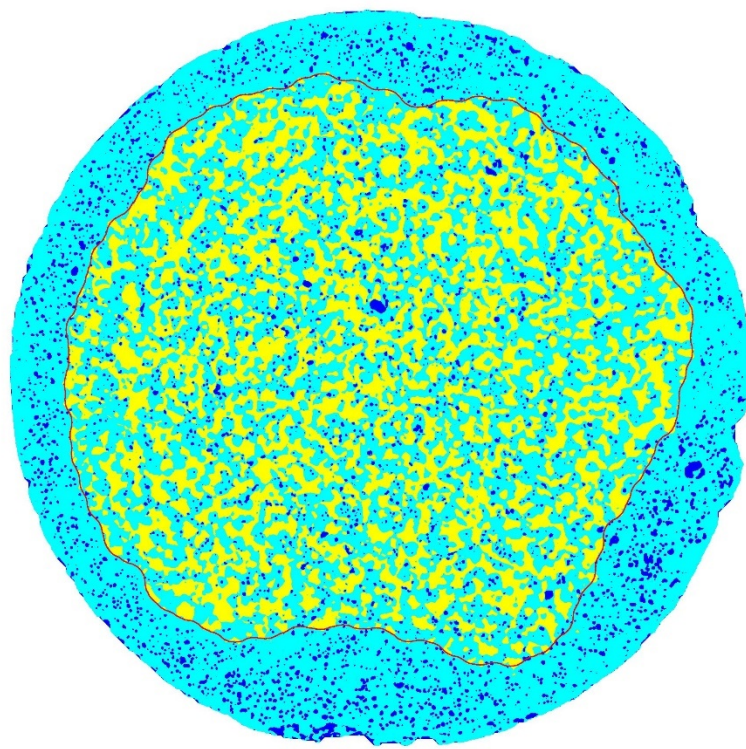
P17030905N188



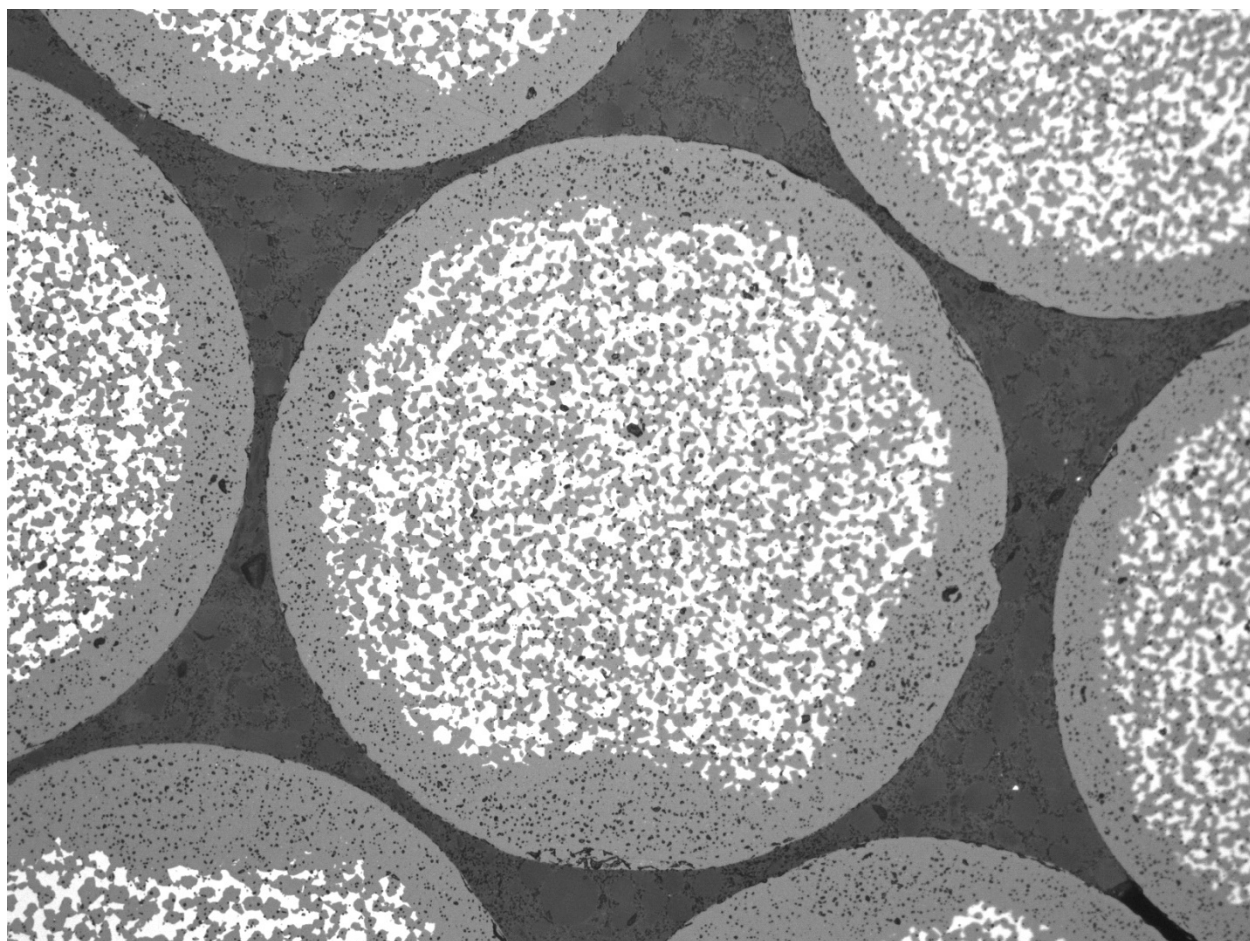
P17030905N189 segmented



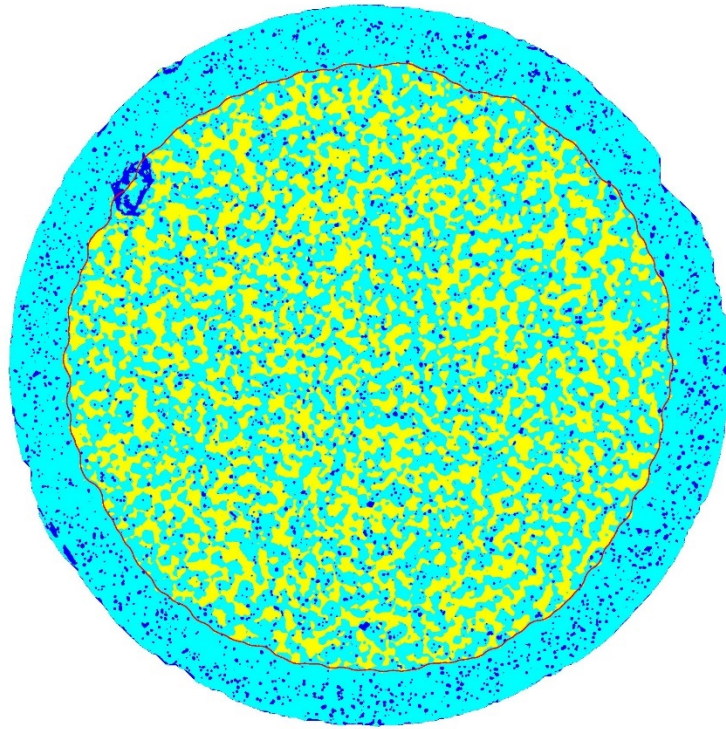
P17030905N189



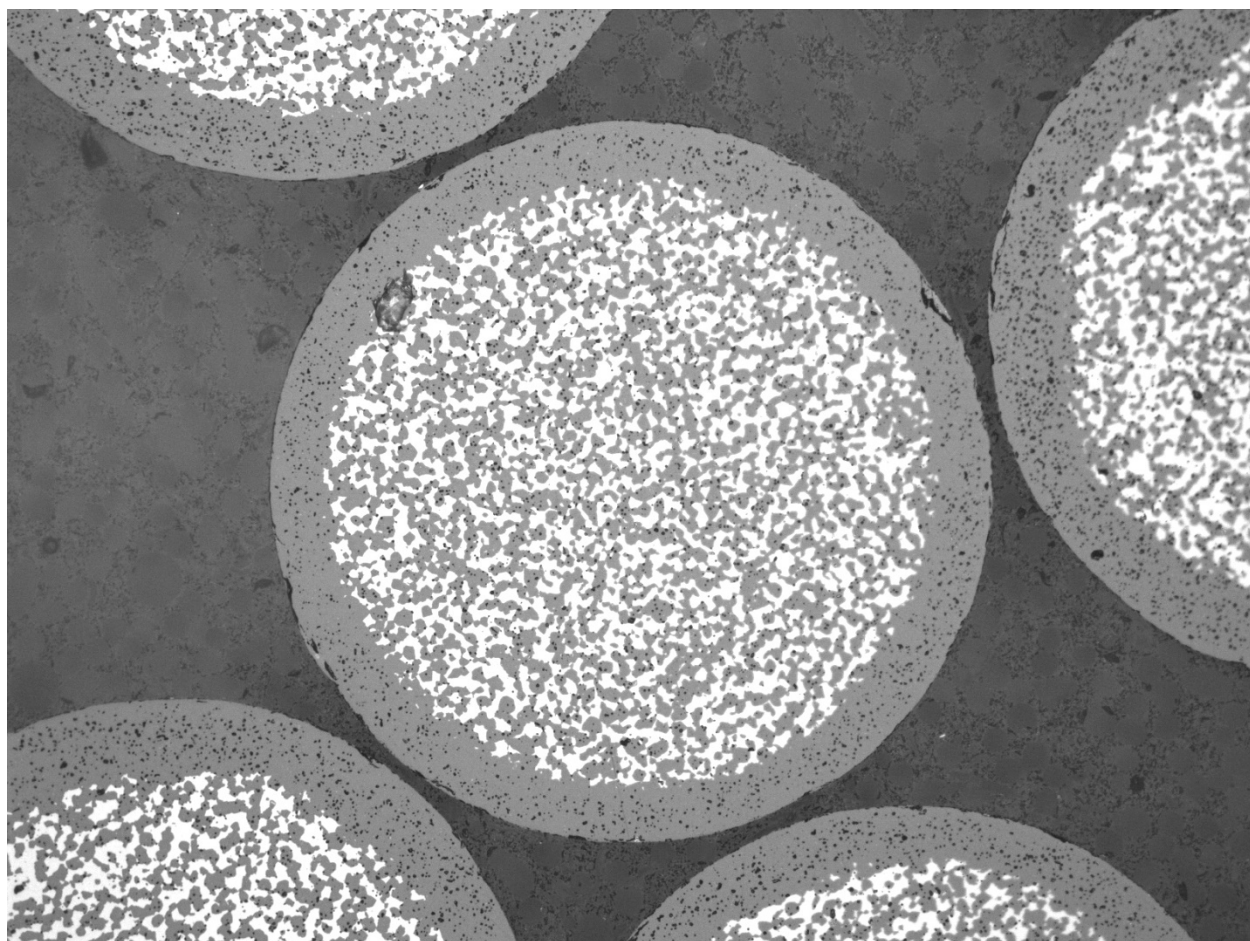
P17030905N190 segmented



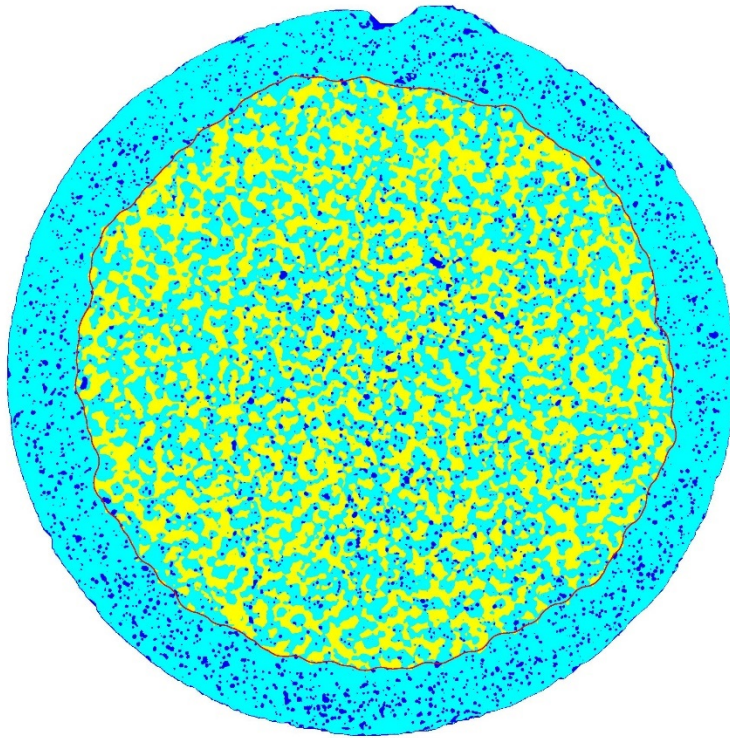
P17030905N190



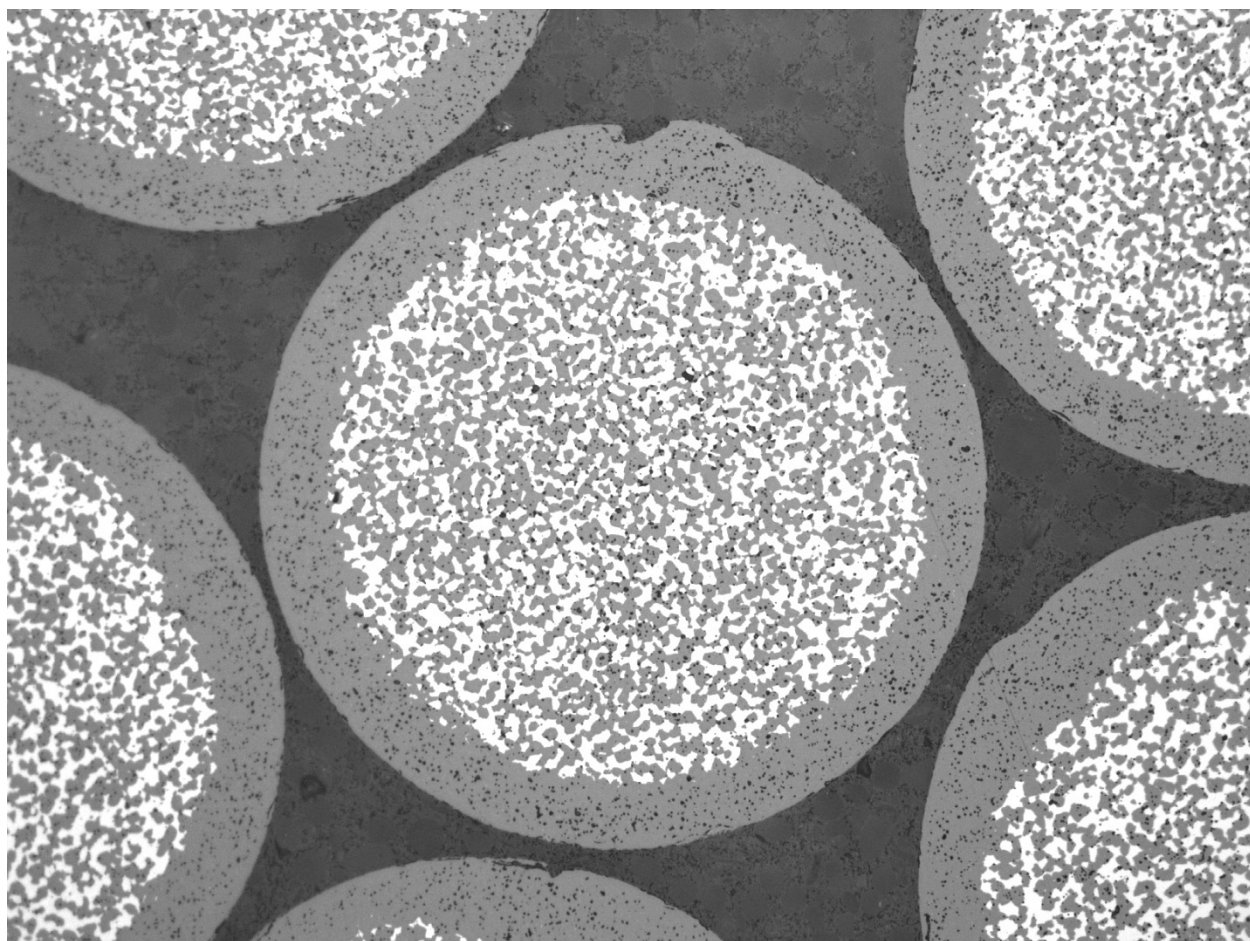
P17030905N192 segmented



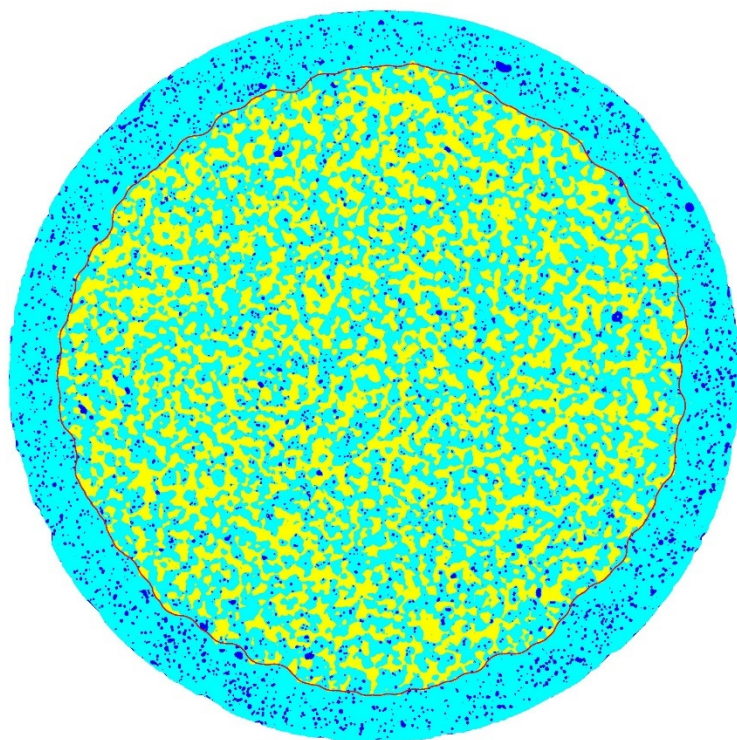
P17030905N192



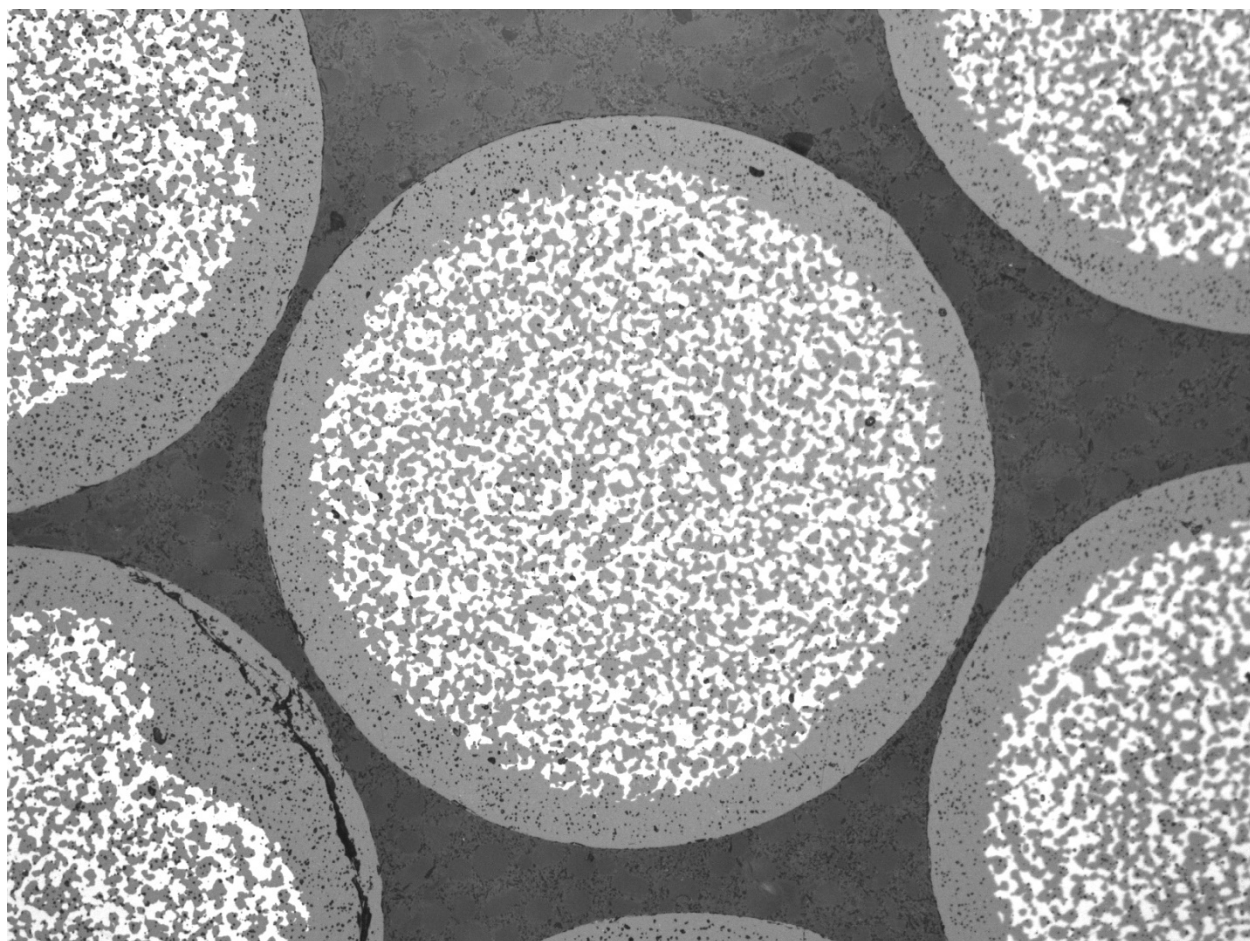
P17030905N193 segmented



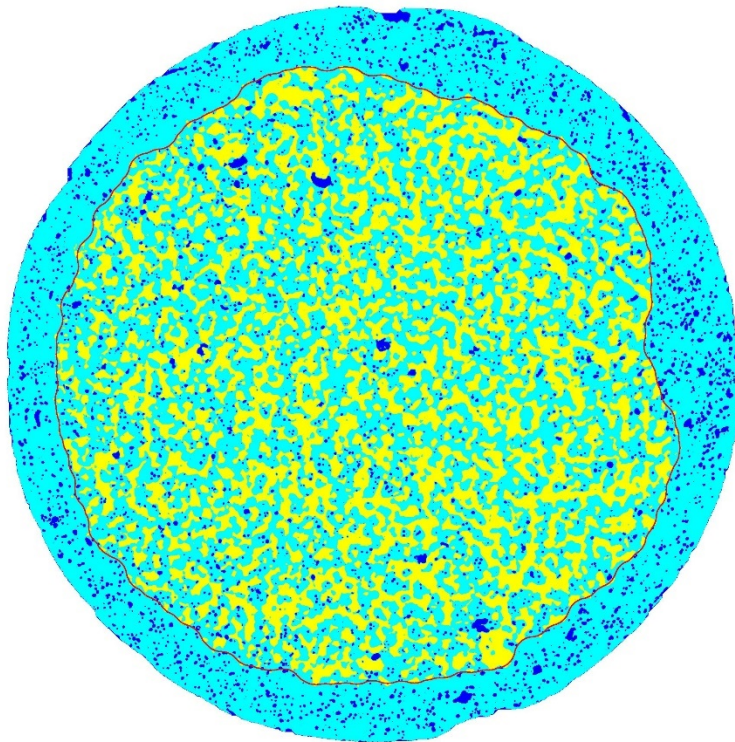
P17030905N193



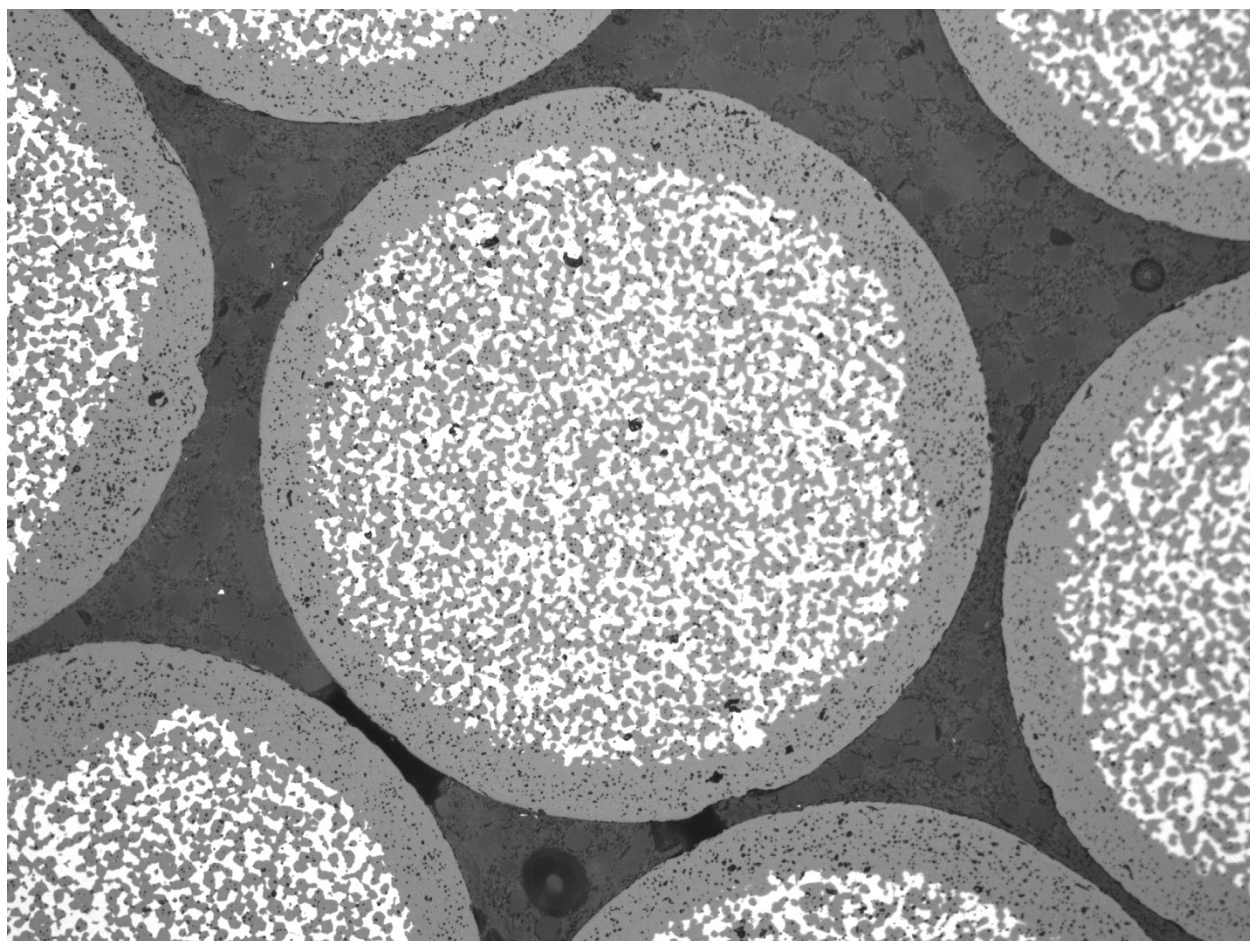
P17030905N195 segmented



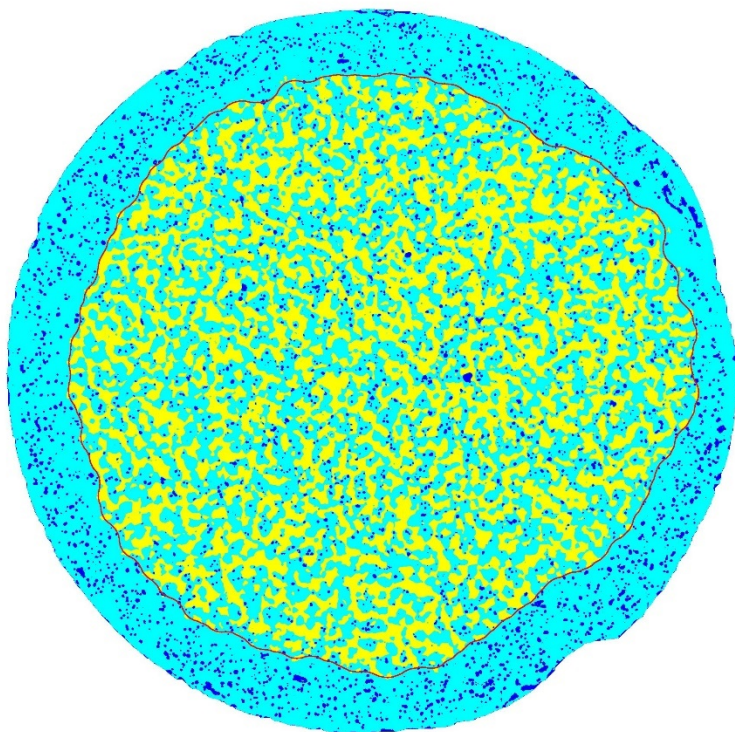
P17030905N195



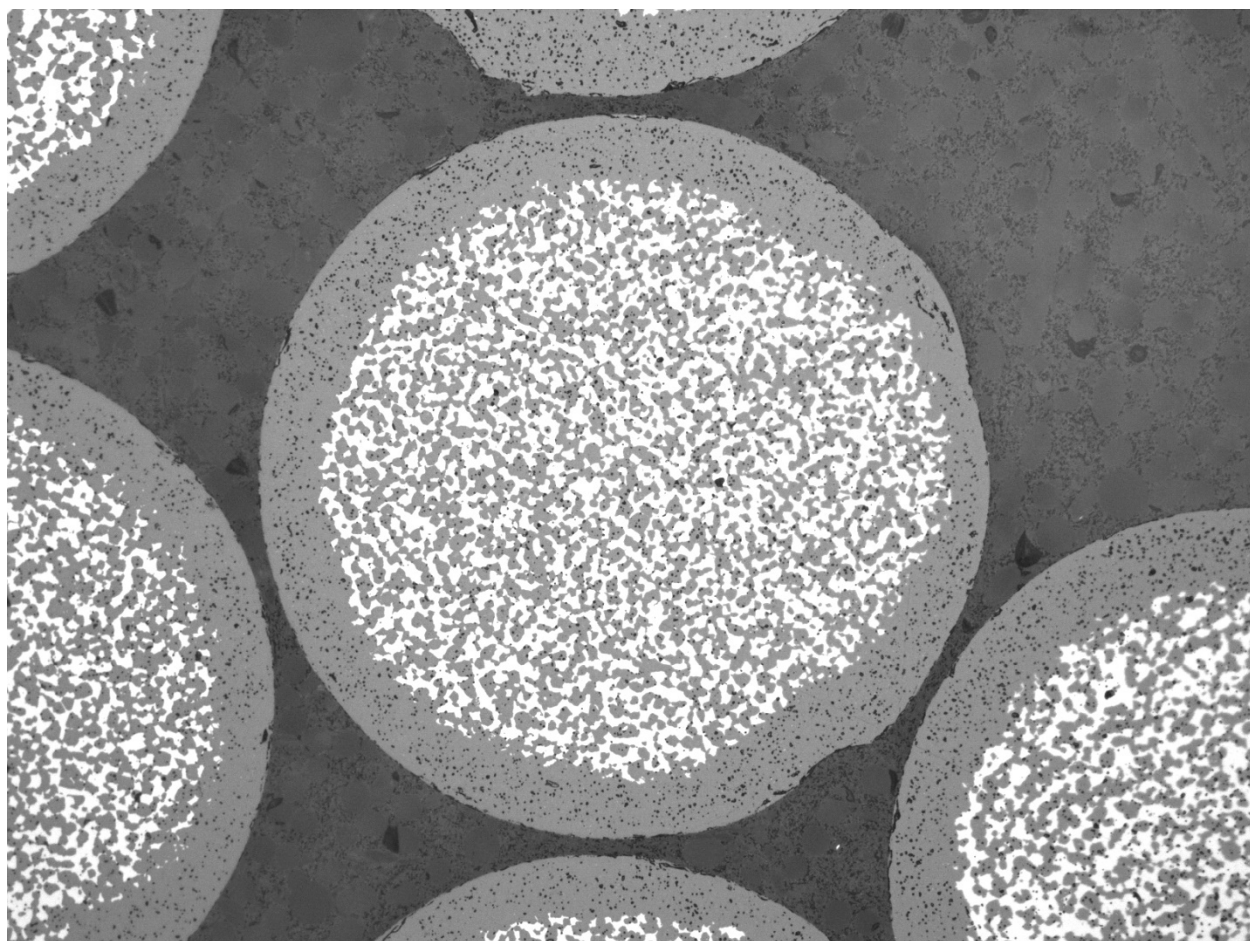
P17030905N196 segmented



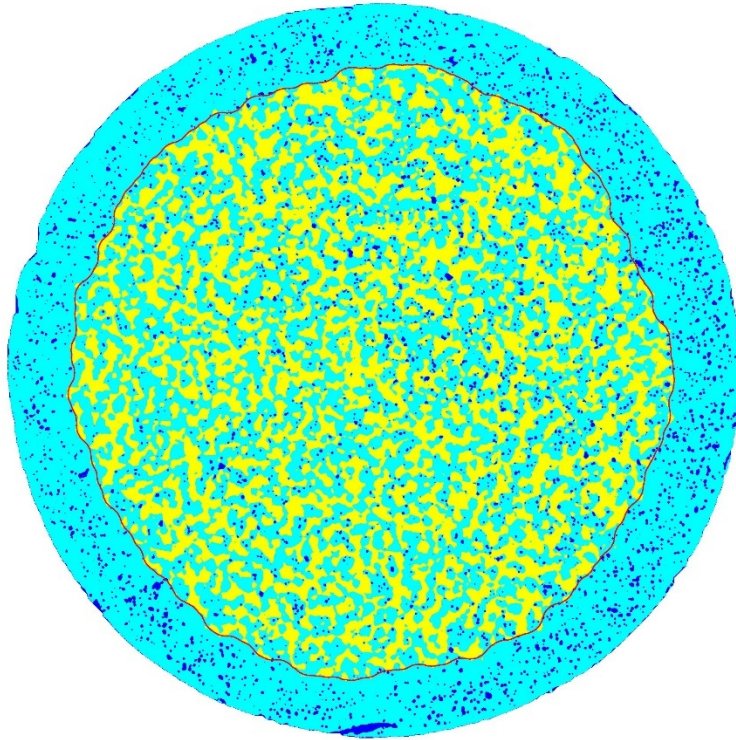
P17030905N196



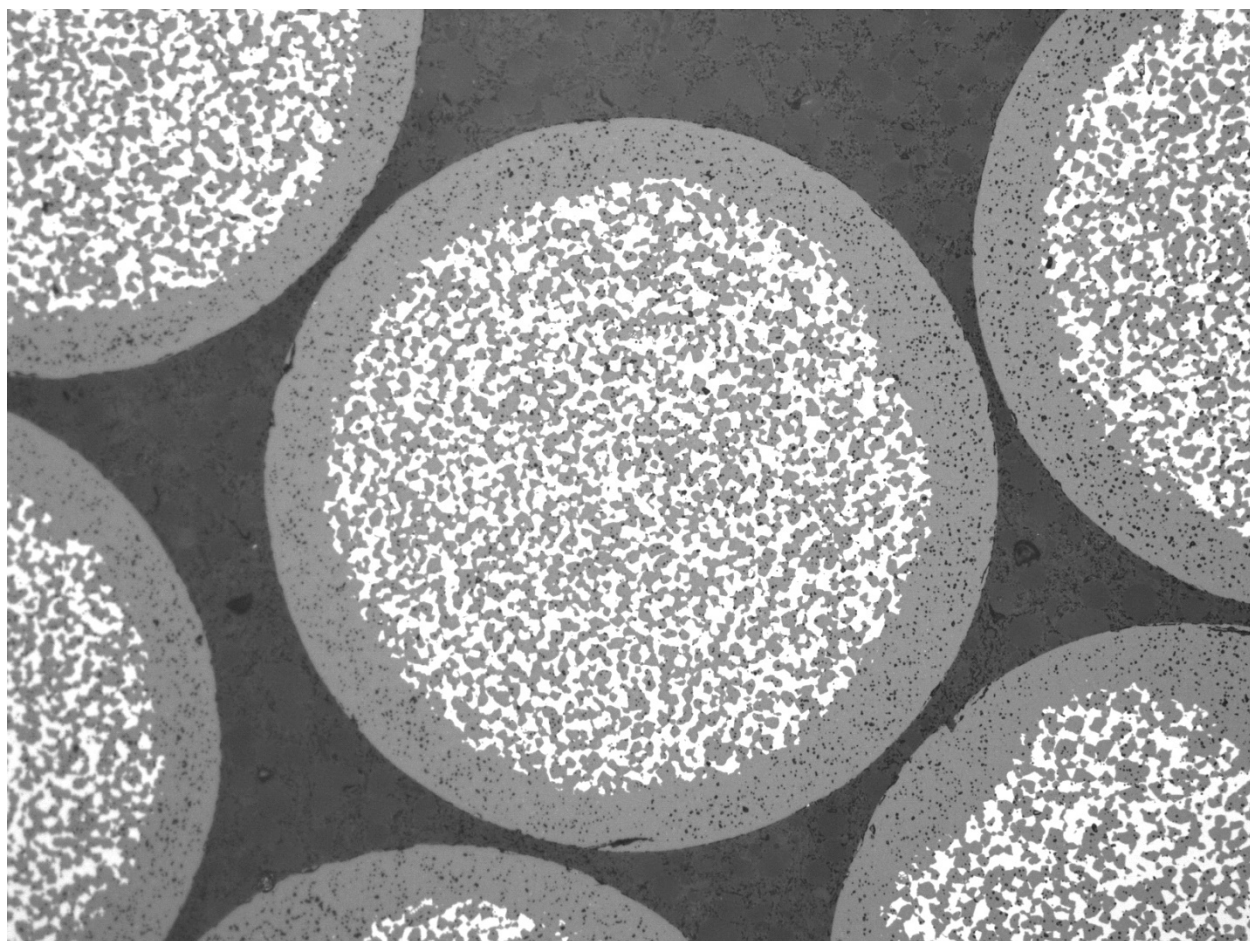
P17030905N197 segmented



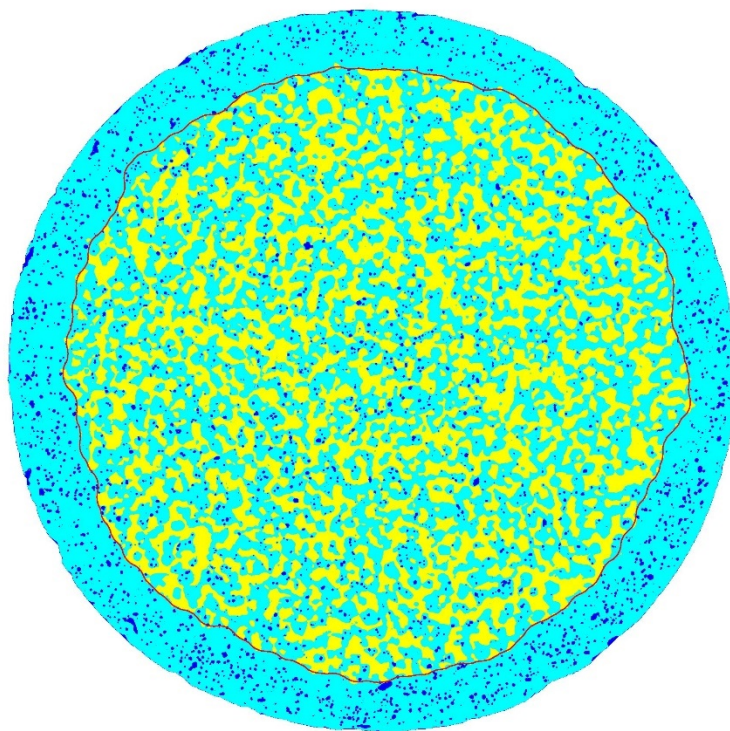
P17030905N197



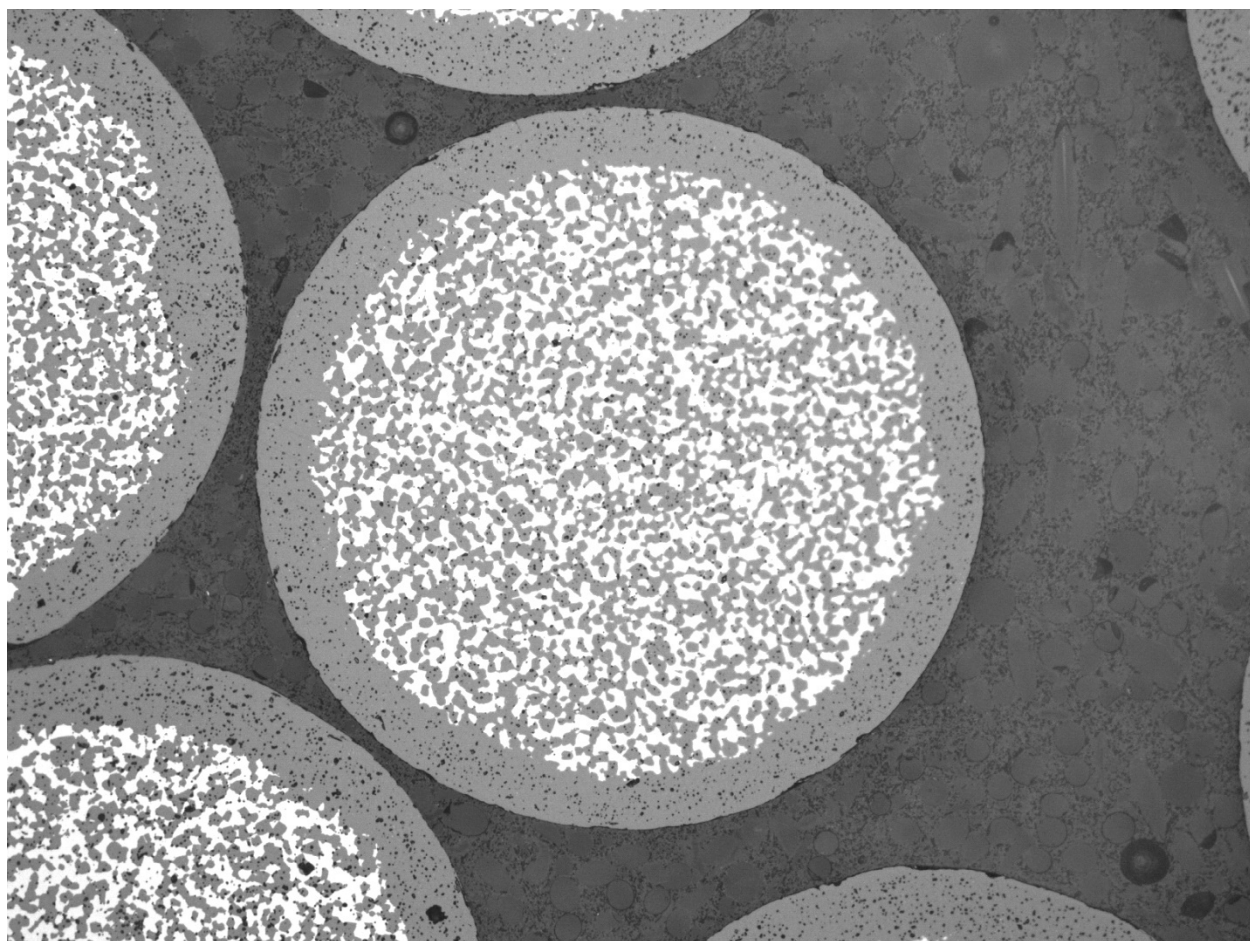
P17030905N198 segmented



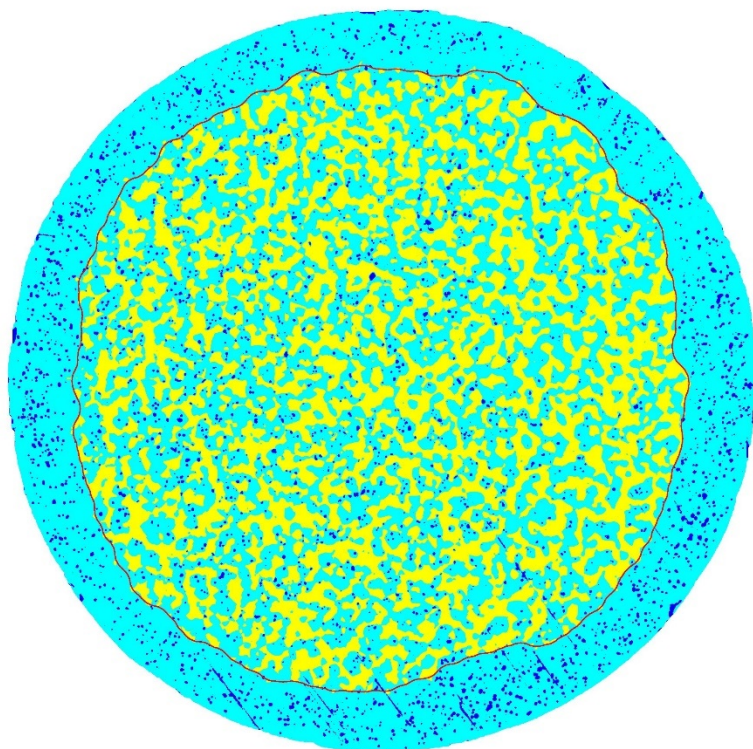
P17030905N198



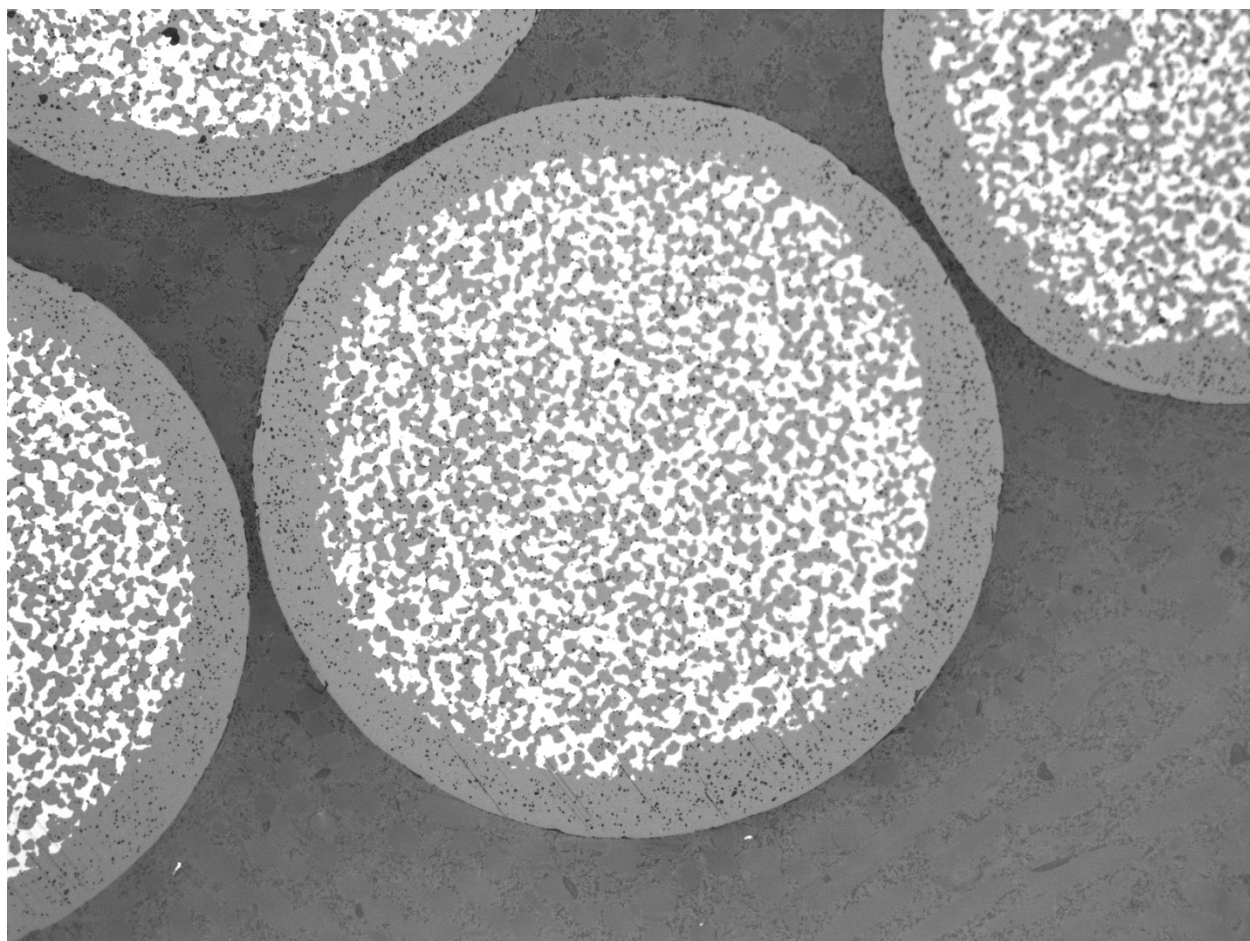
P17030905N199 segmented



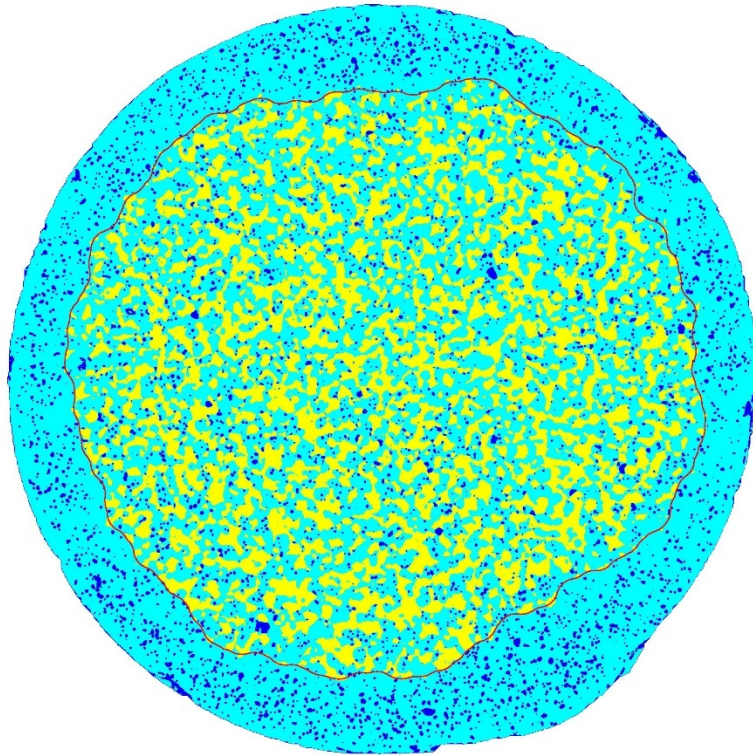
P17030905N199



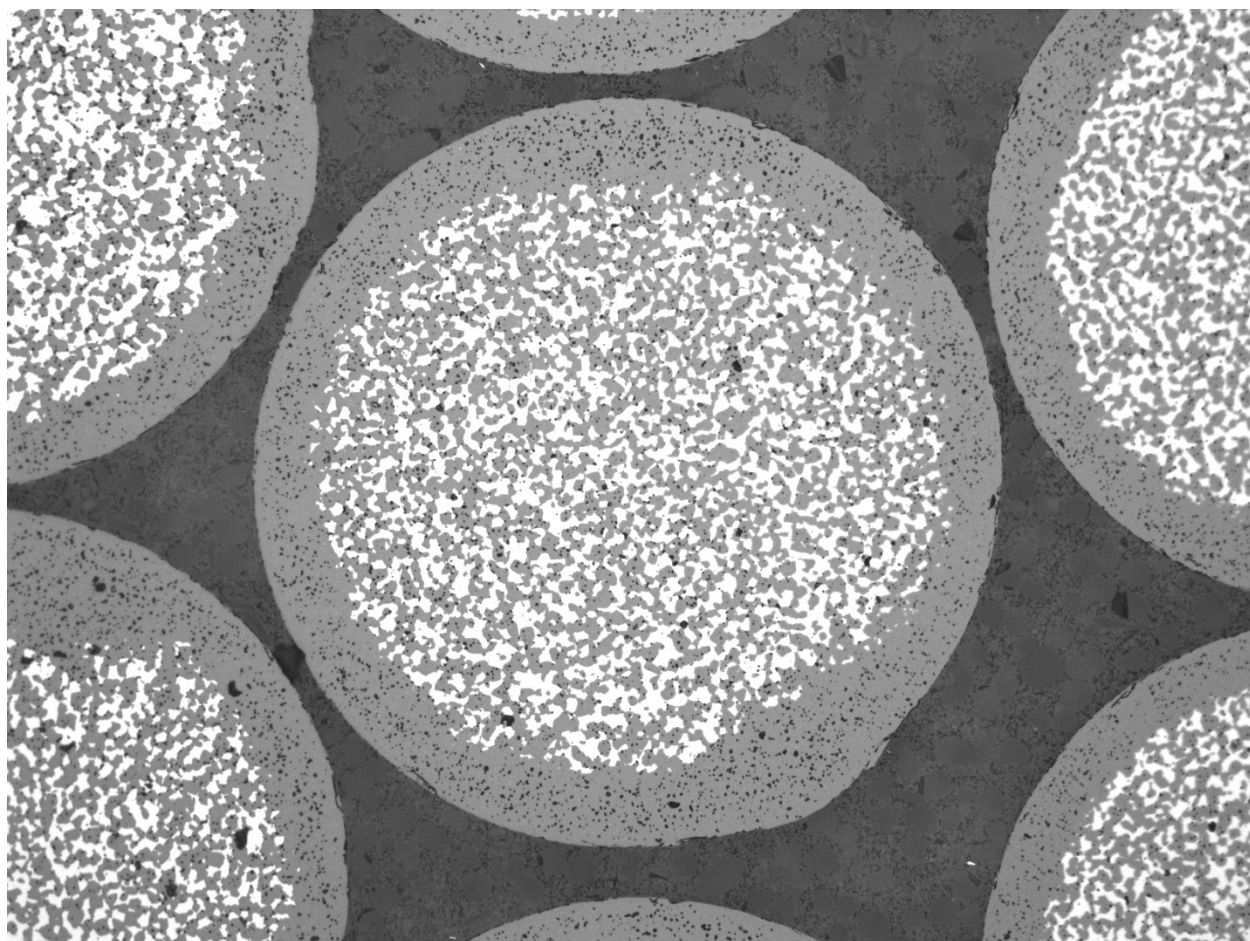
P17030905N200 segmented



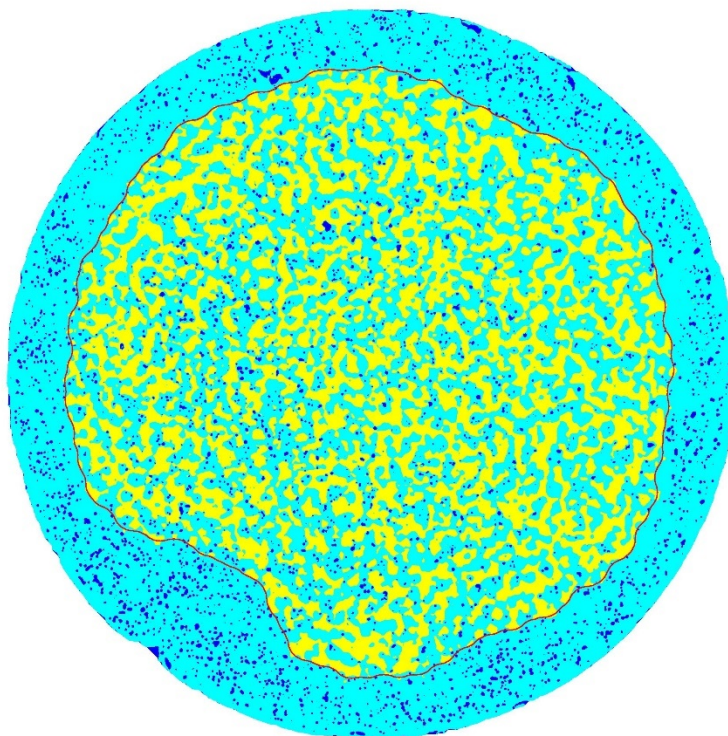
P17030905N200



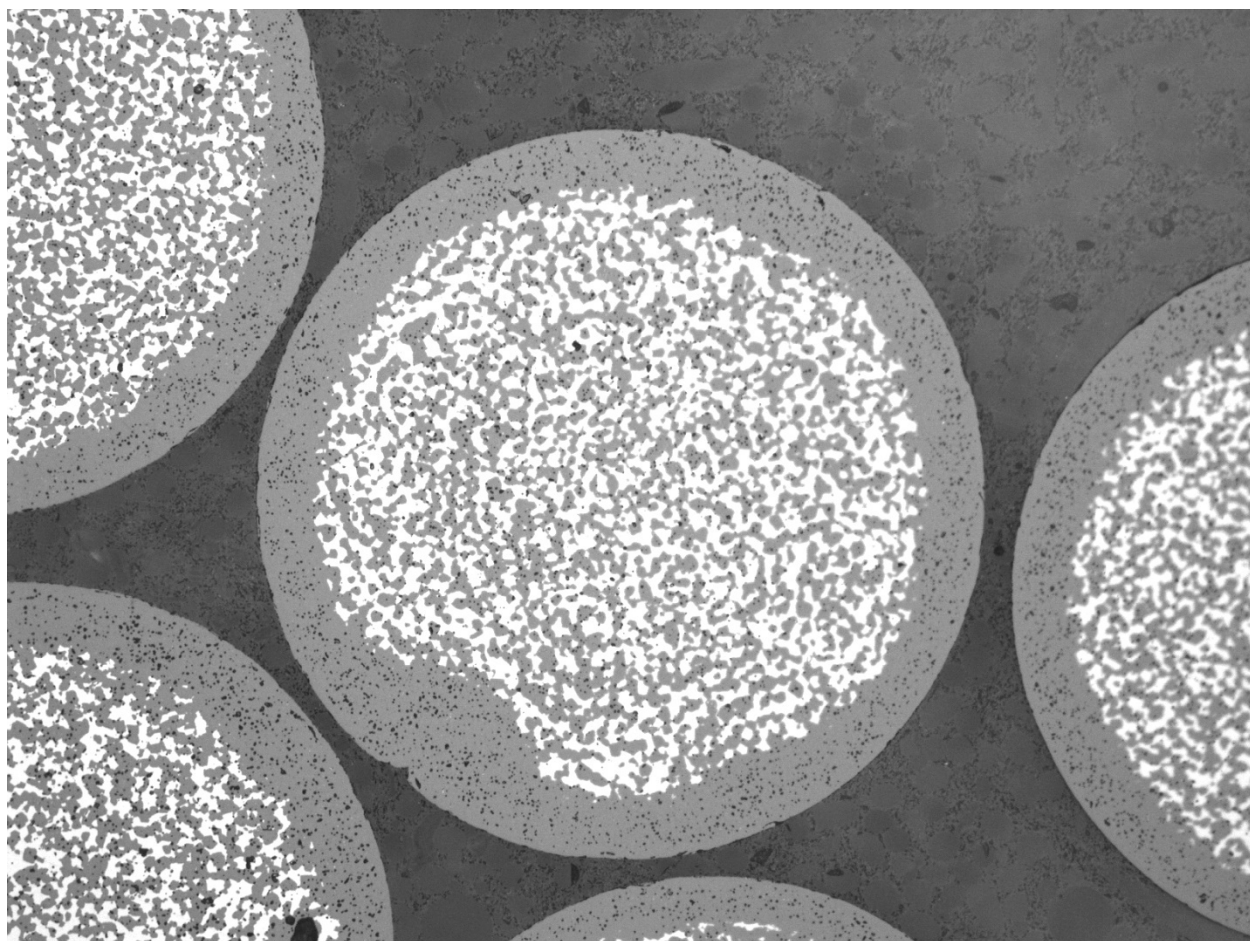
P17030905N201 segmented



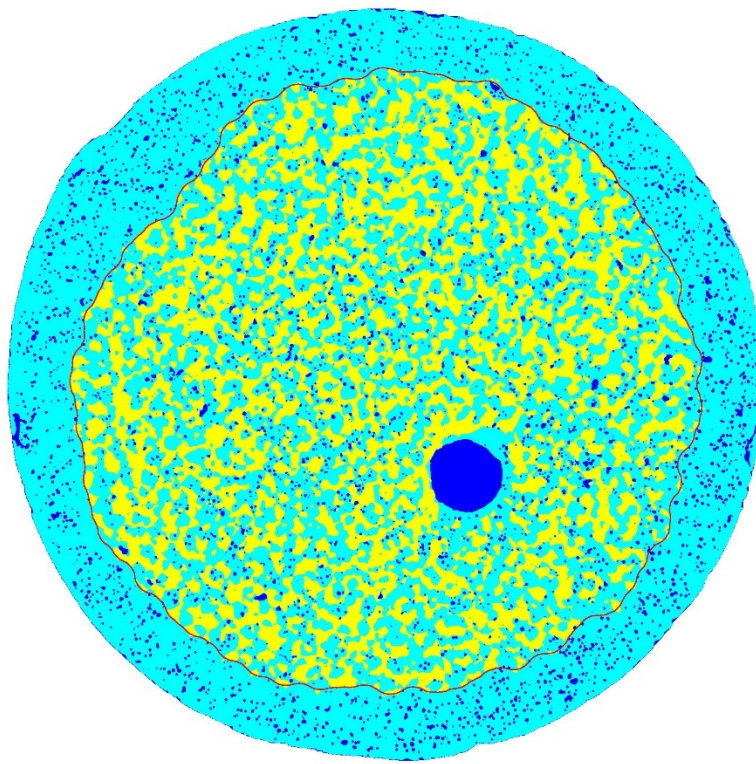
P17030905N201



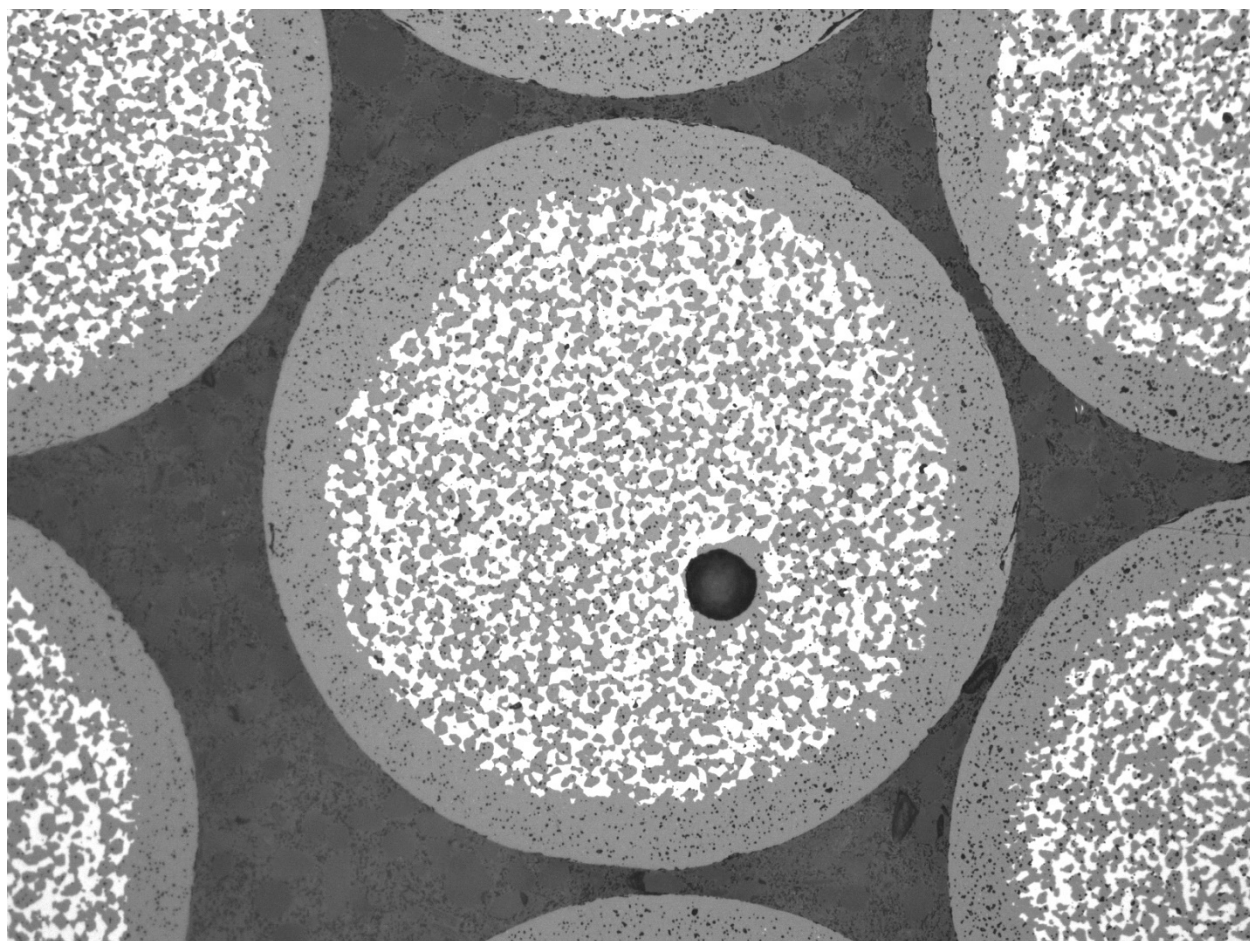
P17030905N202 segmented



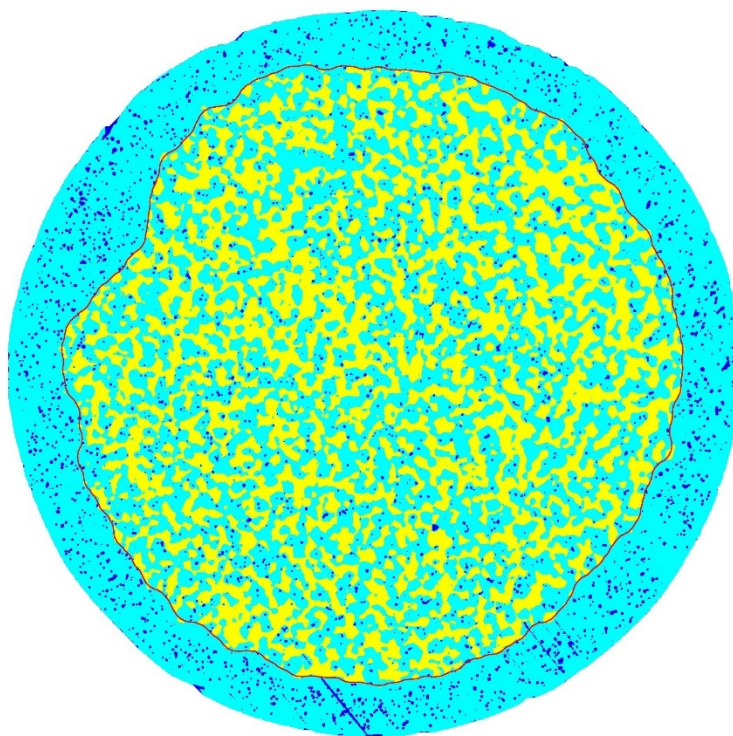
P17030905N202



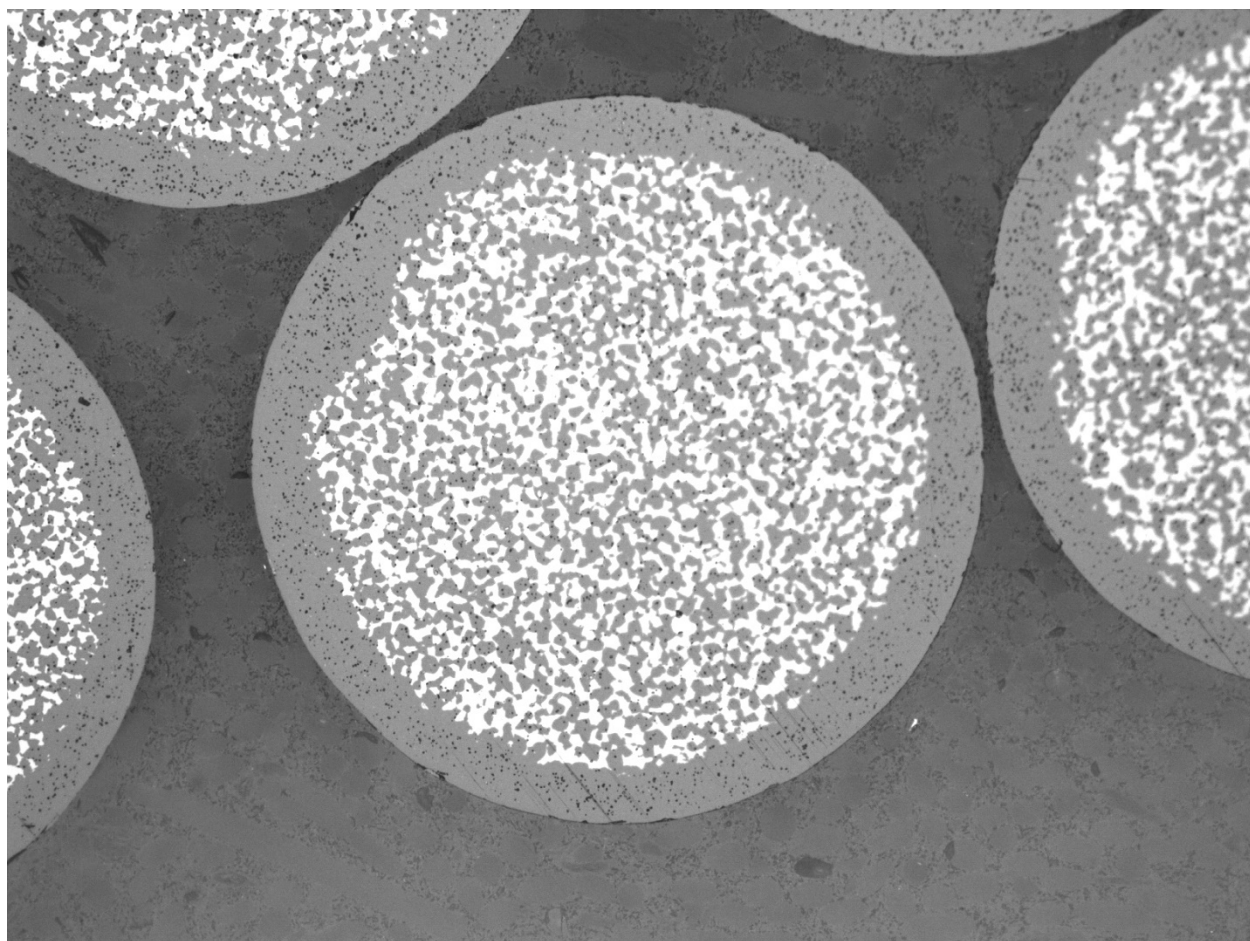
P17030905N203 segmented



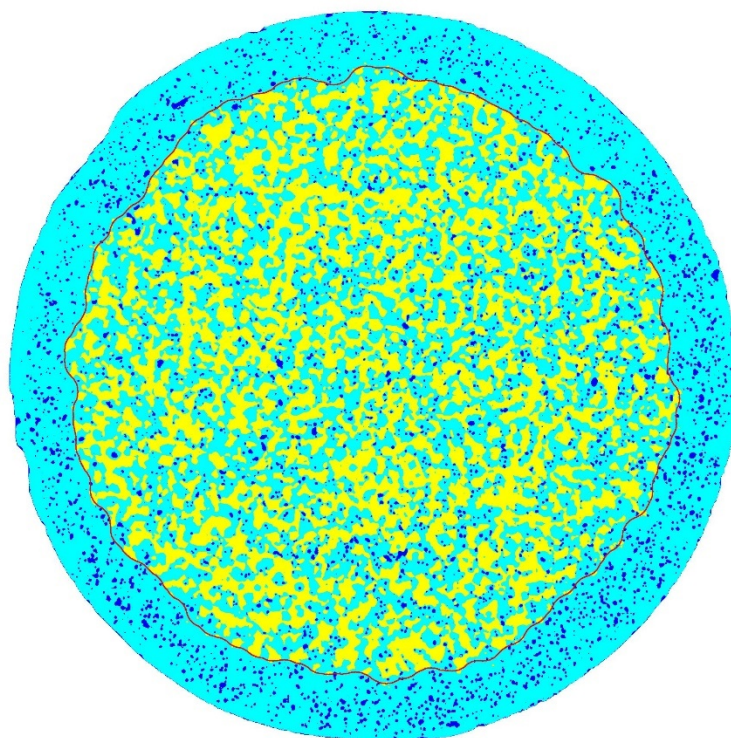
P17030905N203



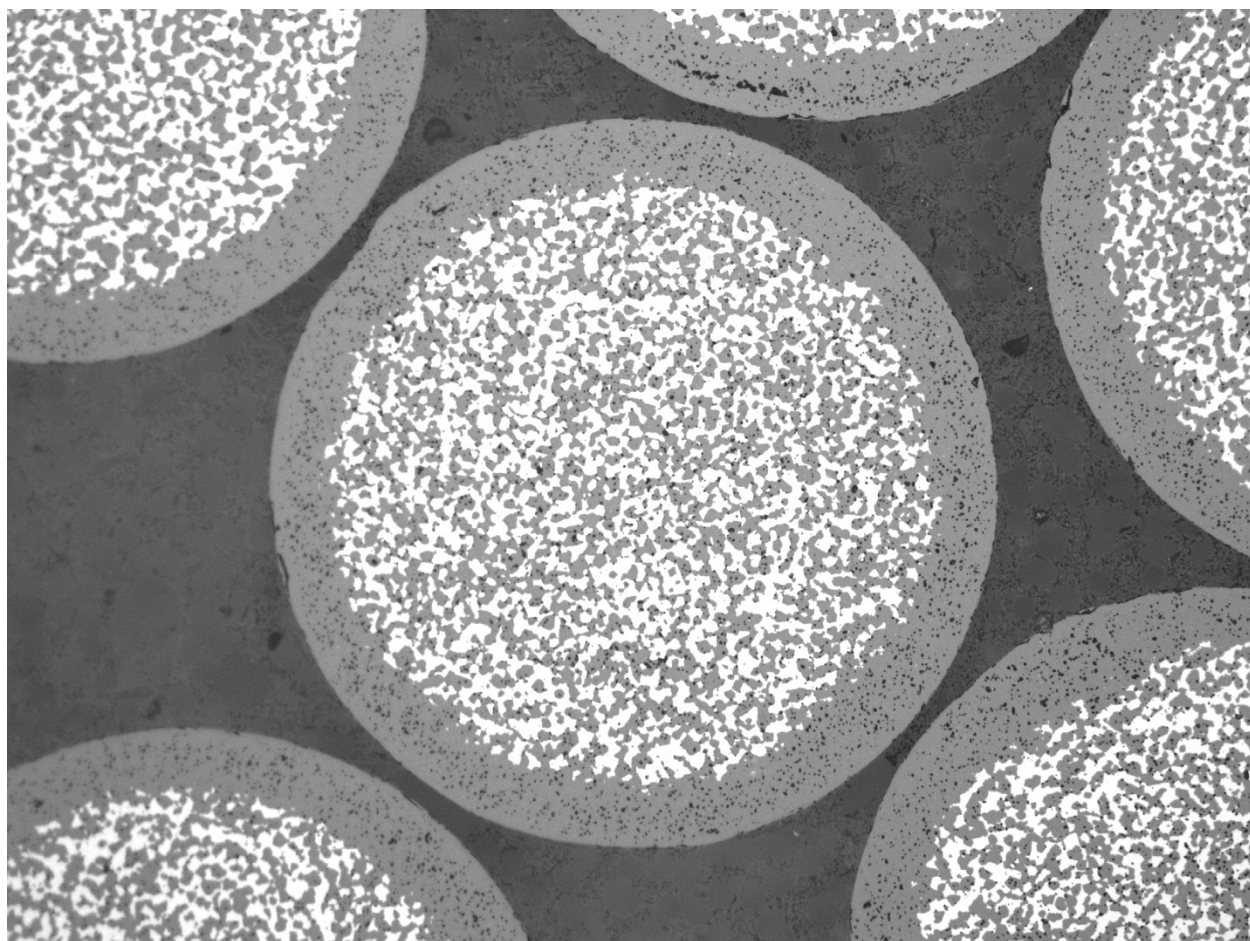
P17030905N204 segmented



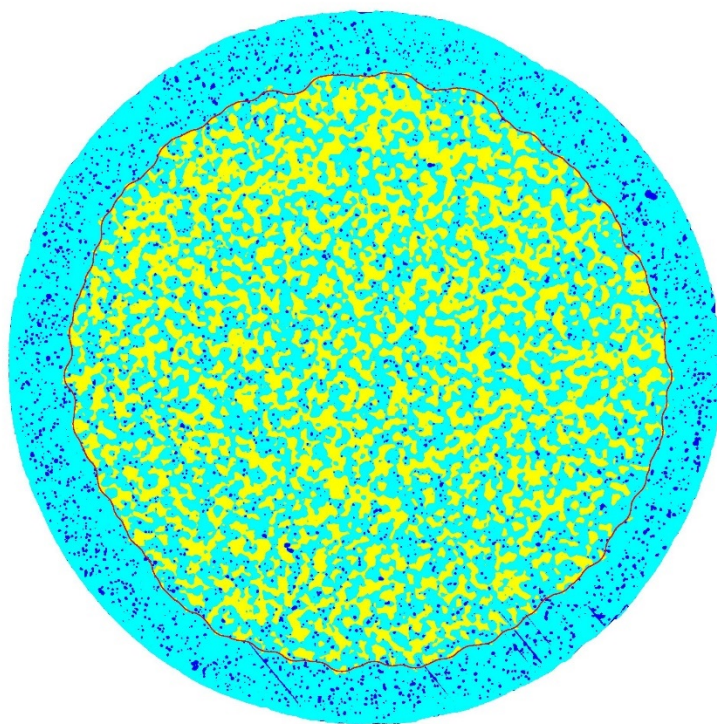
P17030905N204



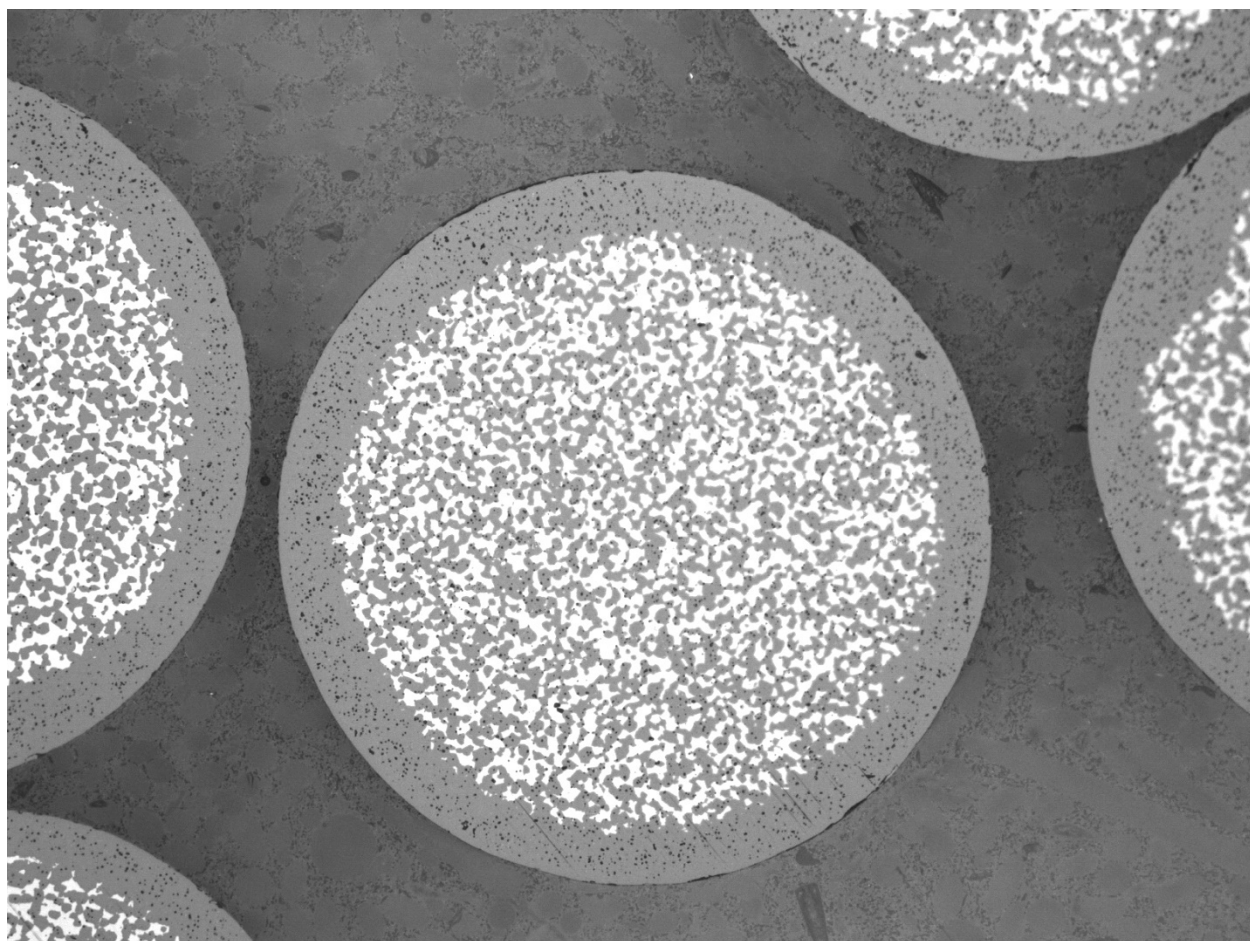
P17030905N205 segmented



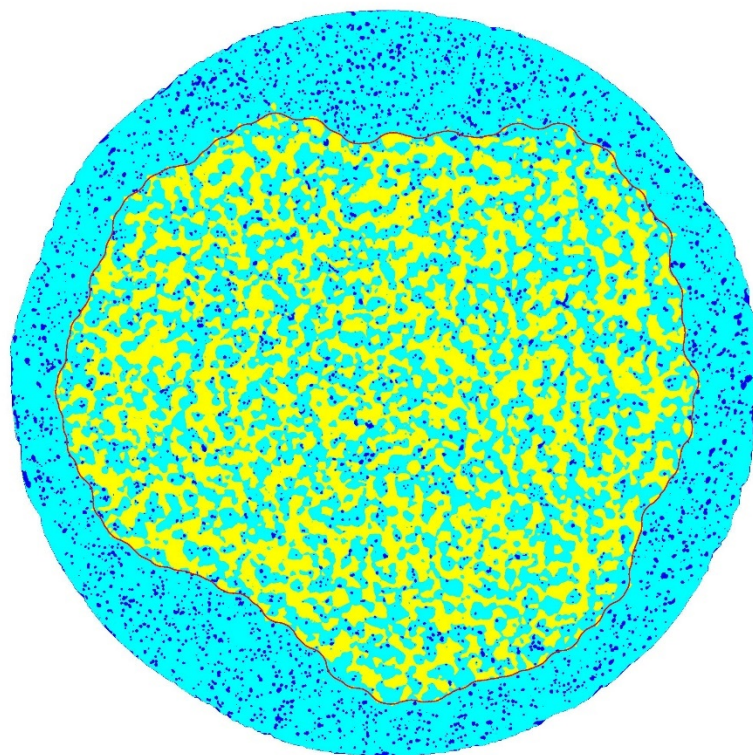
P17030905N205



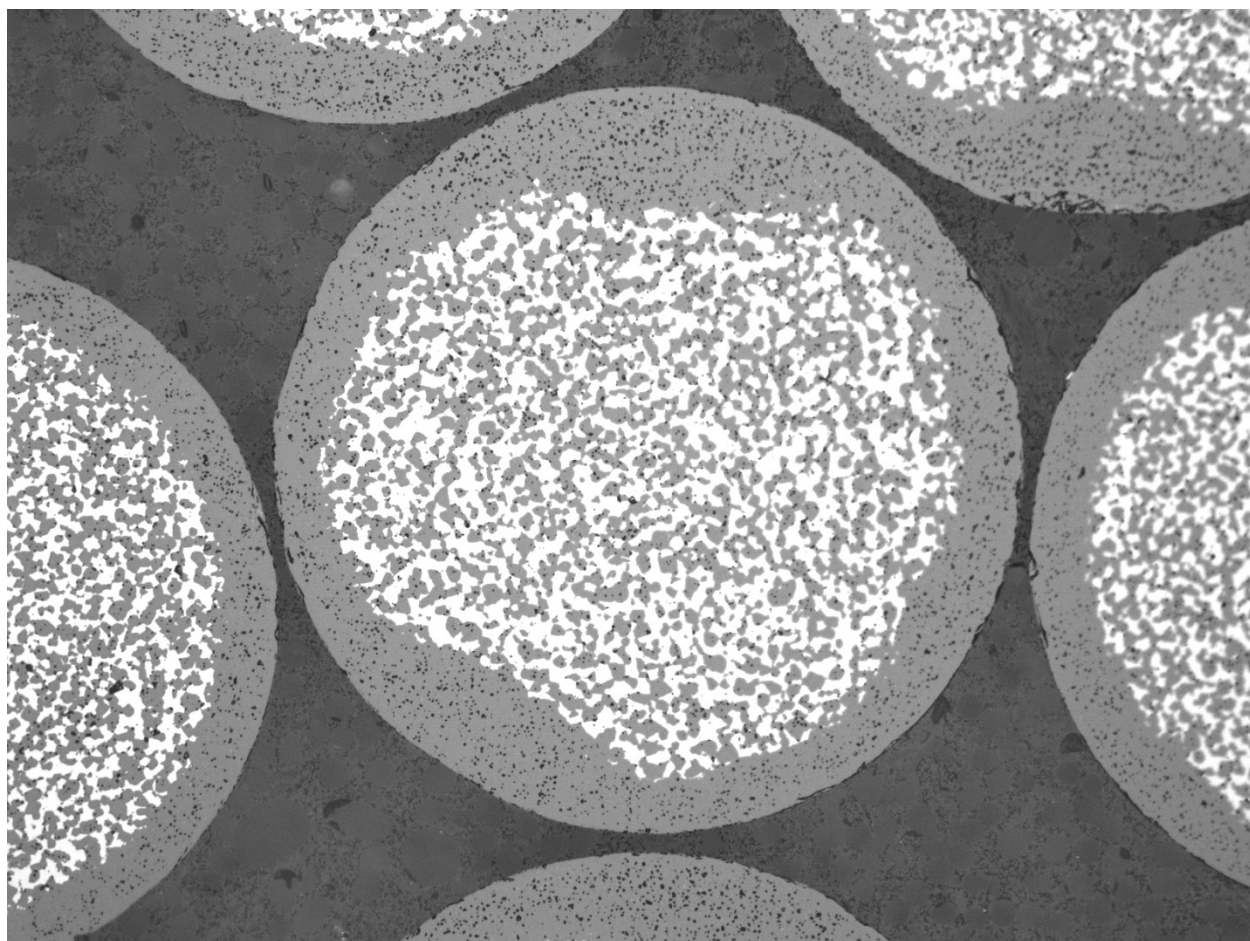
P17030905N207 segmented



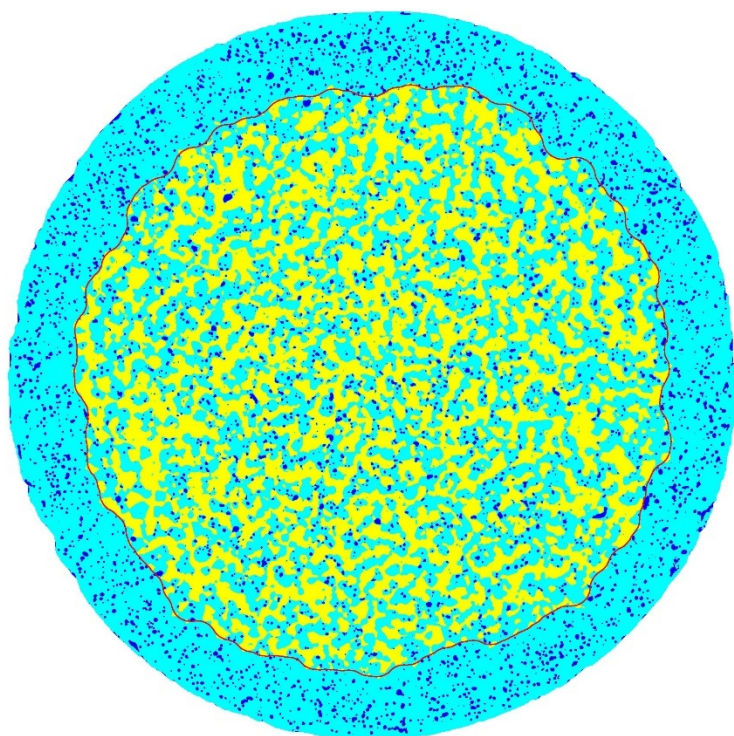
P17030905N207



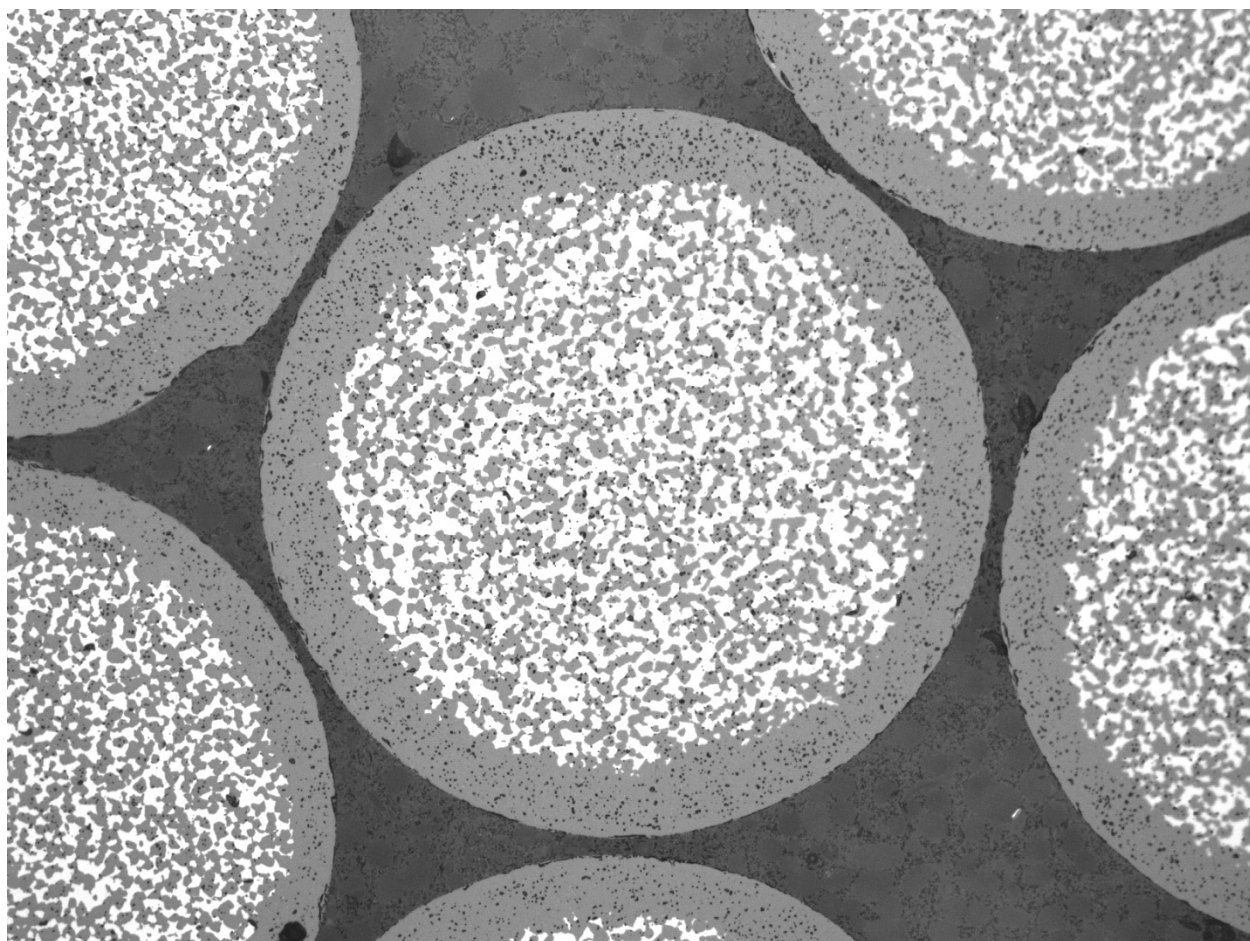
P17030905N208 segmented



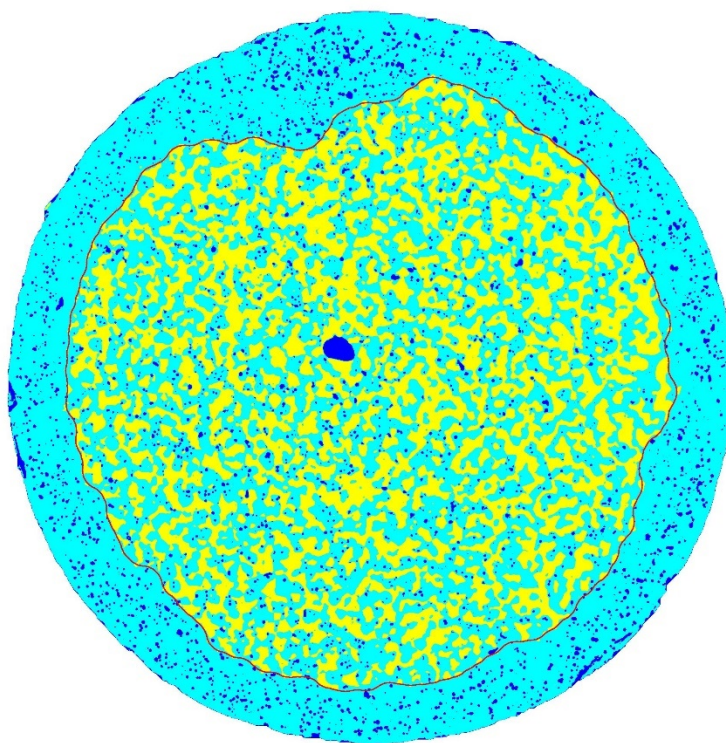
P17030905N208



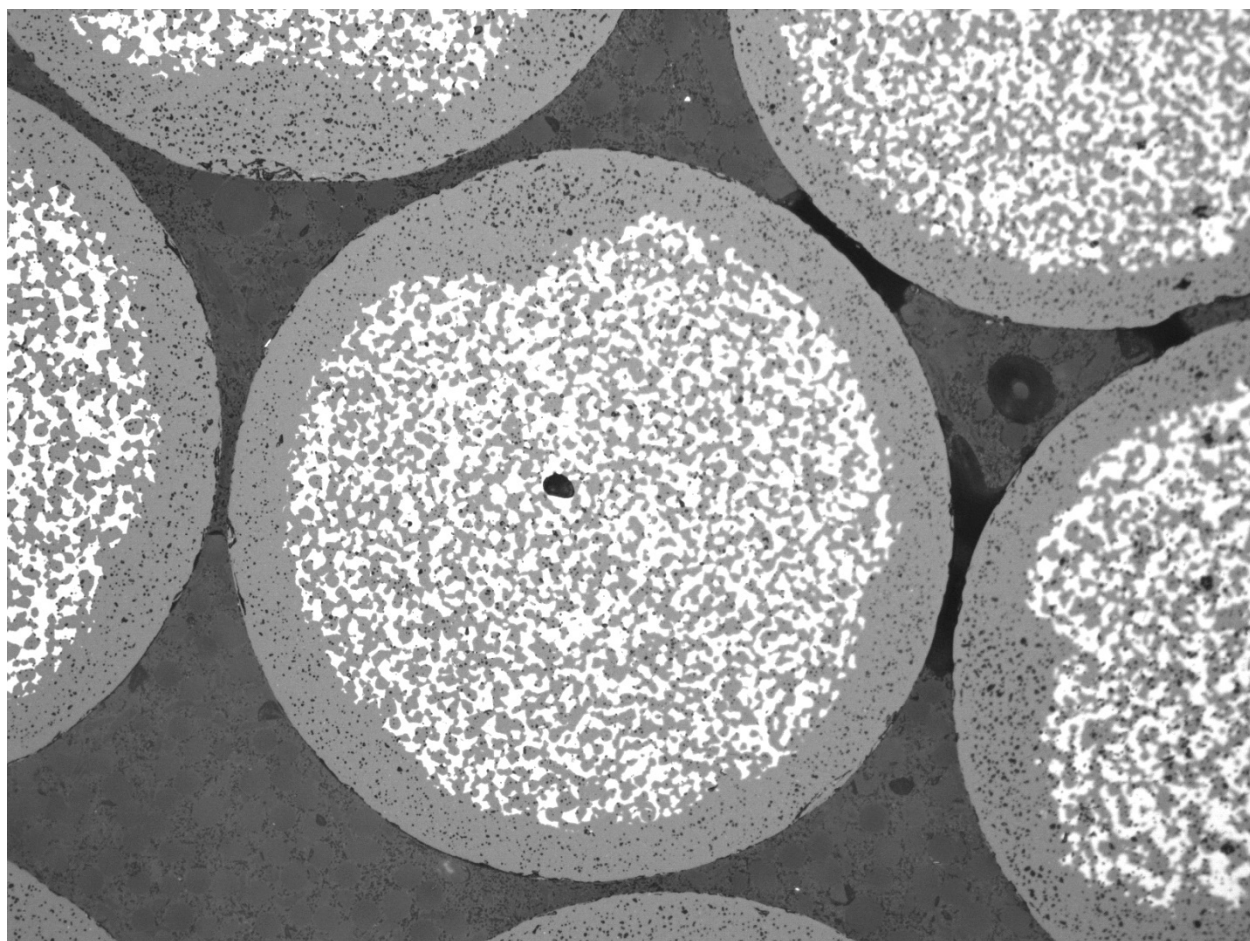
P17030905N209 segmented



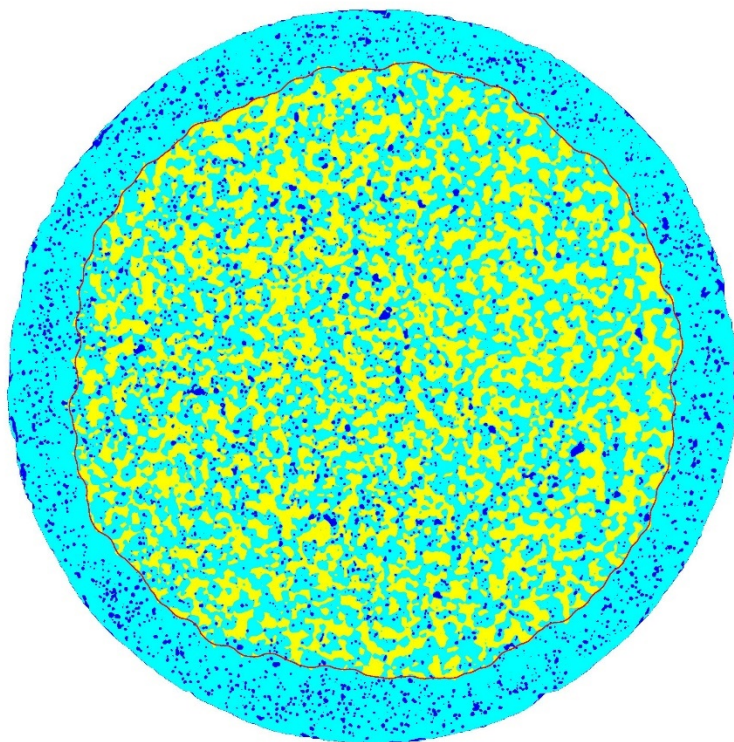
P17030905N209



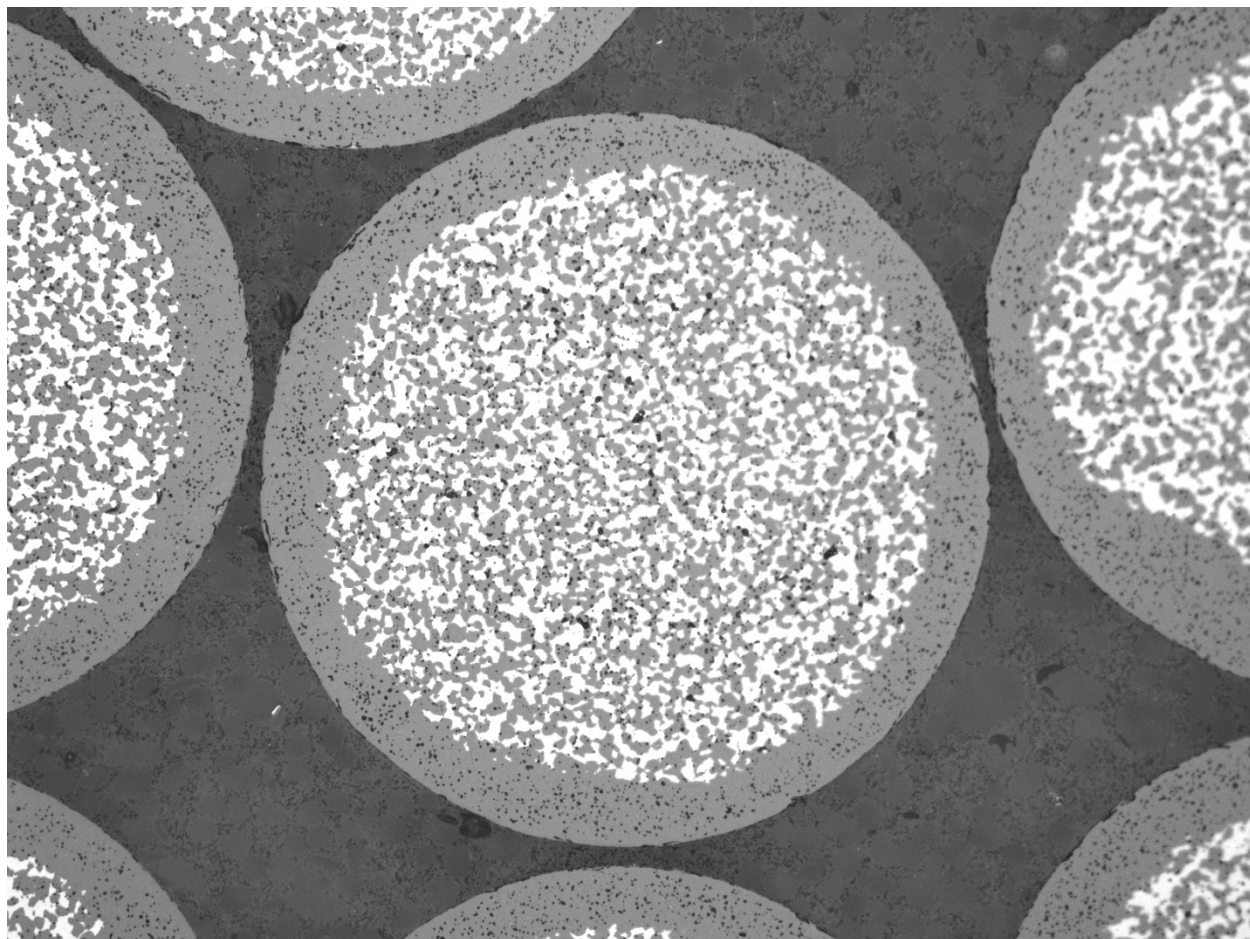
P17030905N211 segmented



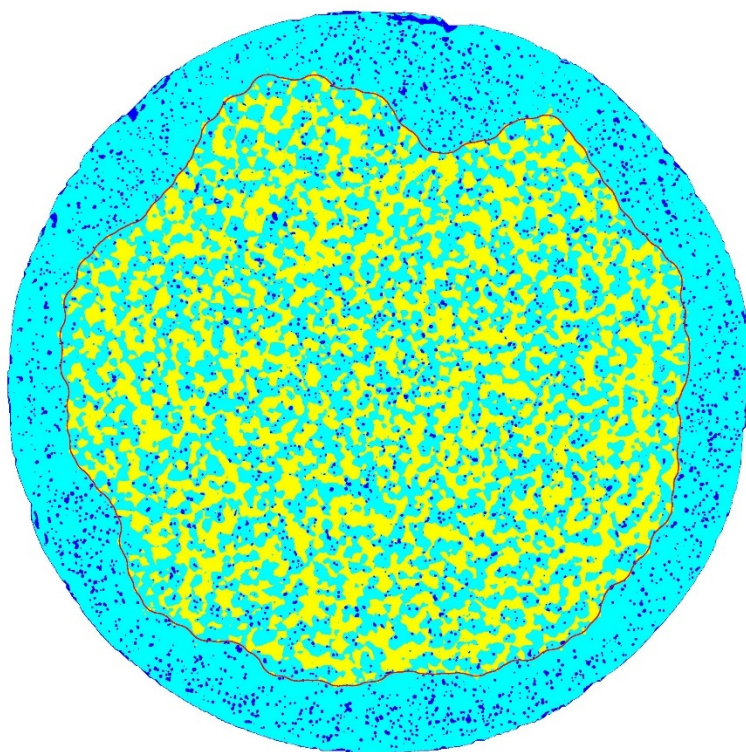
P17030905N211



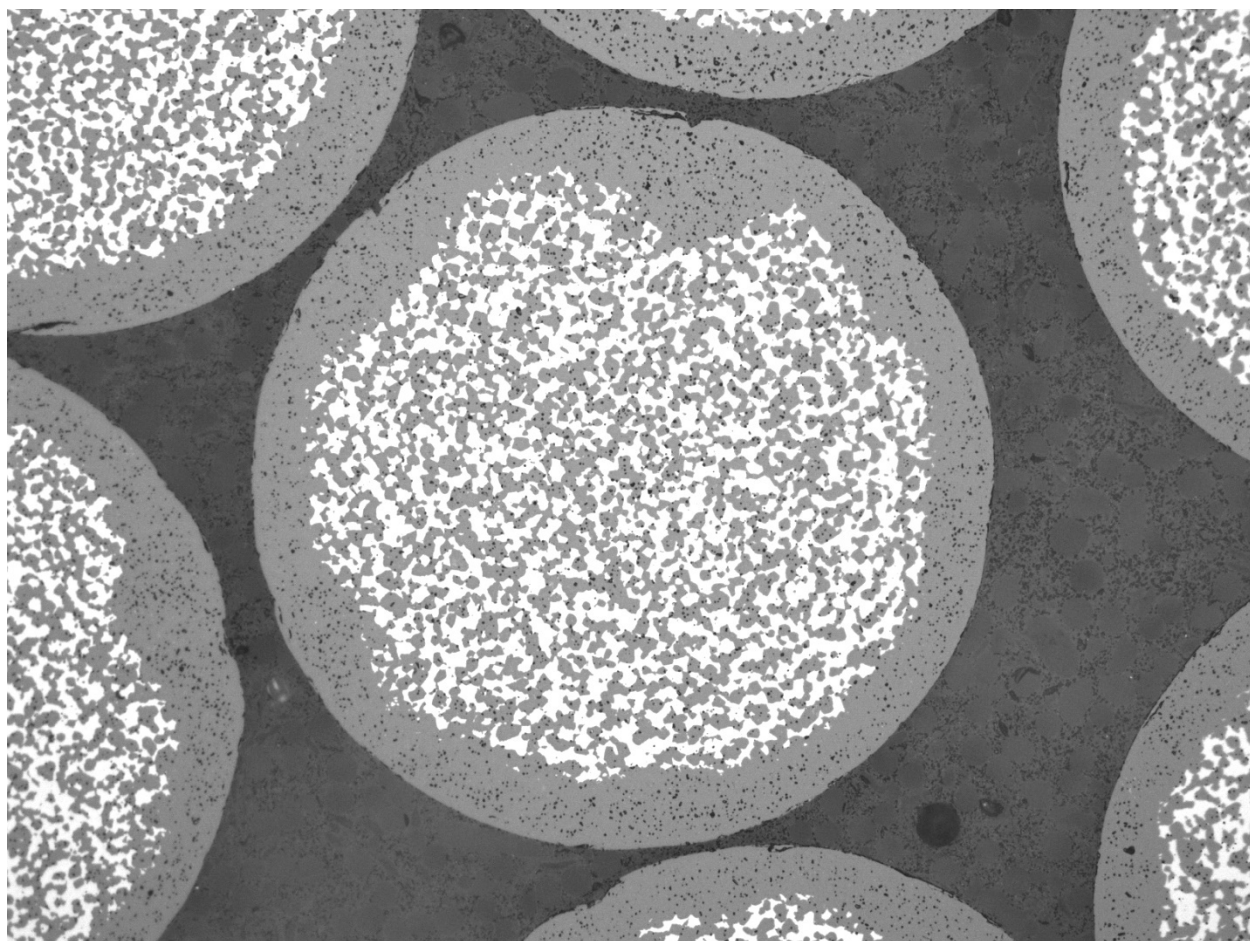
P17030905N212 segmented



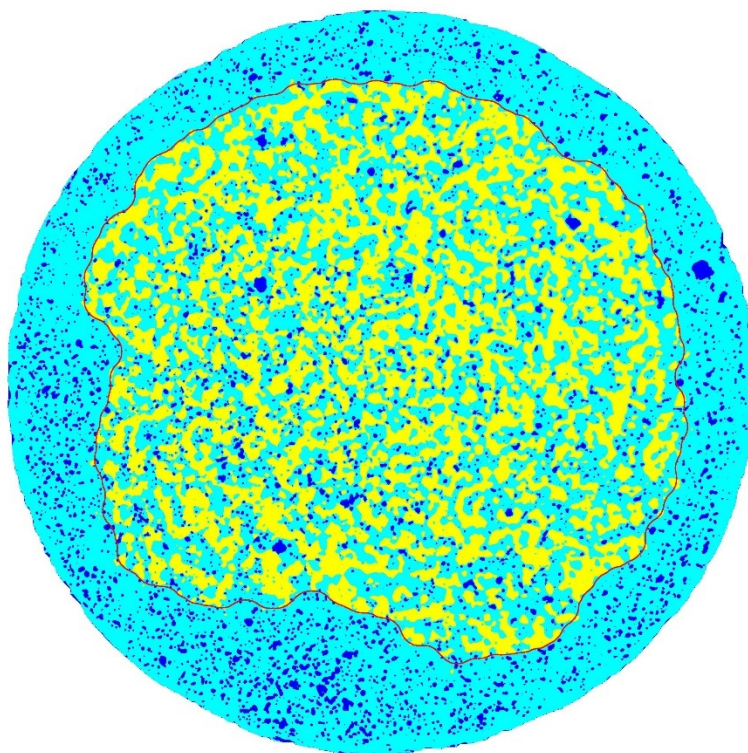
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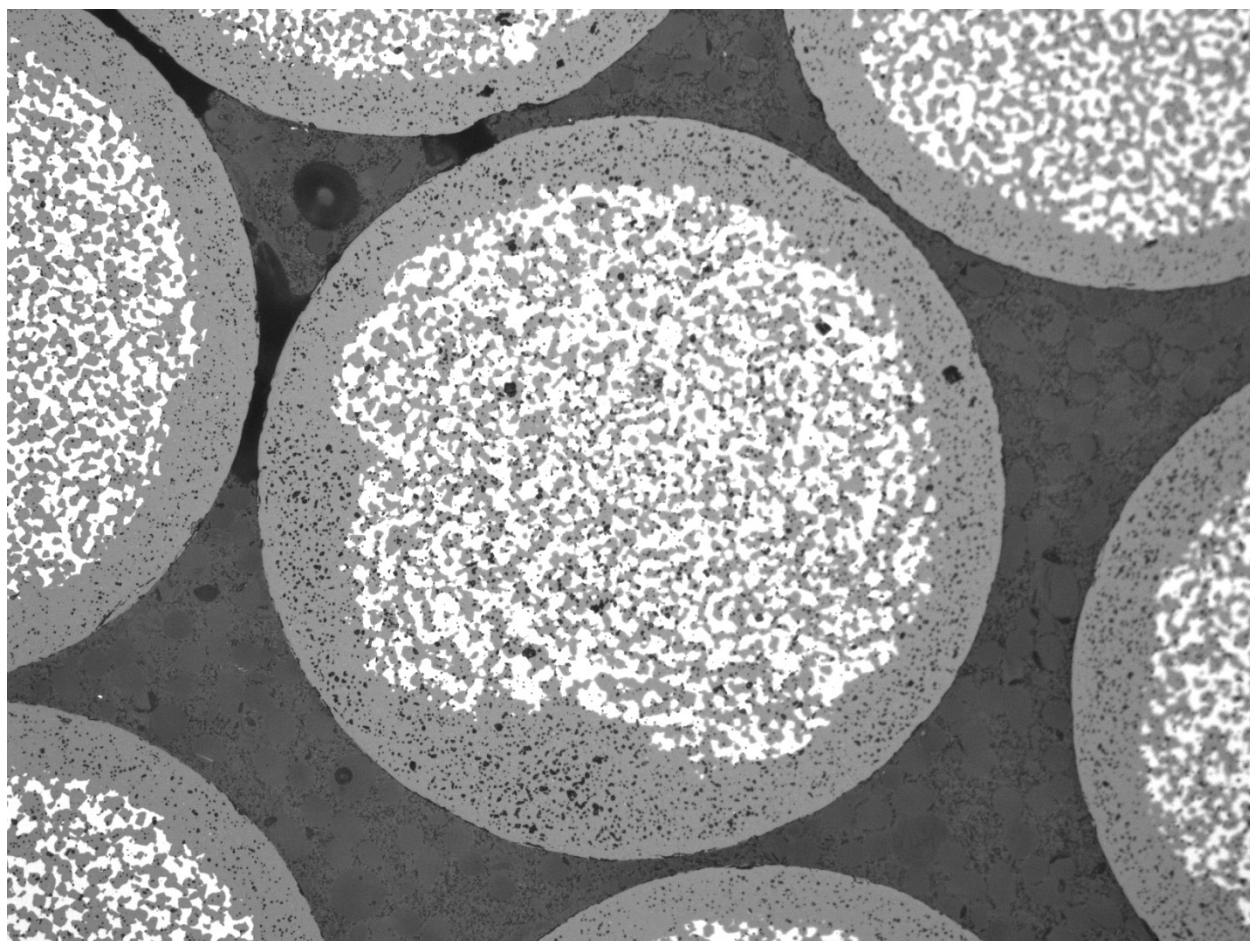
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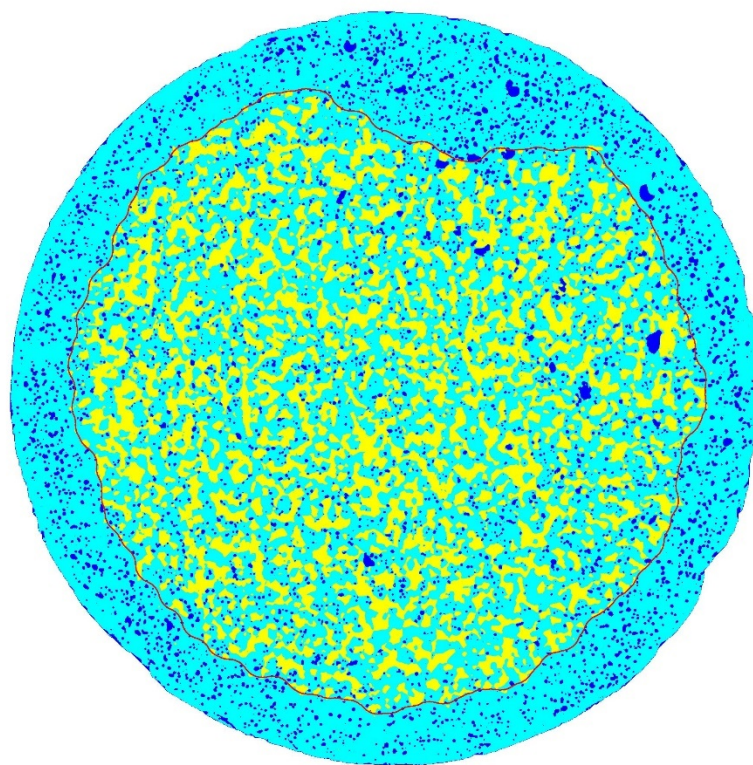
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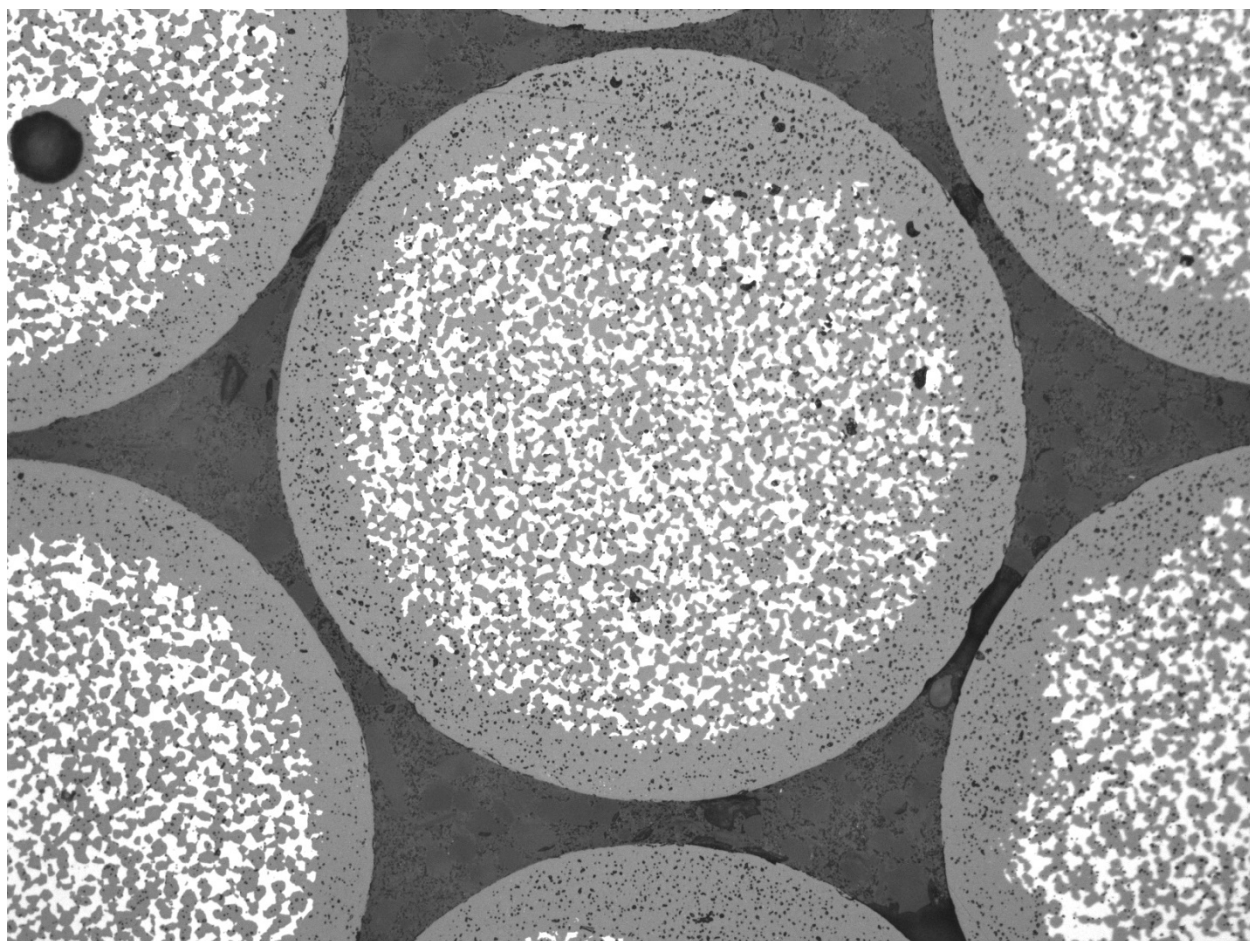
P17030905N214 segmented



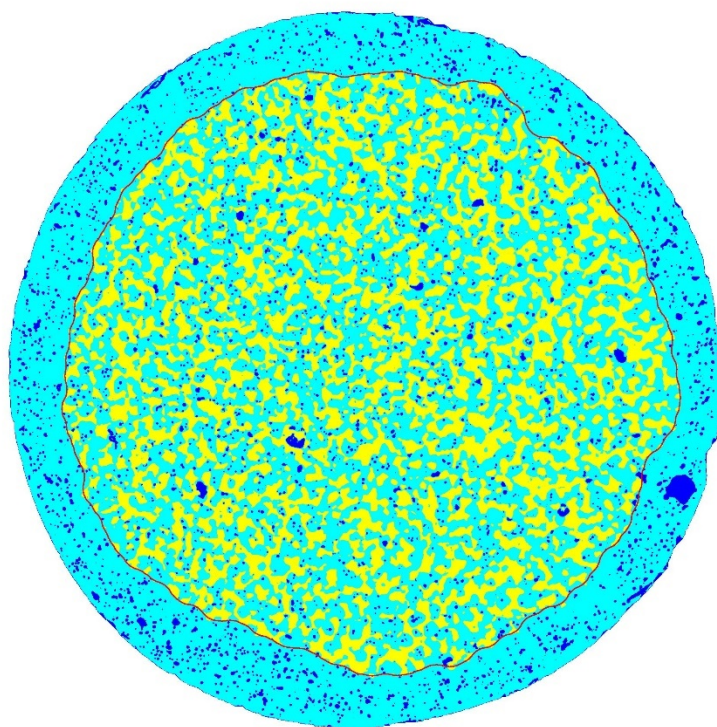
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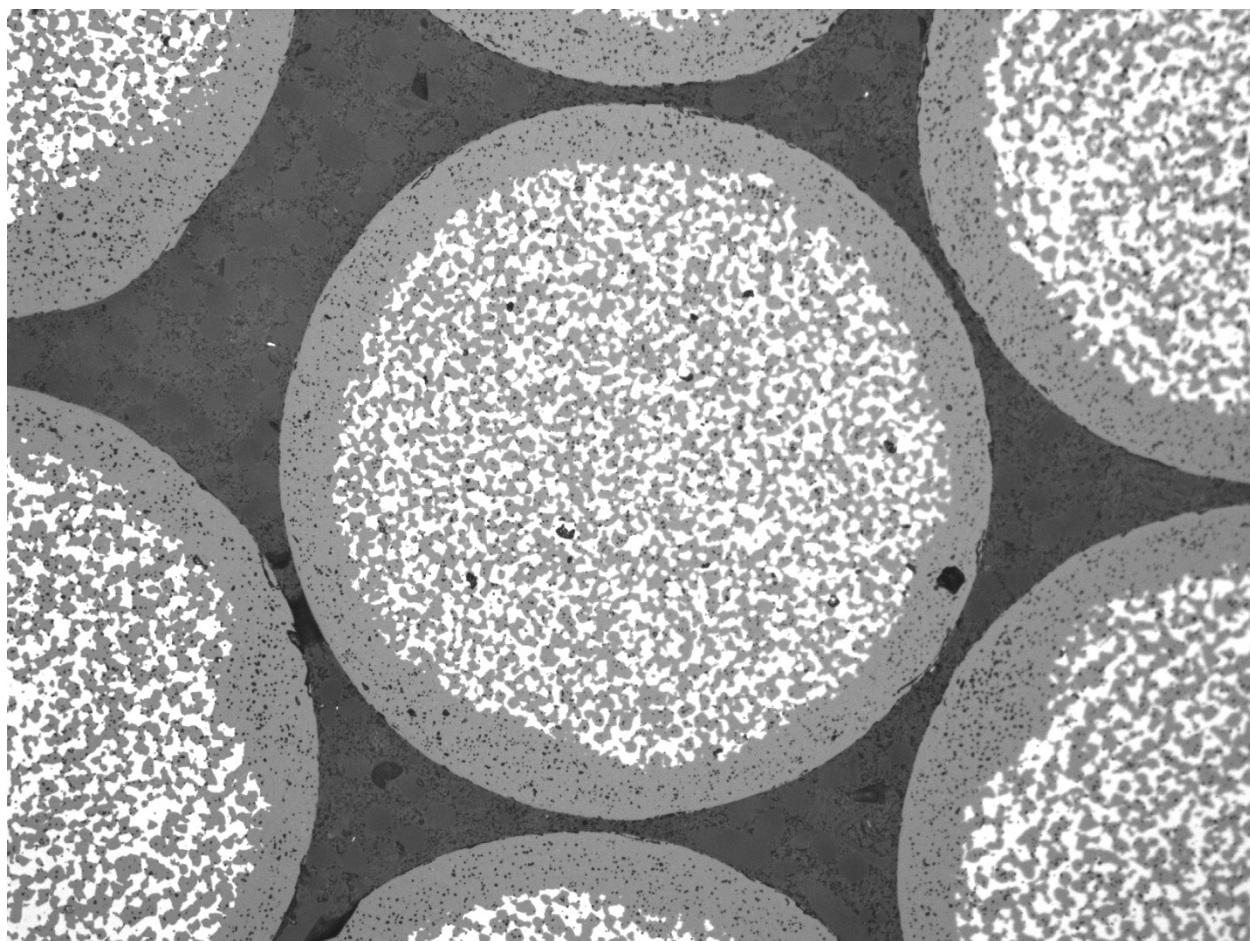
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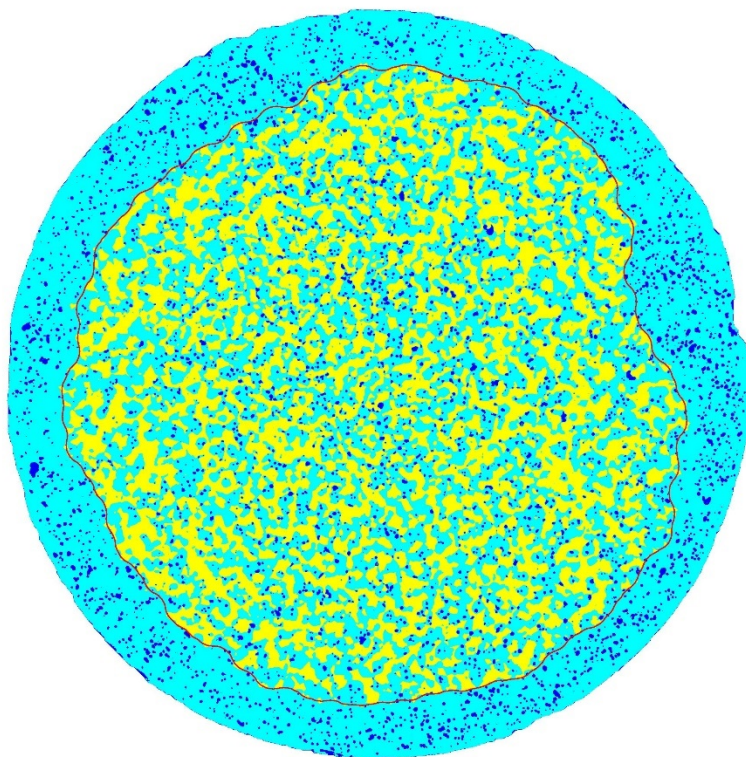
P17030905N215



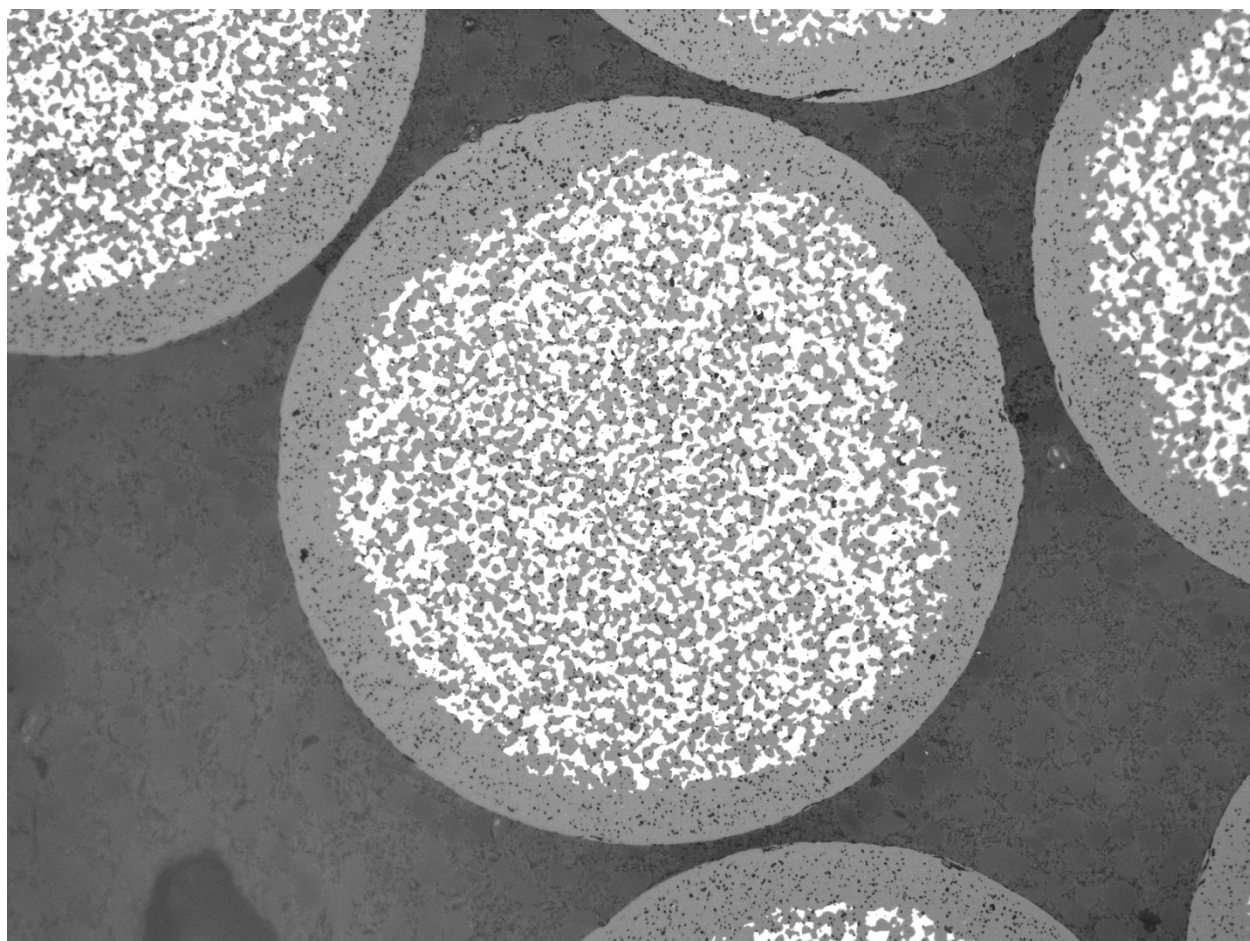
P17030905N217 segmented



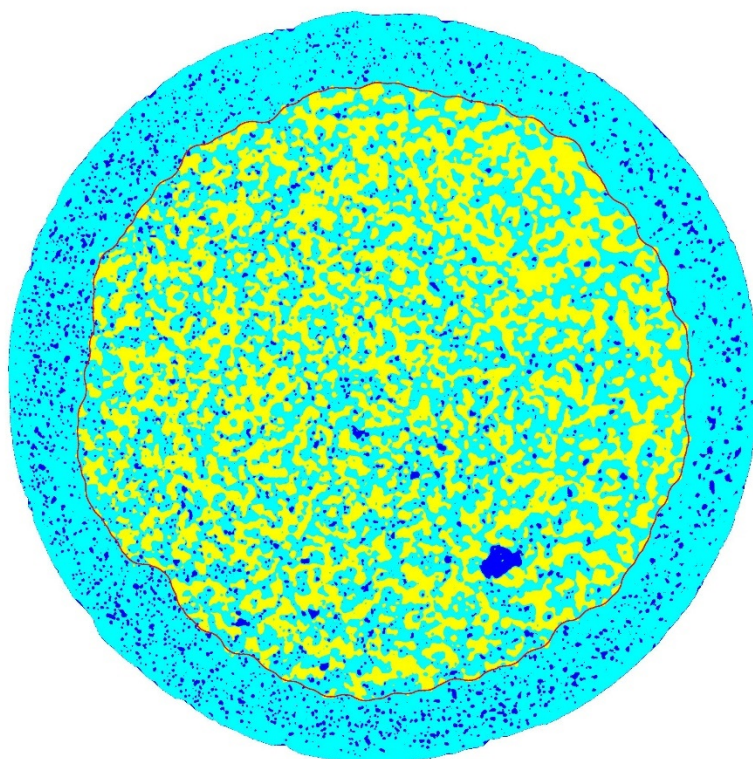
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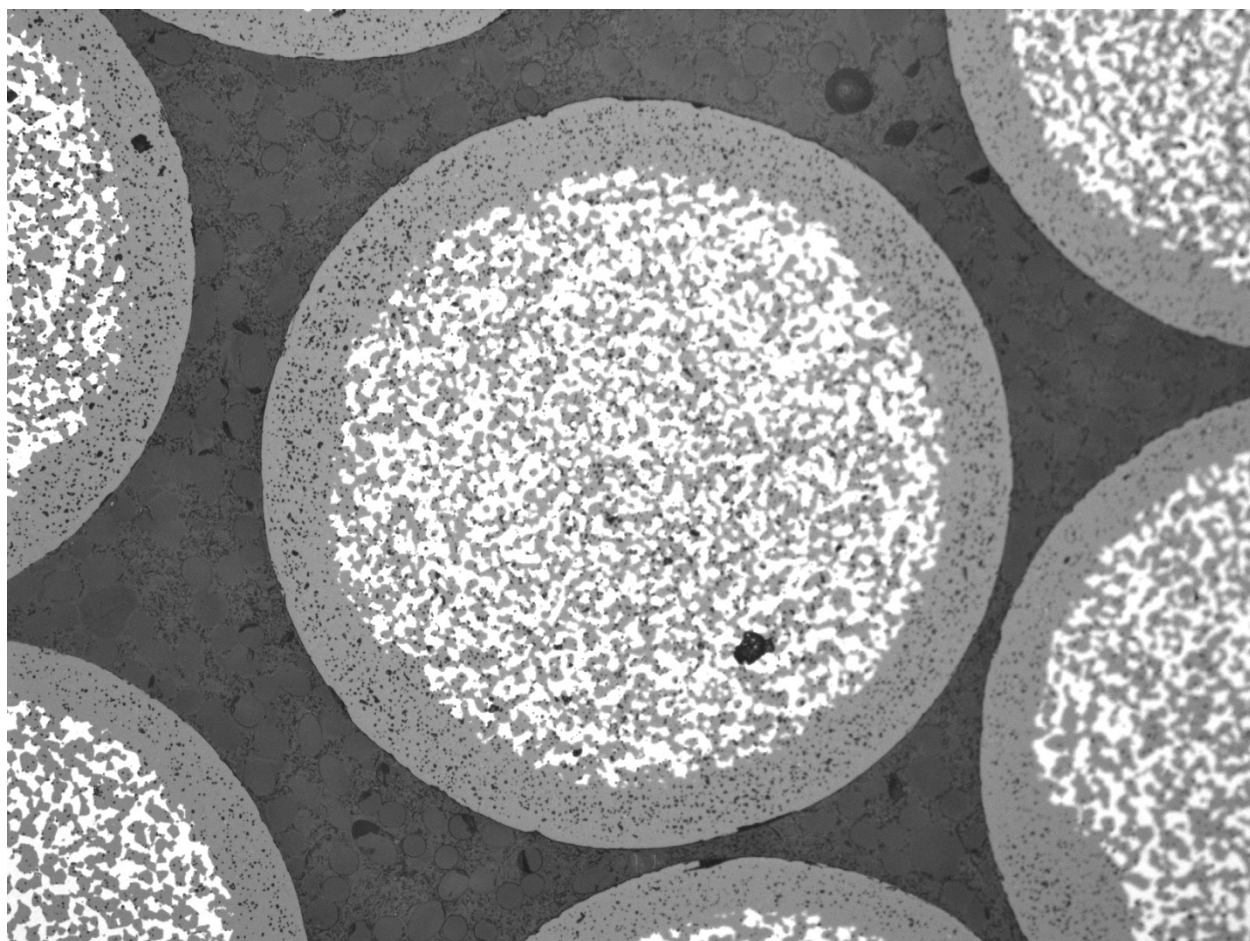
P17030905N218 segmented



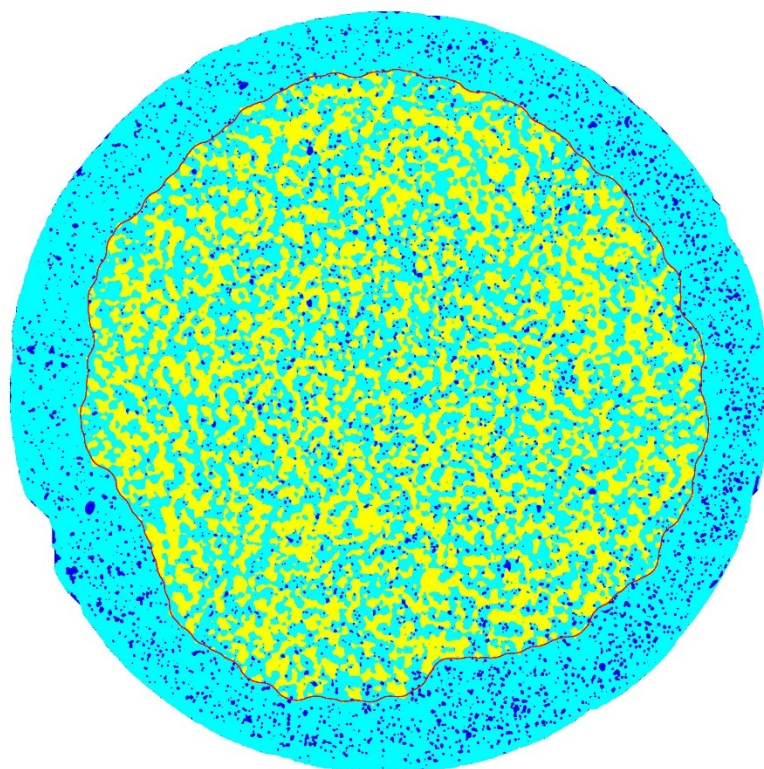
P17030905N218



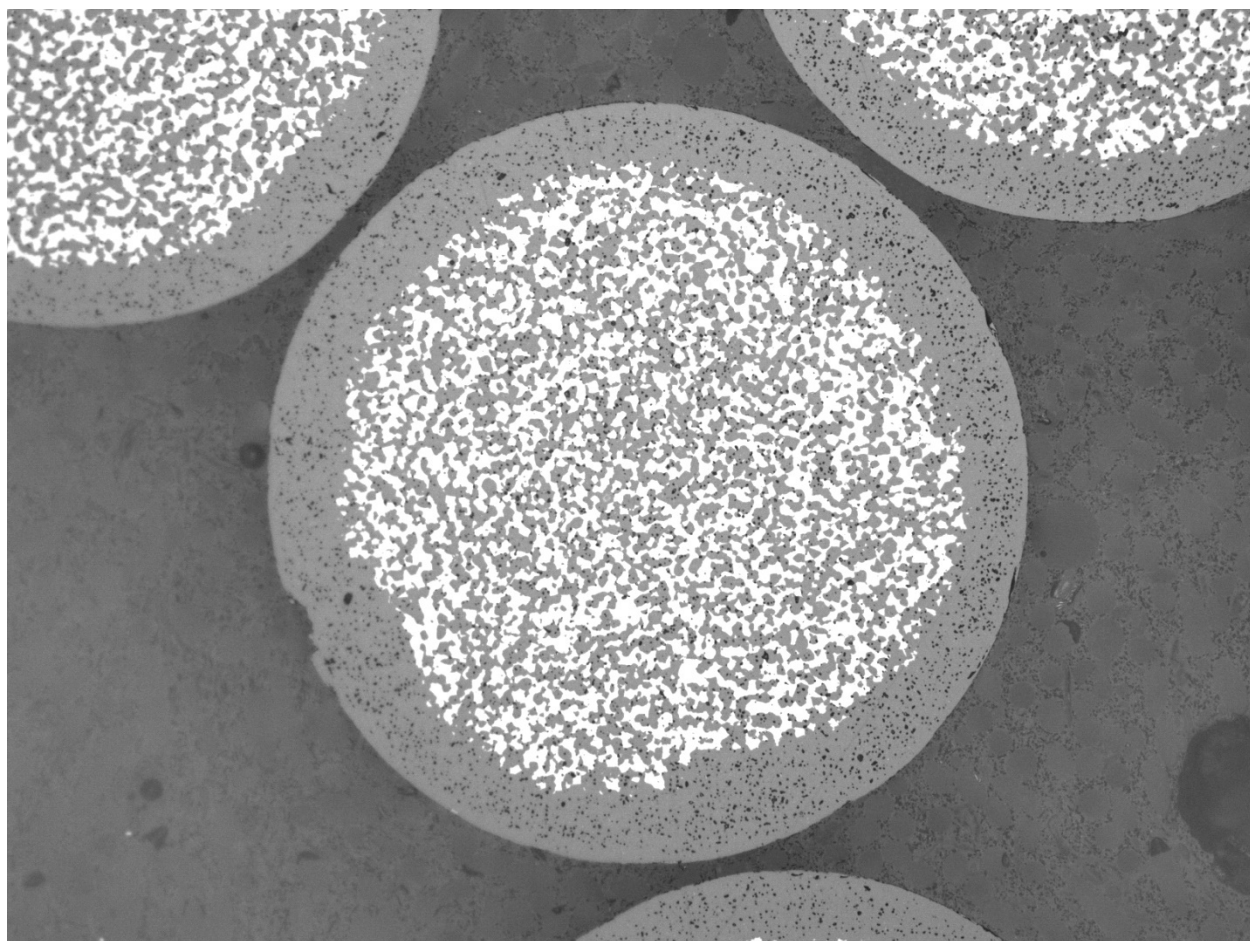
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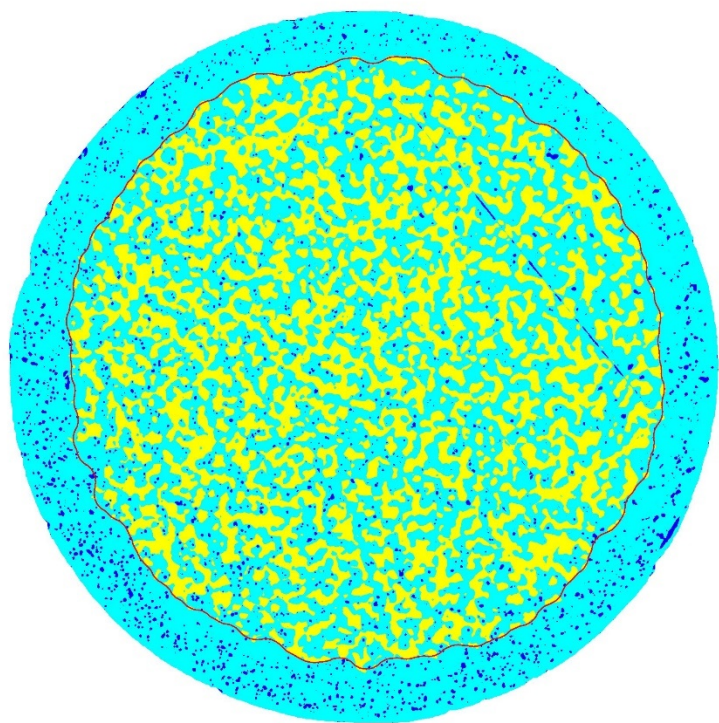
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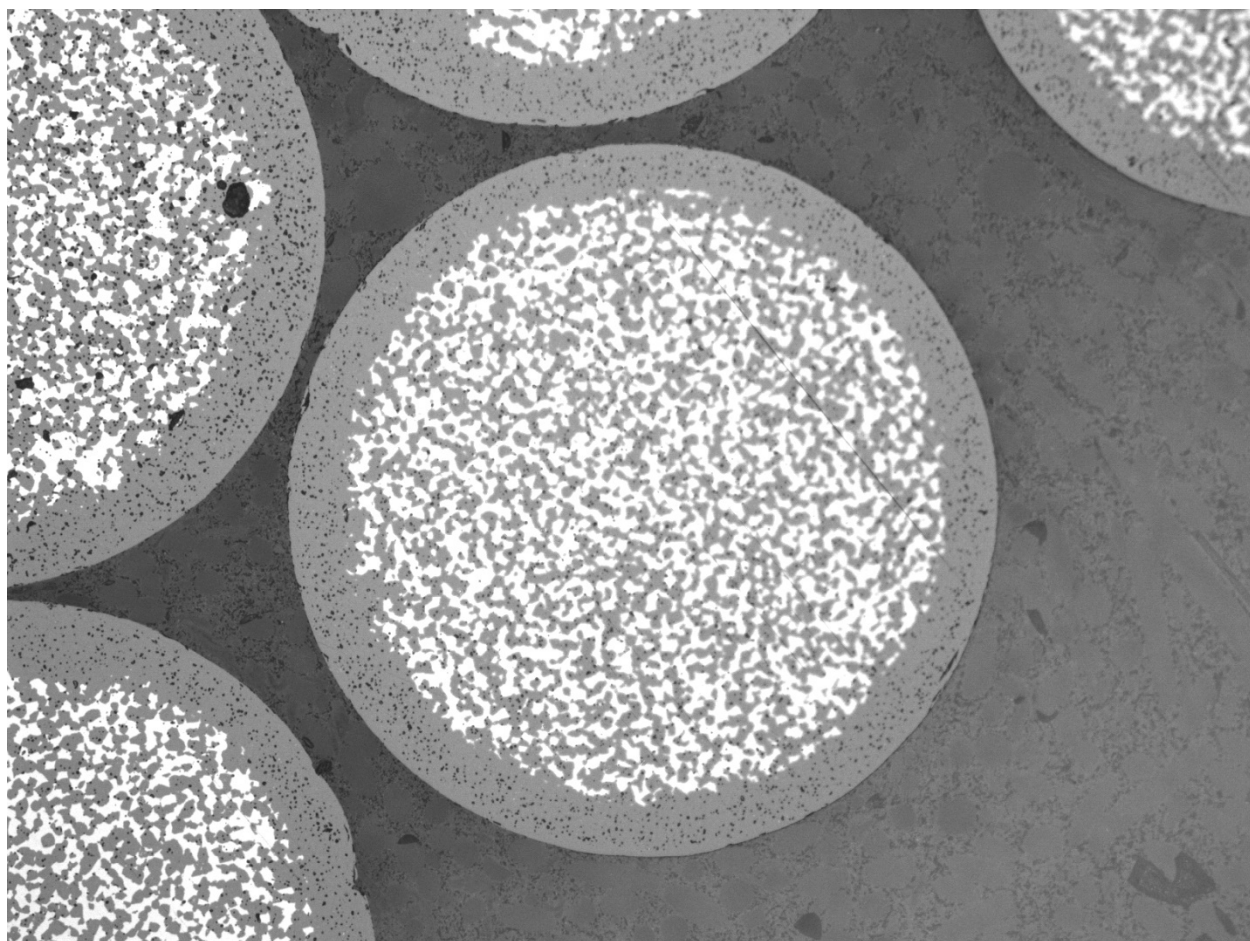
P17030905N220 segmented



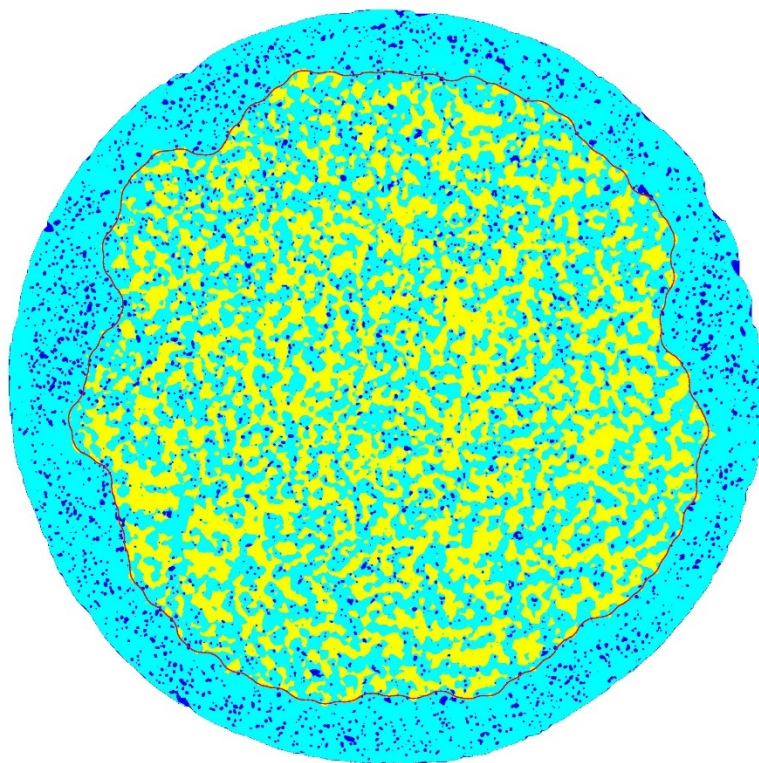
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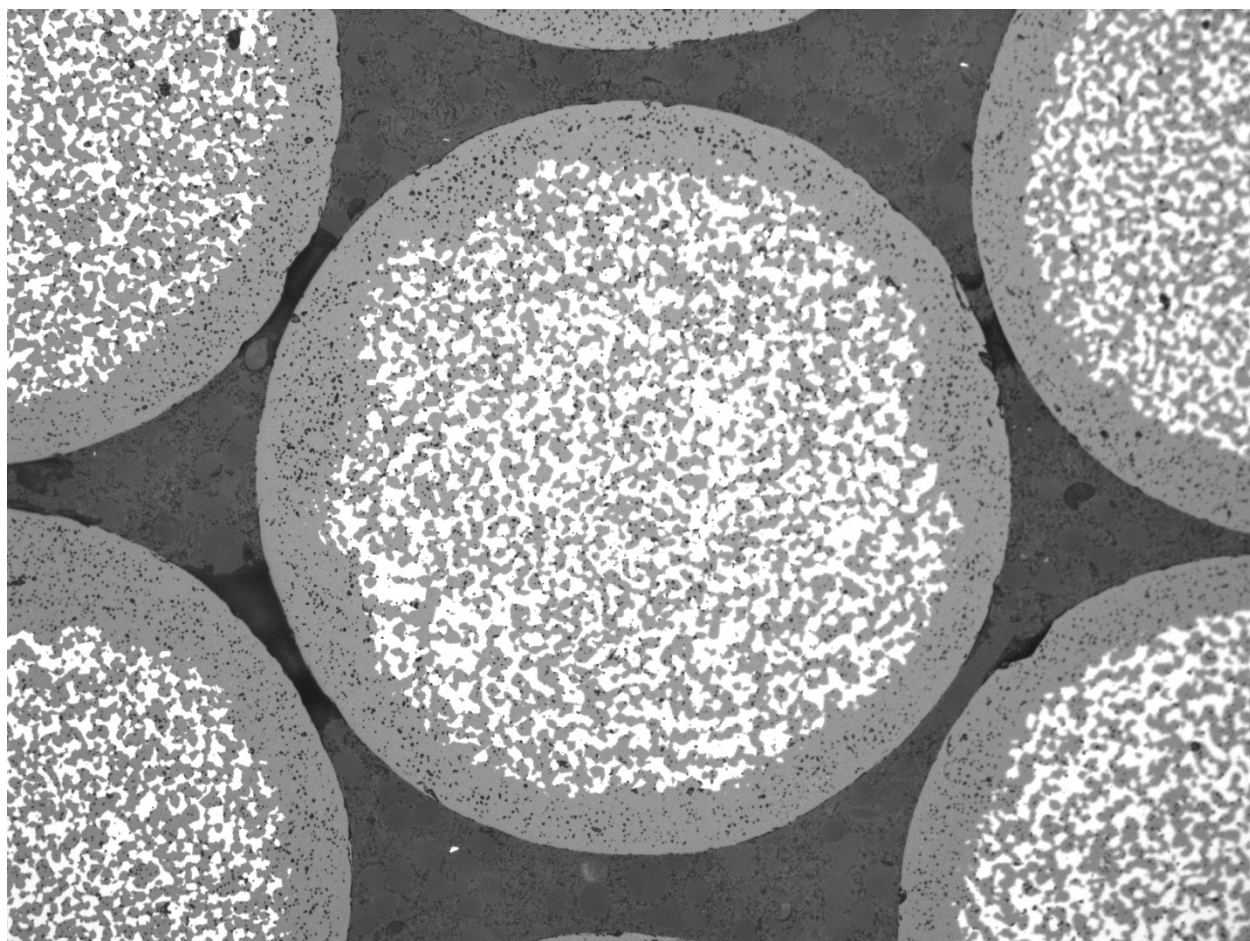
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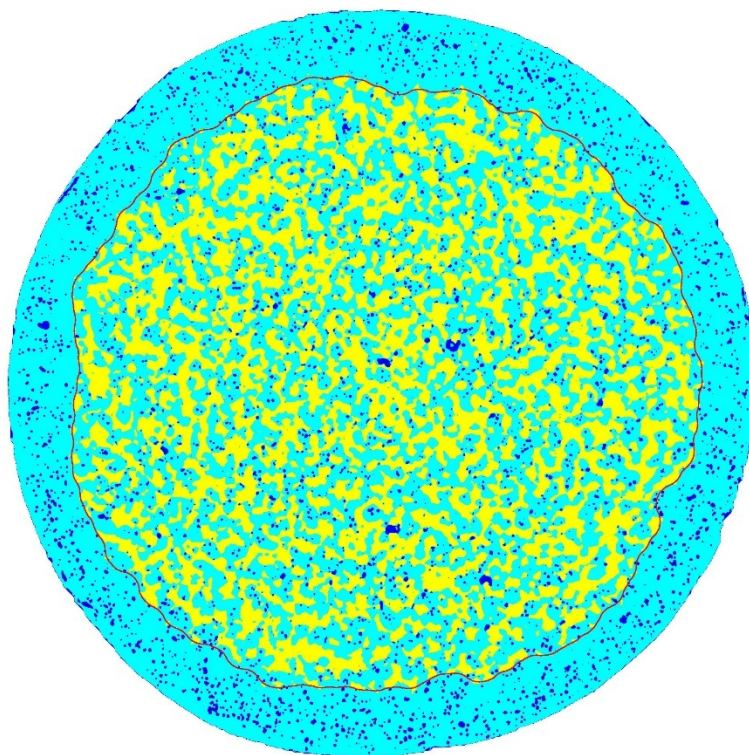
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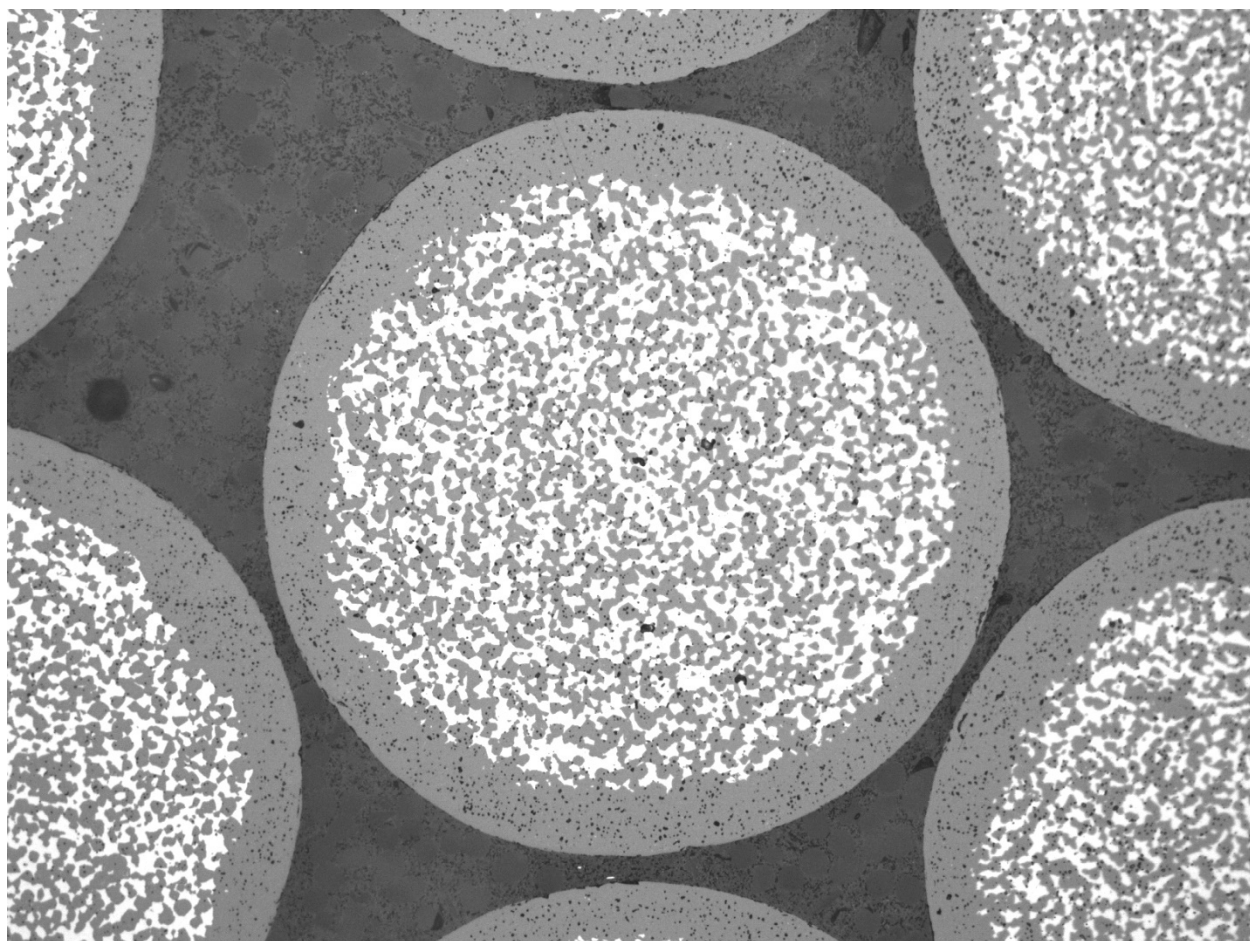
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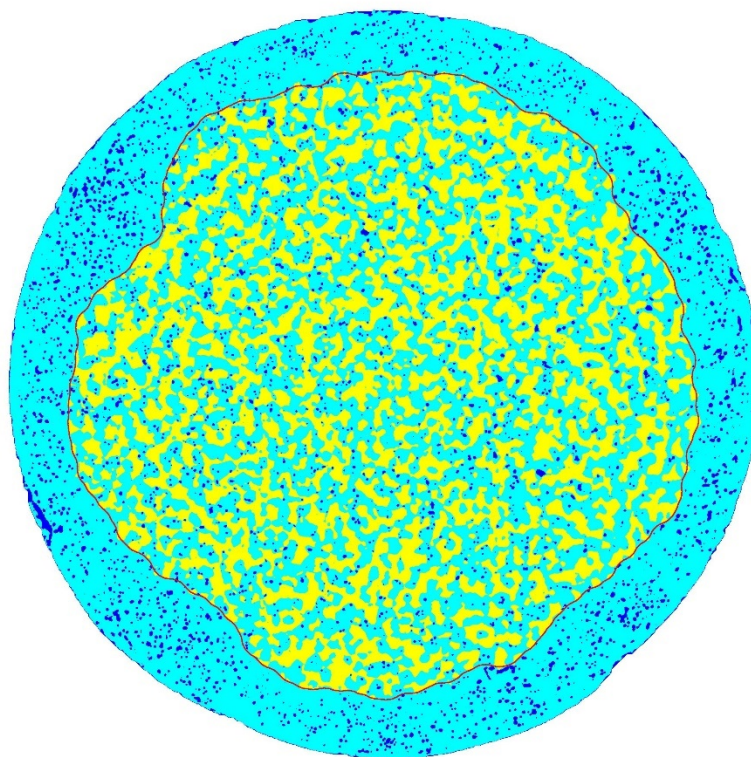
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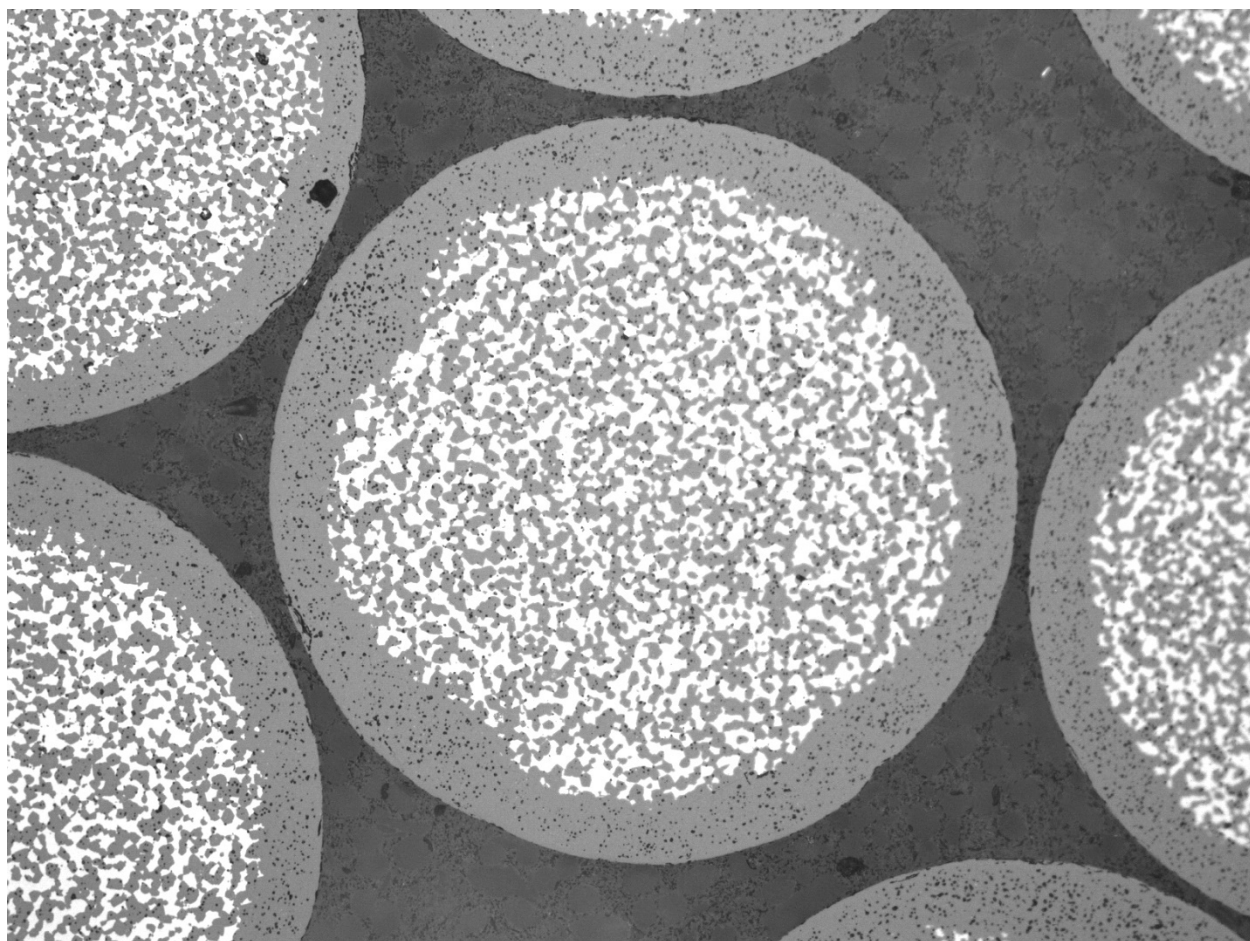
P17030905N223 segmented



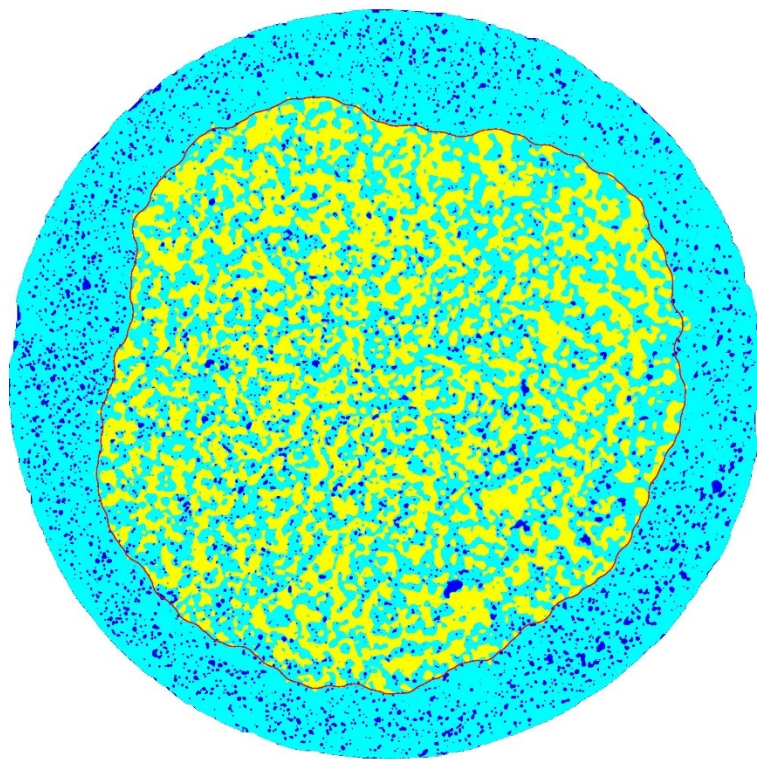
P17030905N223



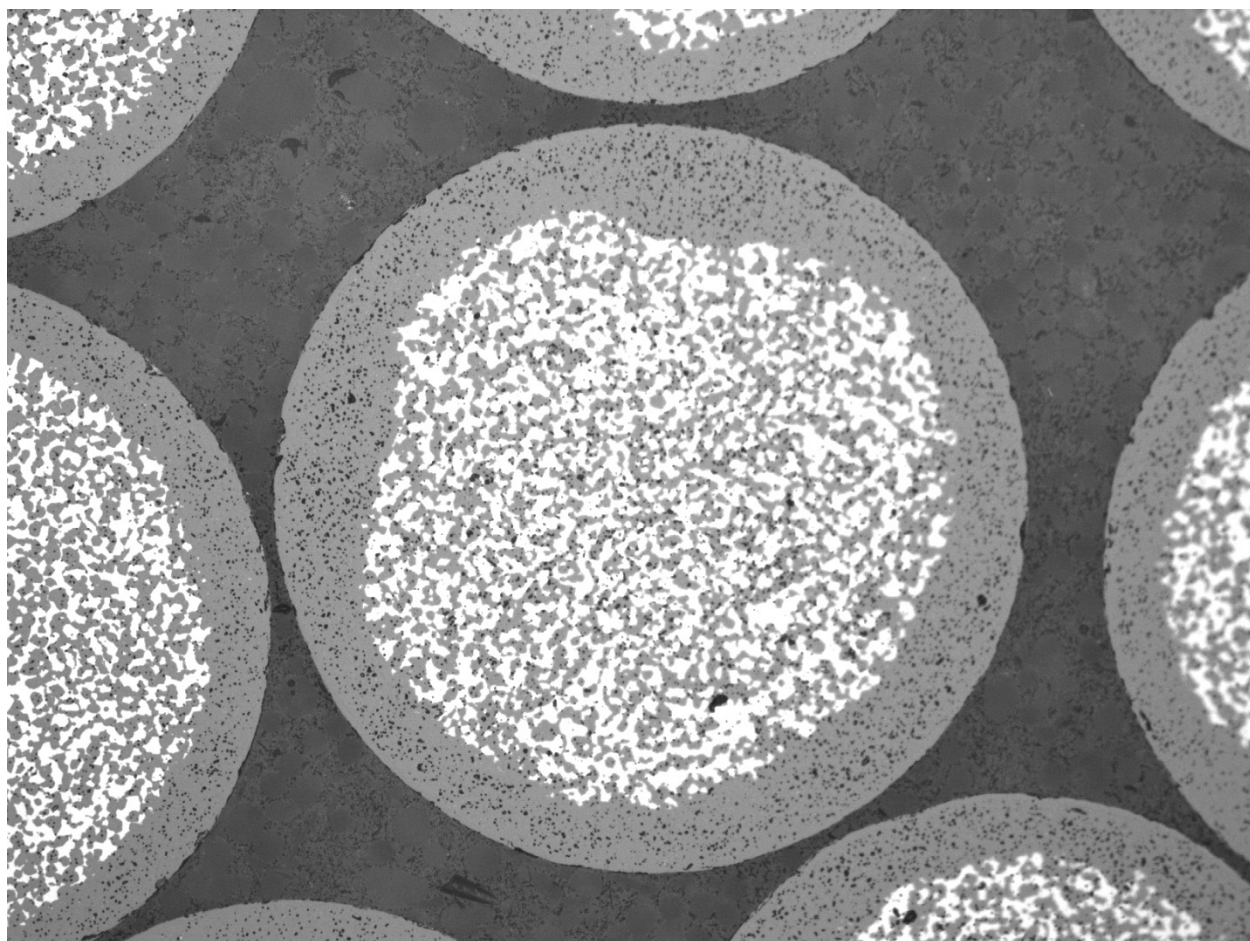
P17030905N225 segmented



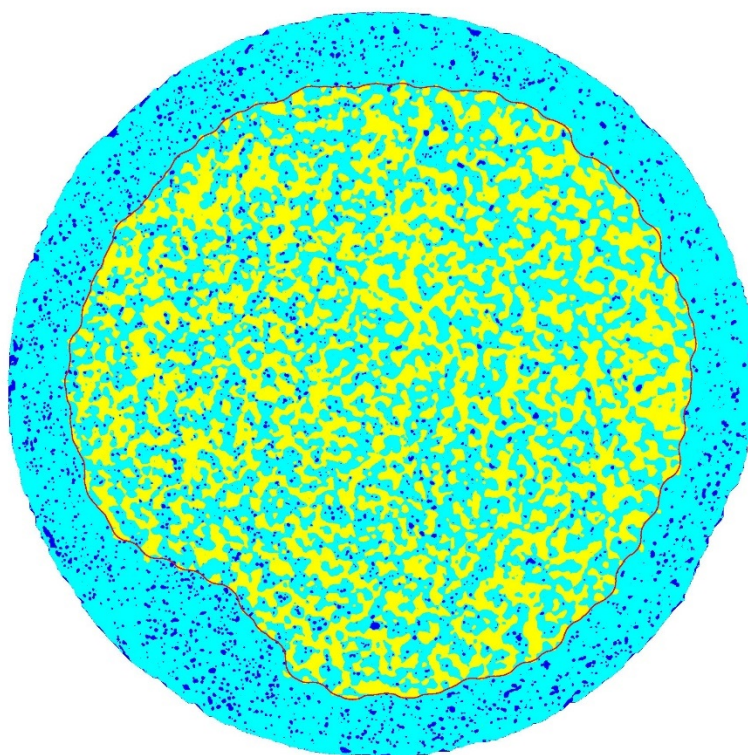
P17030905N225



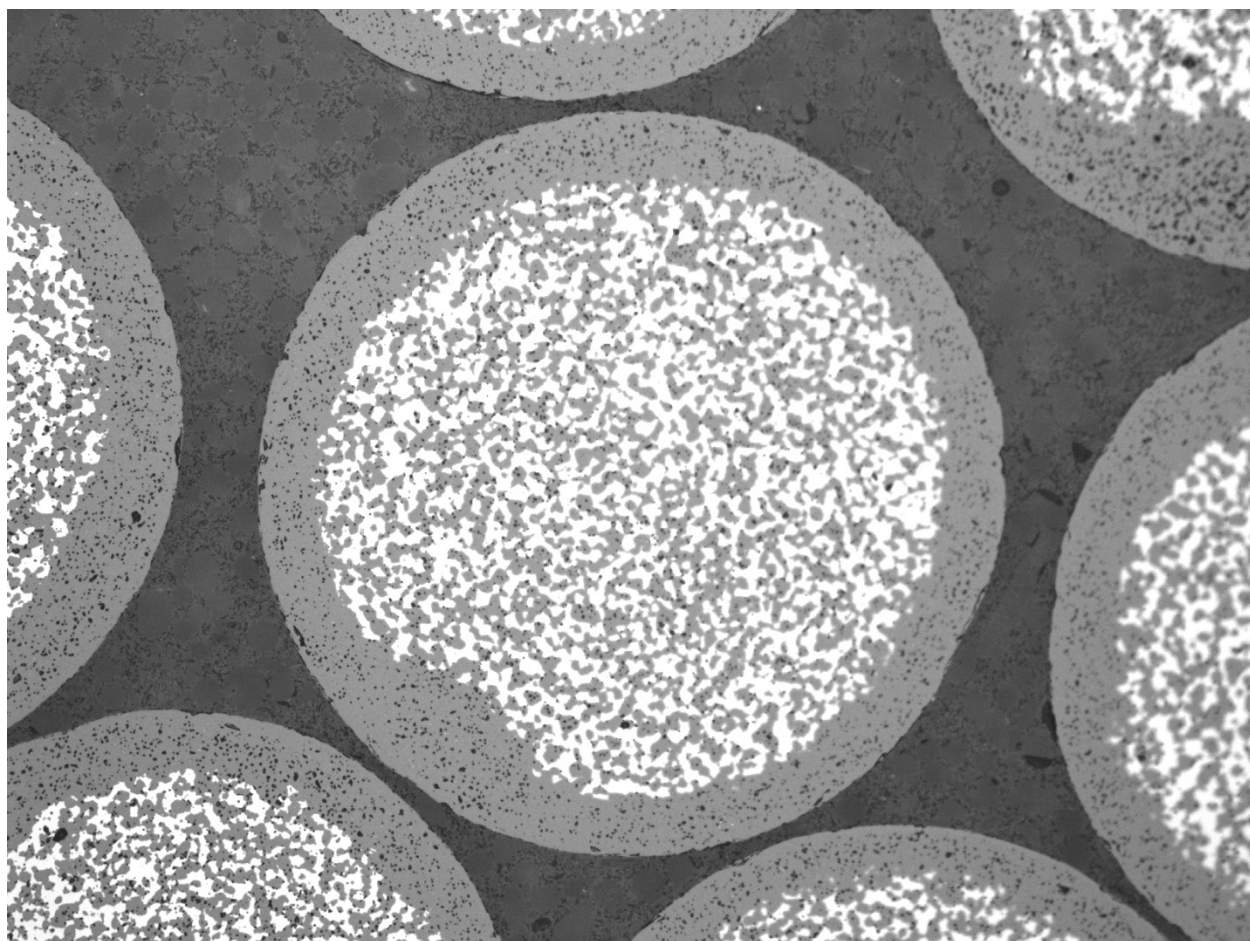
P17030905N226 segmented



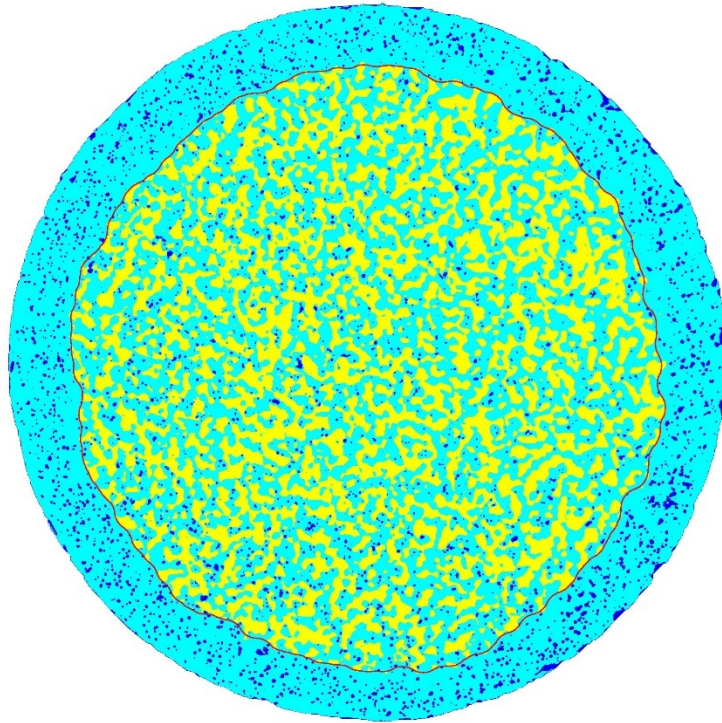
P17030905N226



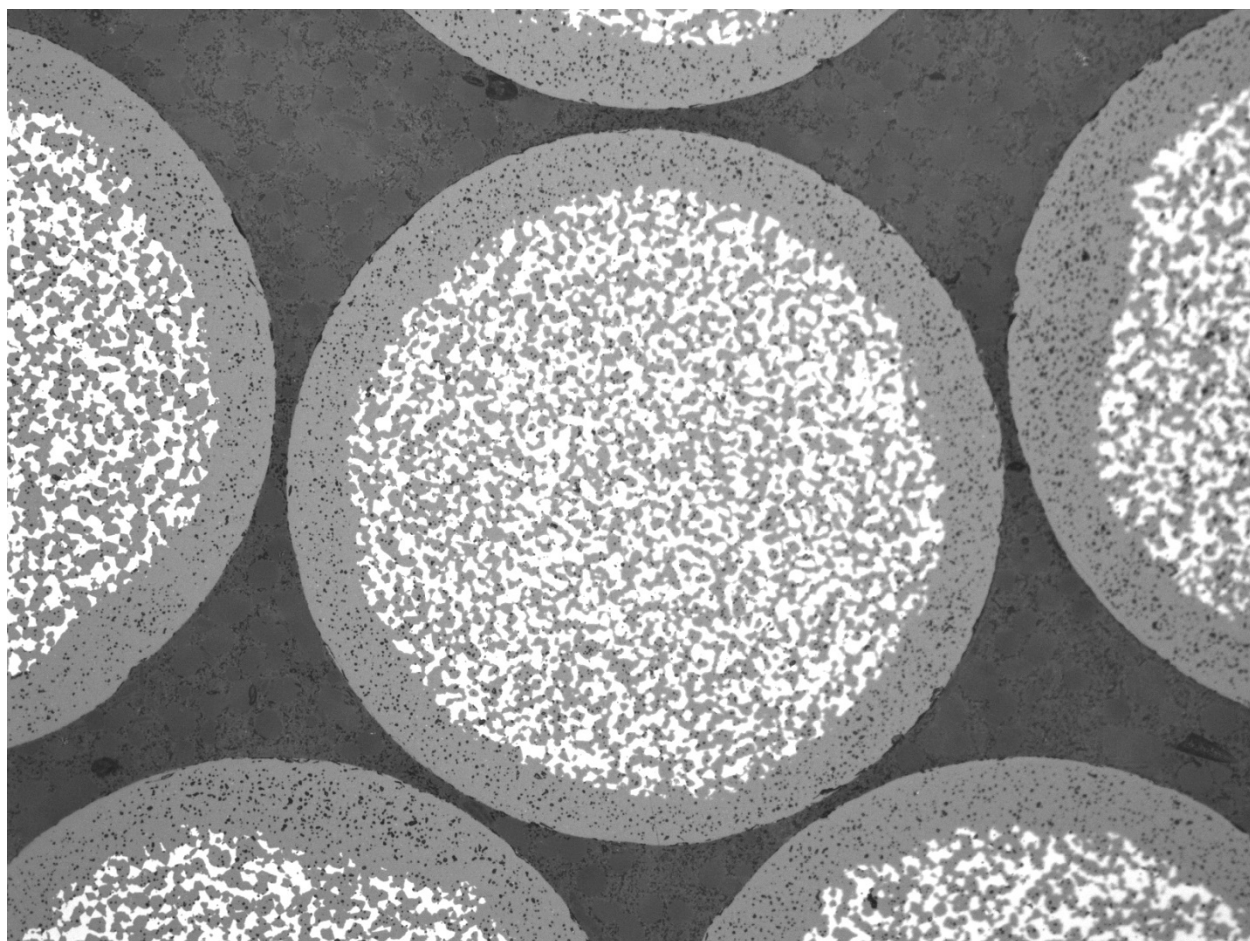
P17030905N227 segmented



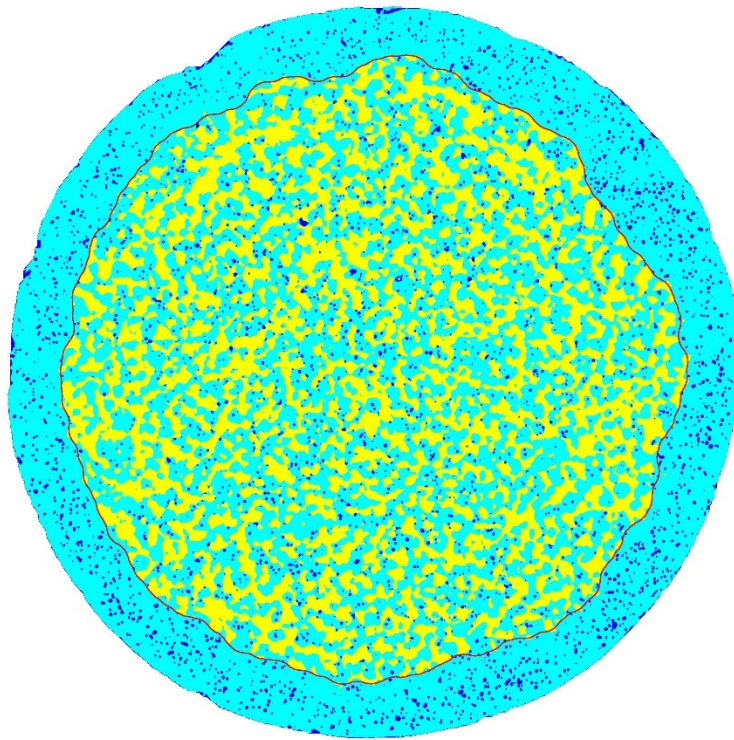
P17030905N227



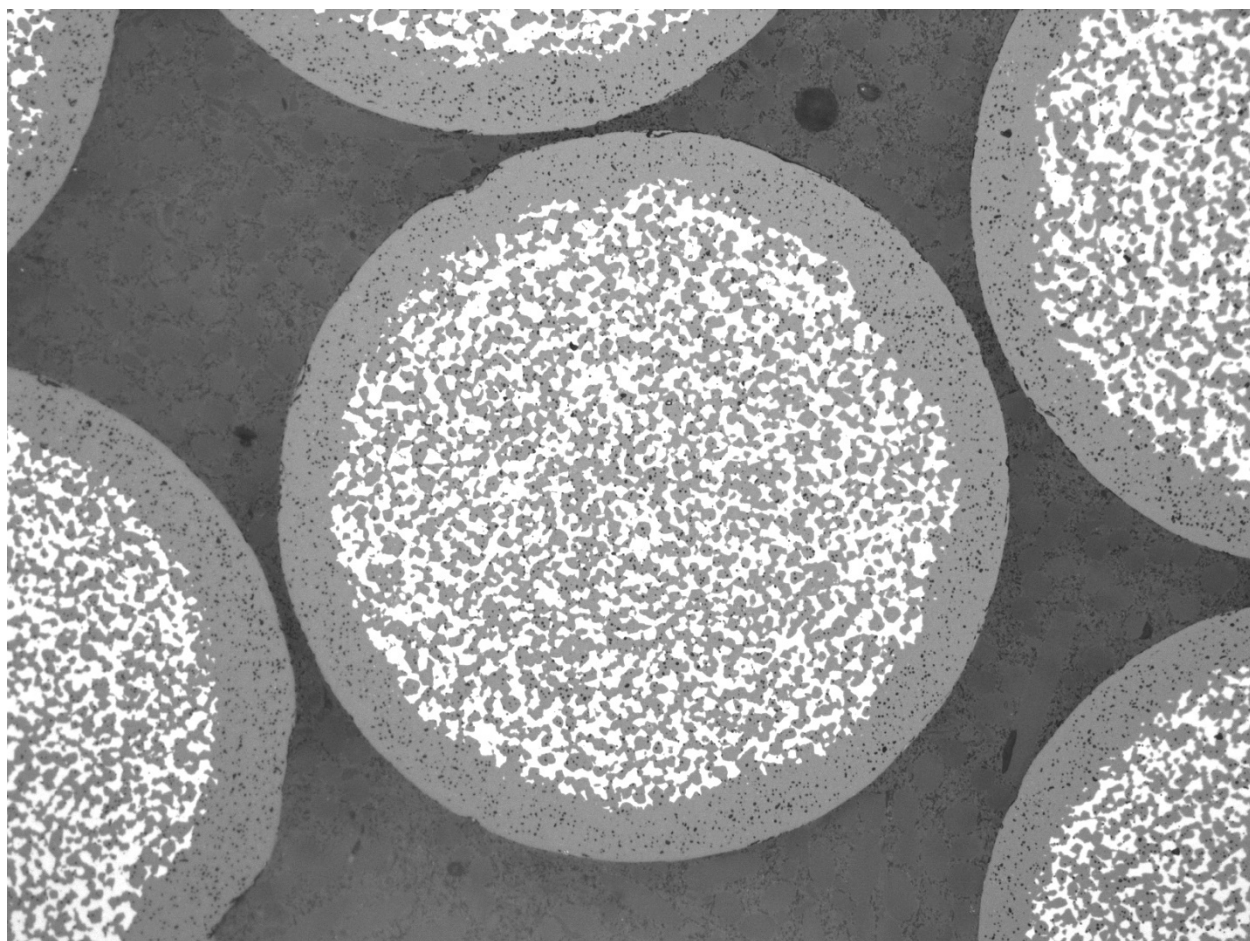
P17030905N228 segmented



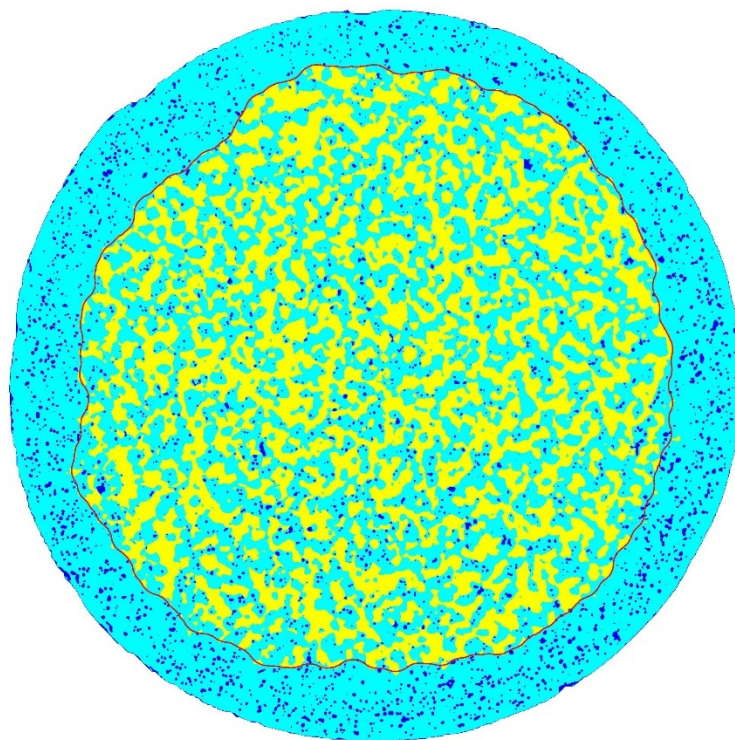
P17030905N228



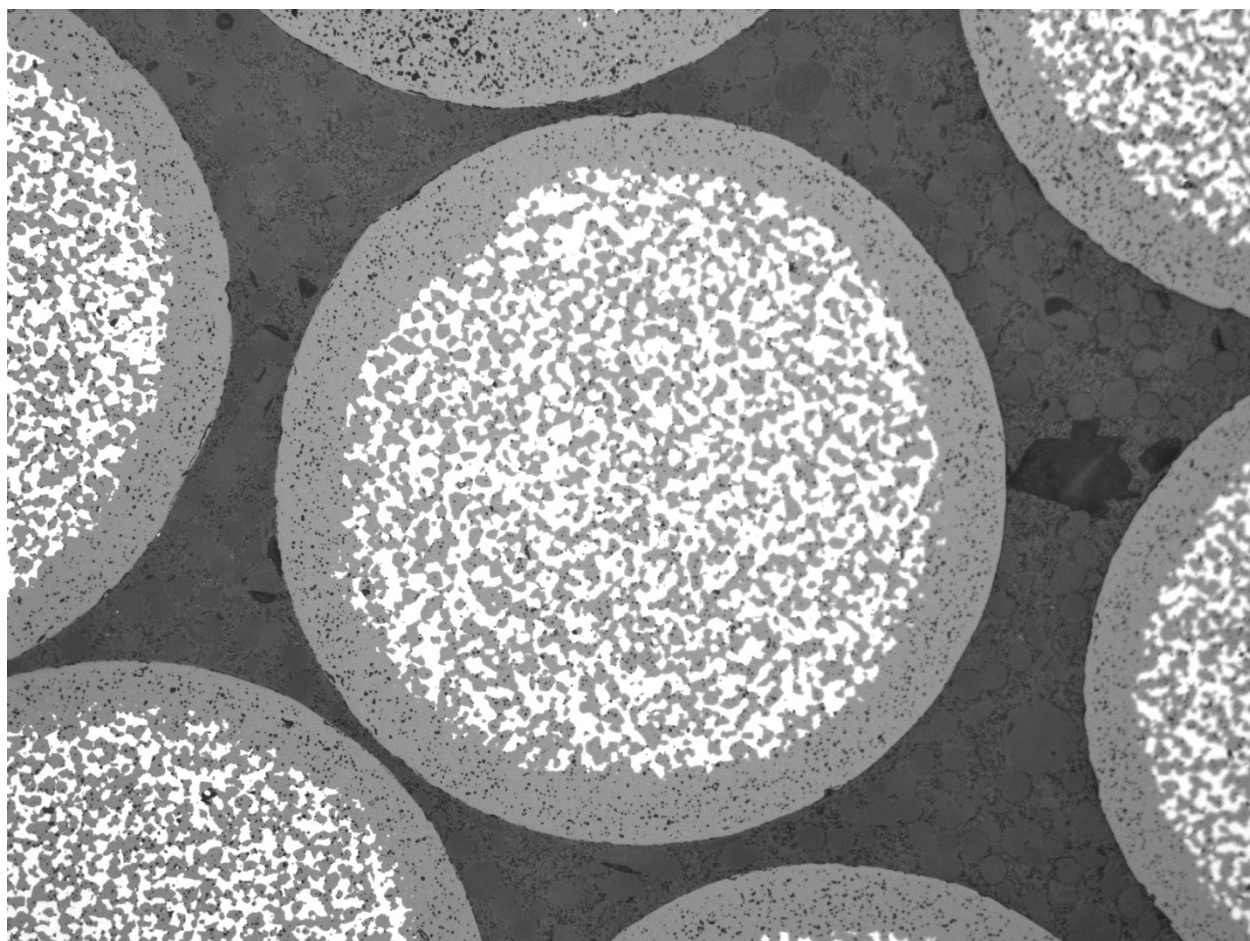
P17030905N229 segmented



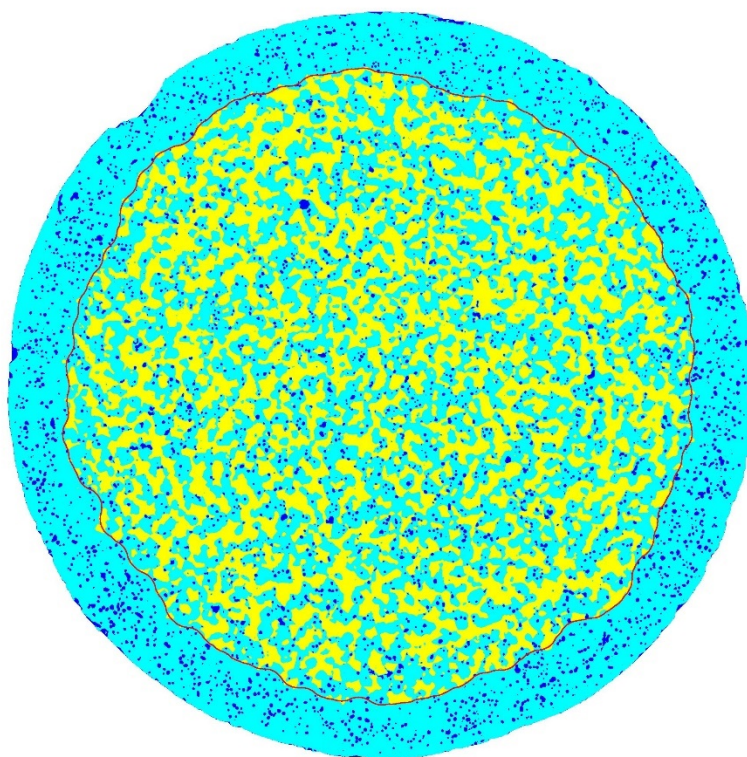
P17030905N229



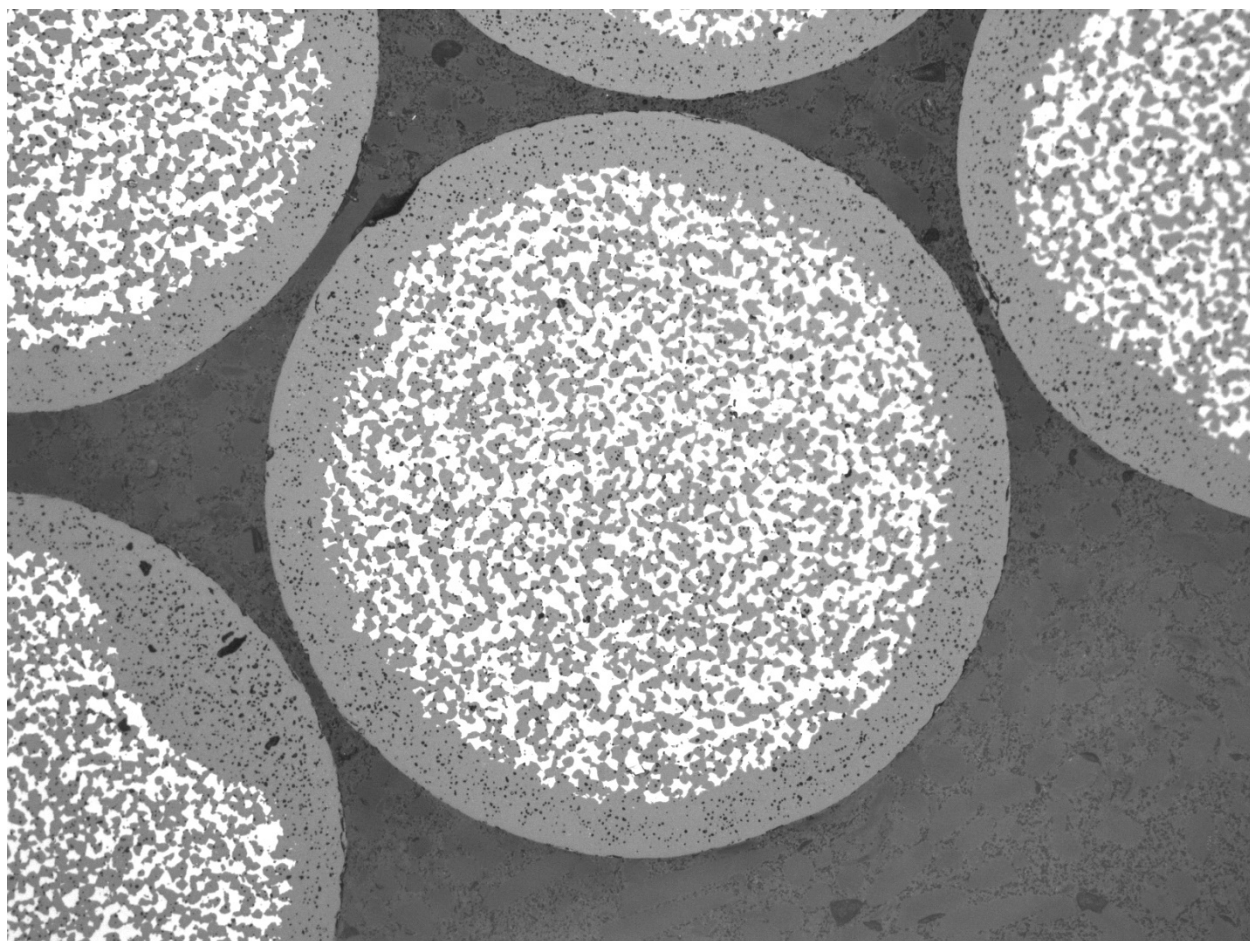
P17030905N230 segmented



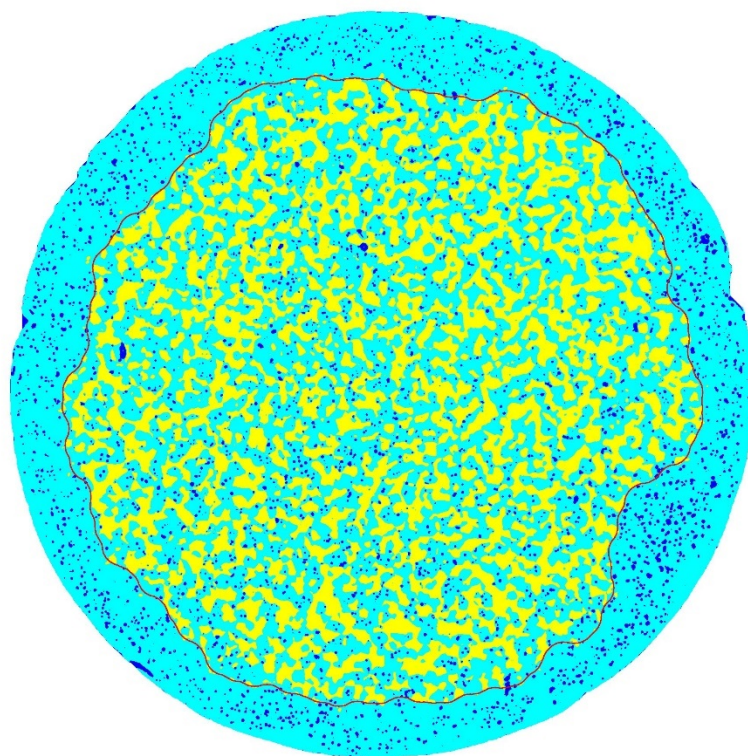
P17030905N230



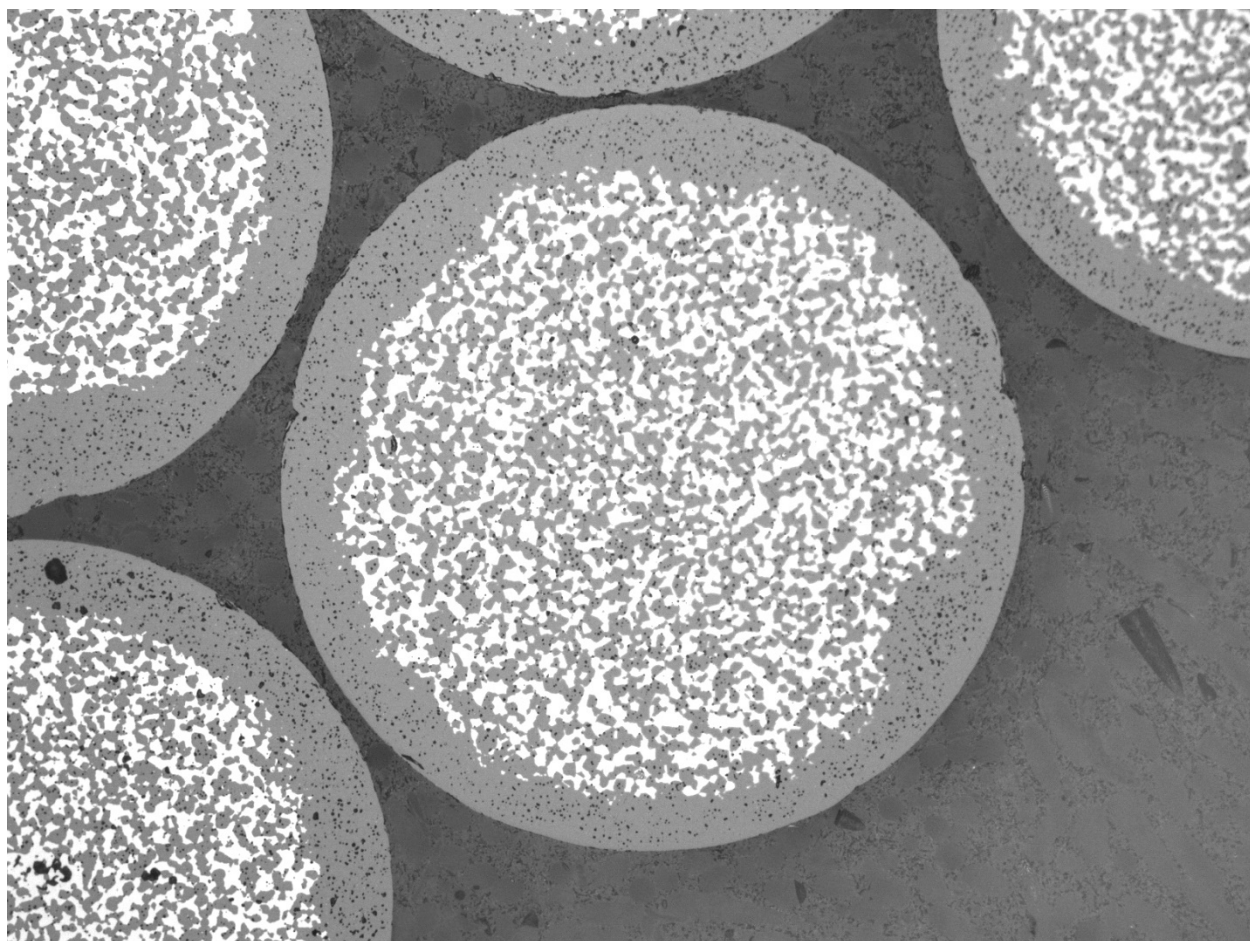
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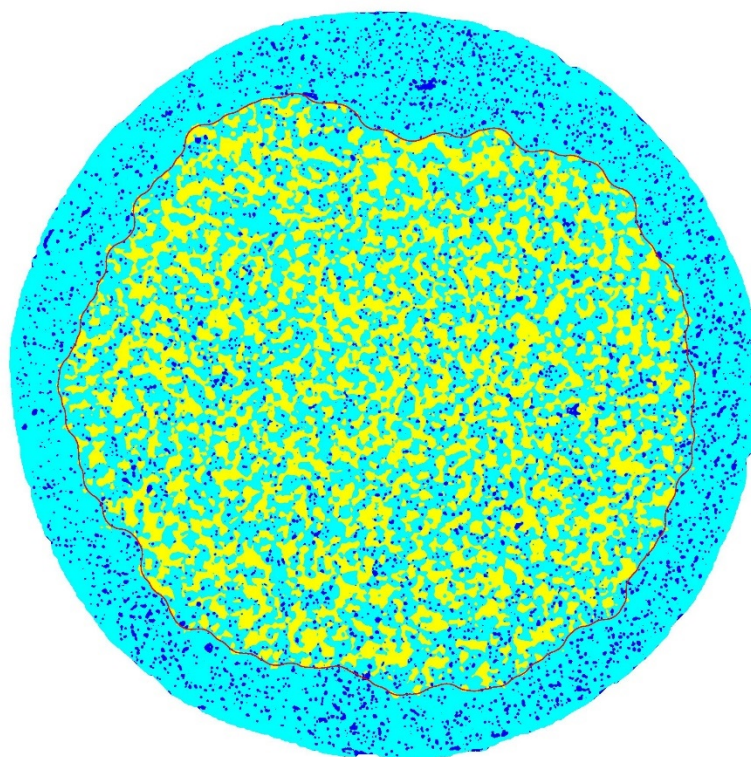
P17030905N231



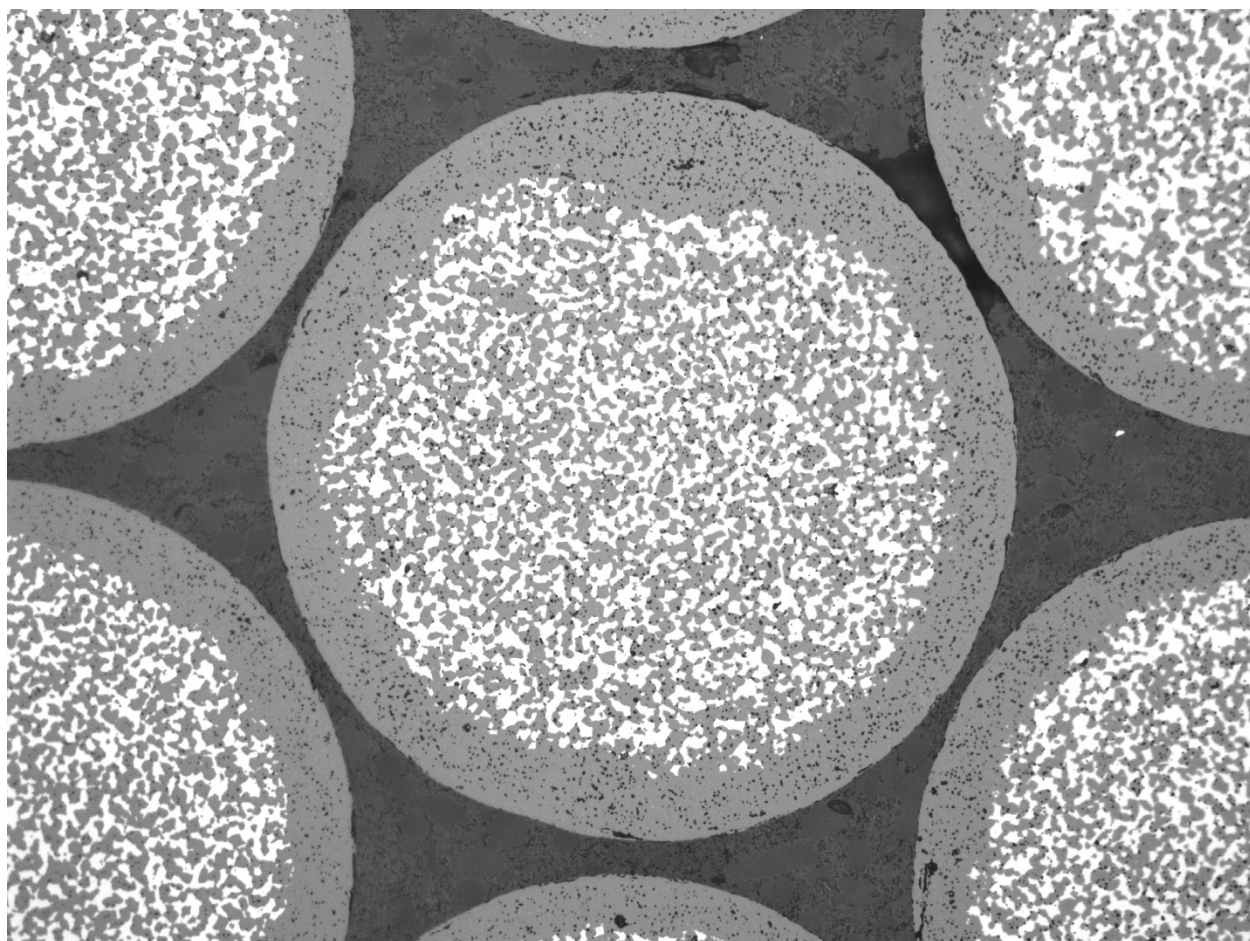
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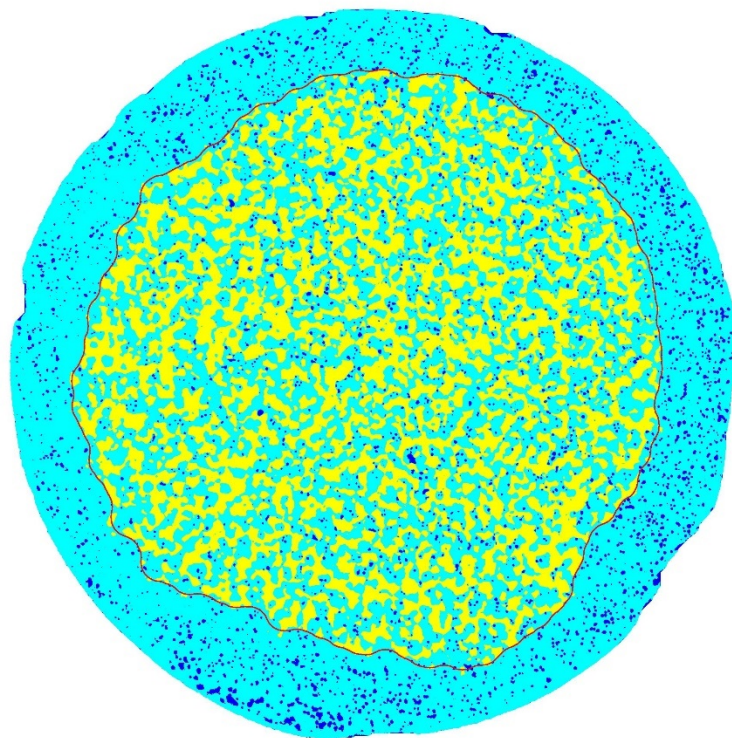
P17030905N232



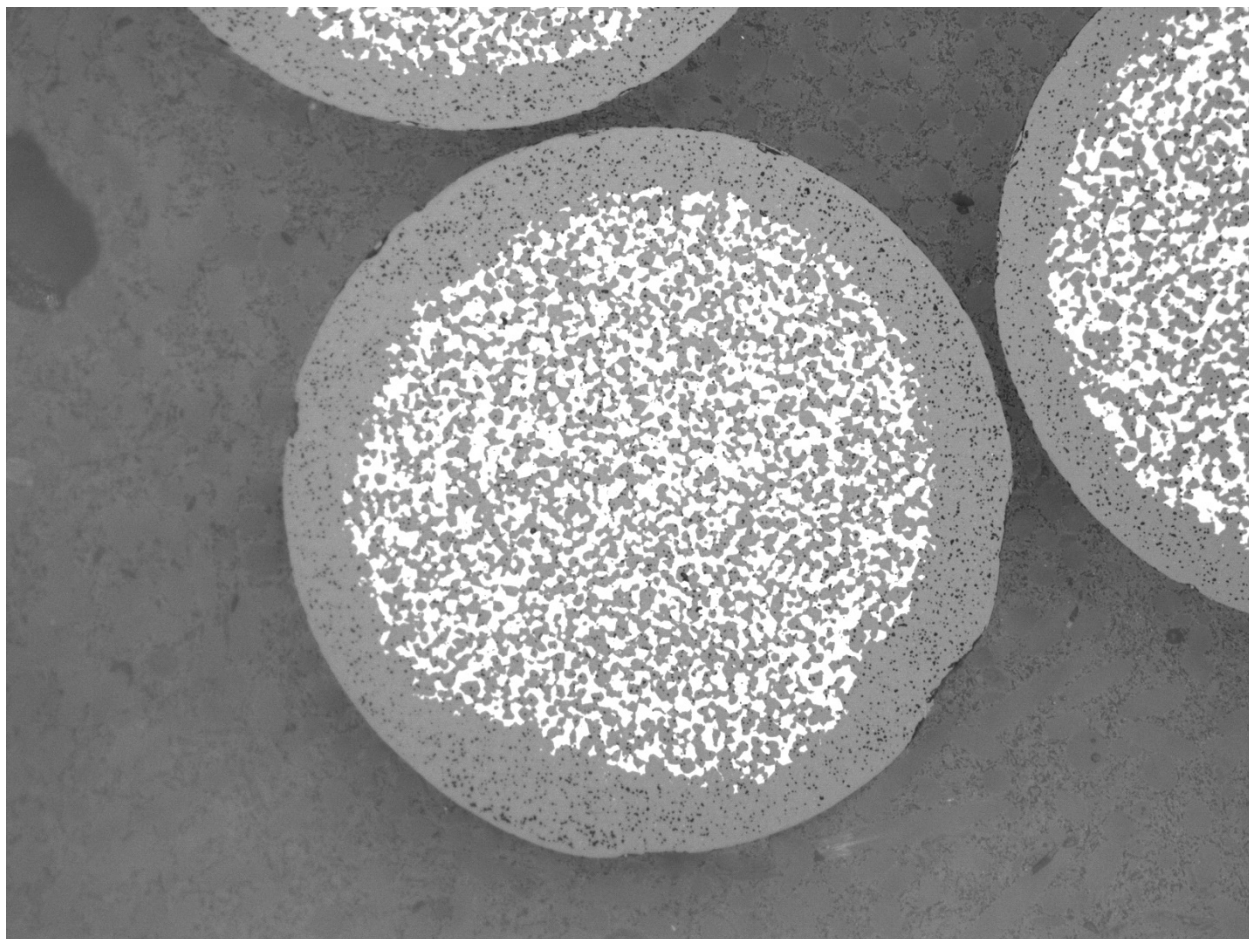
P17030905N233 segmented



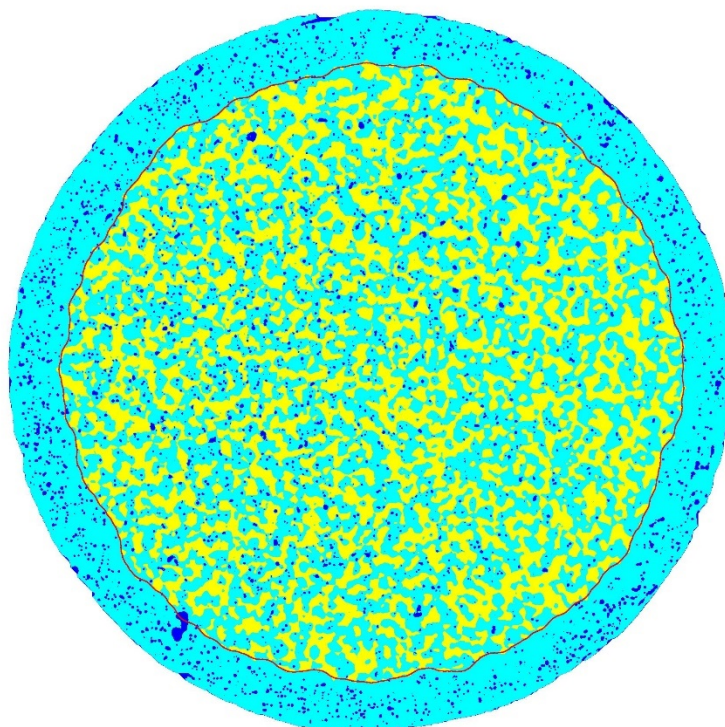
P17030905N233



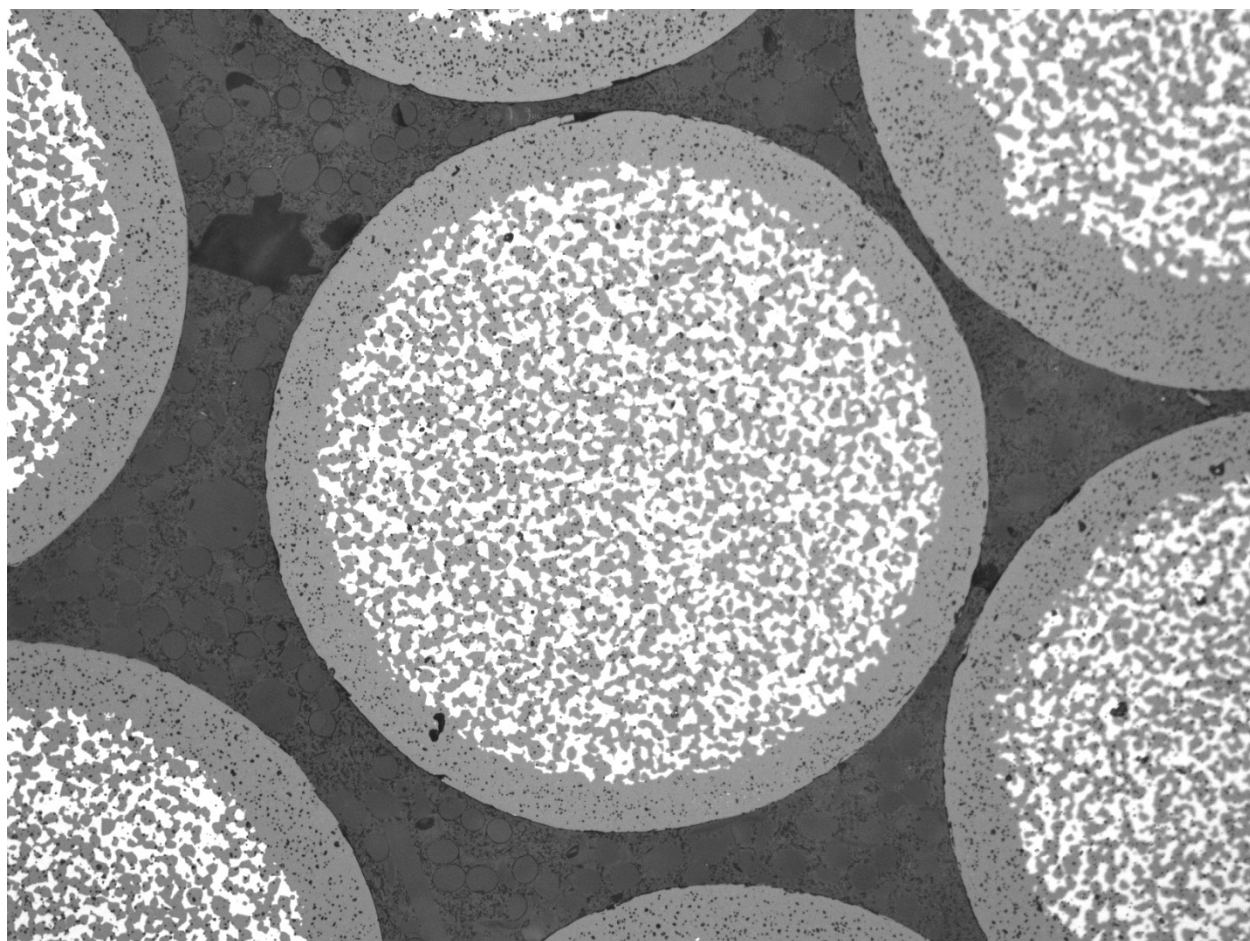
P17030905N234 segmented



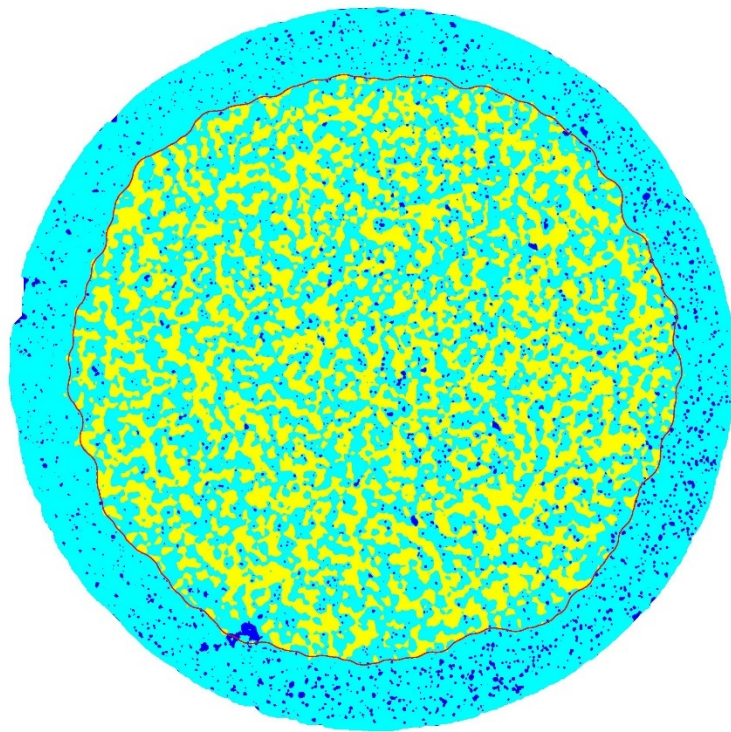
P17030905N234



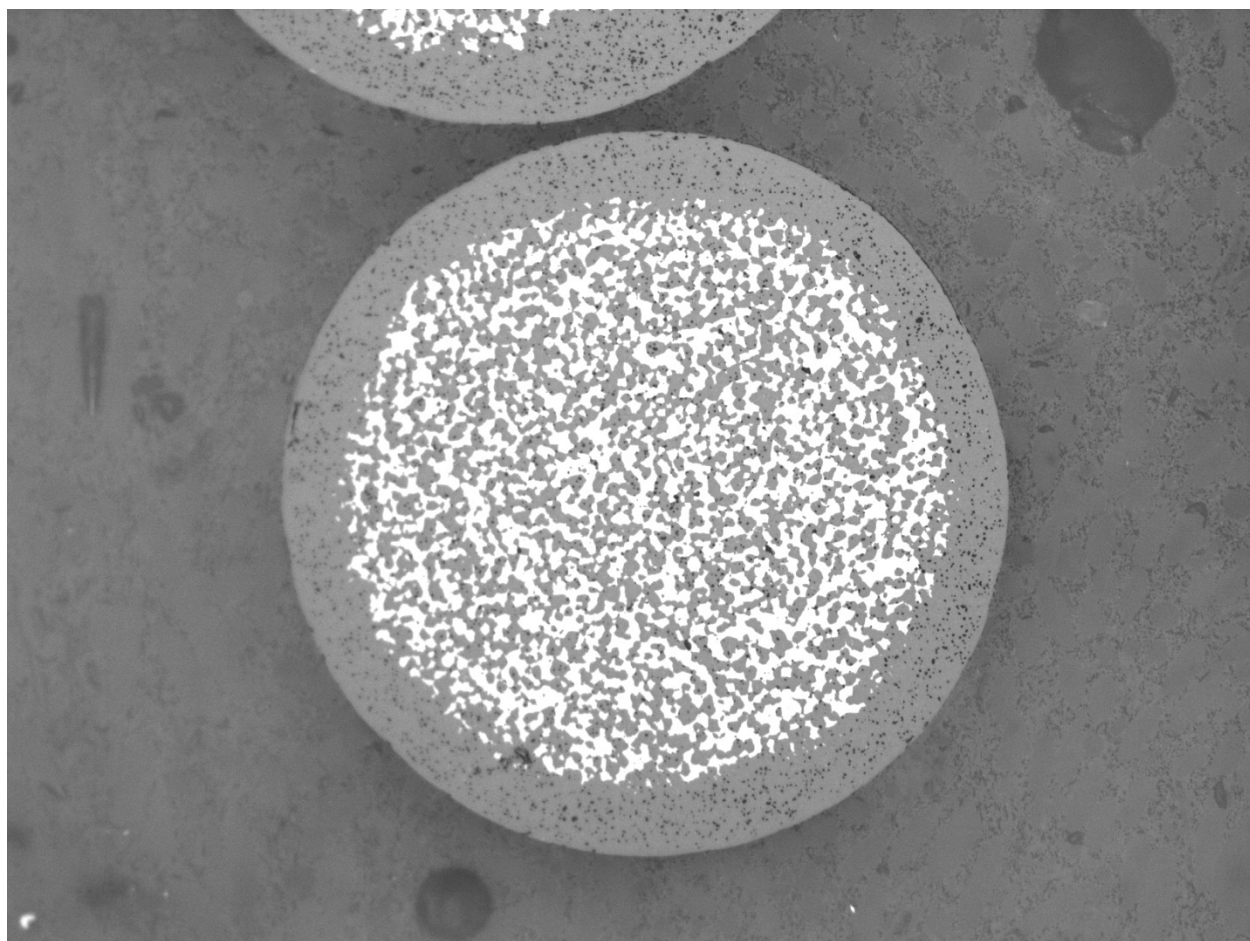
P17030905N235 segmented



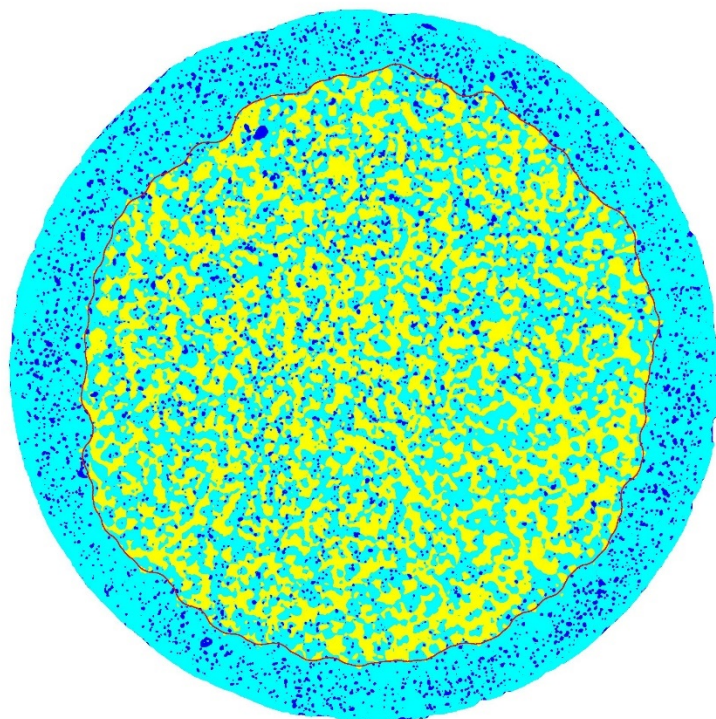
P17030905N235



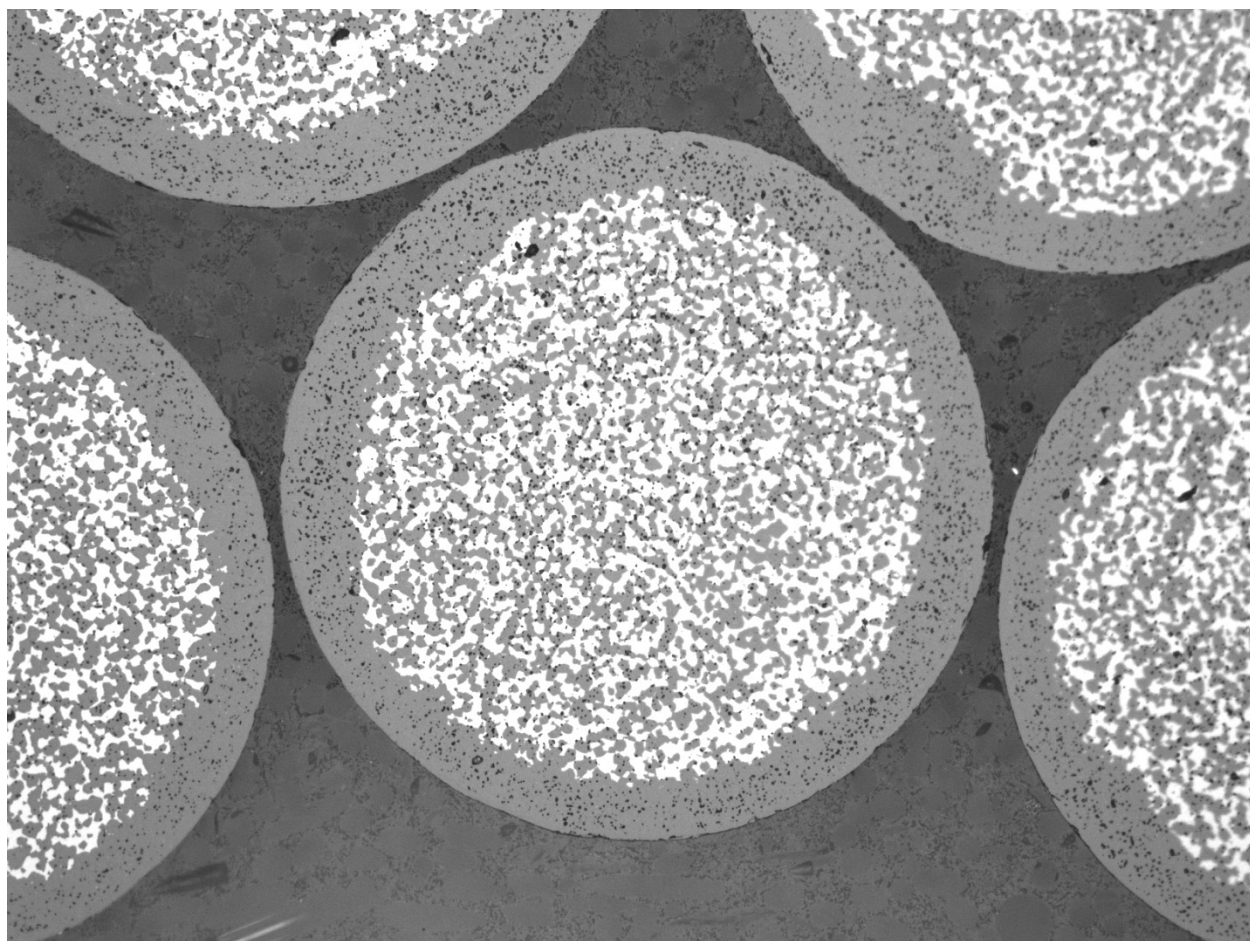
P17030905N236 segmented



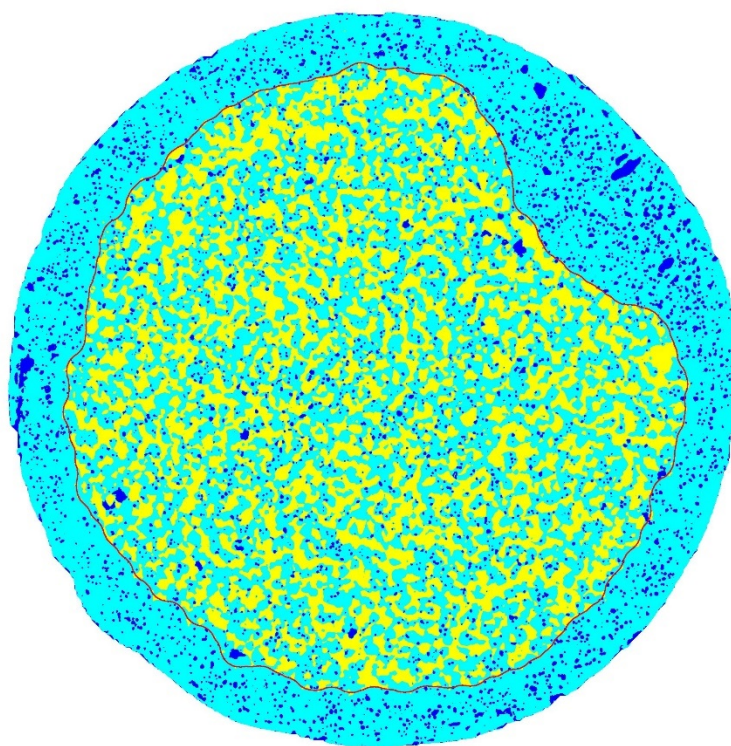
P17030905N236



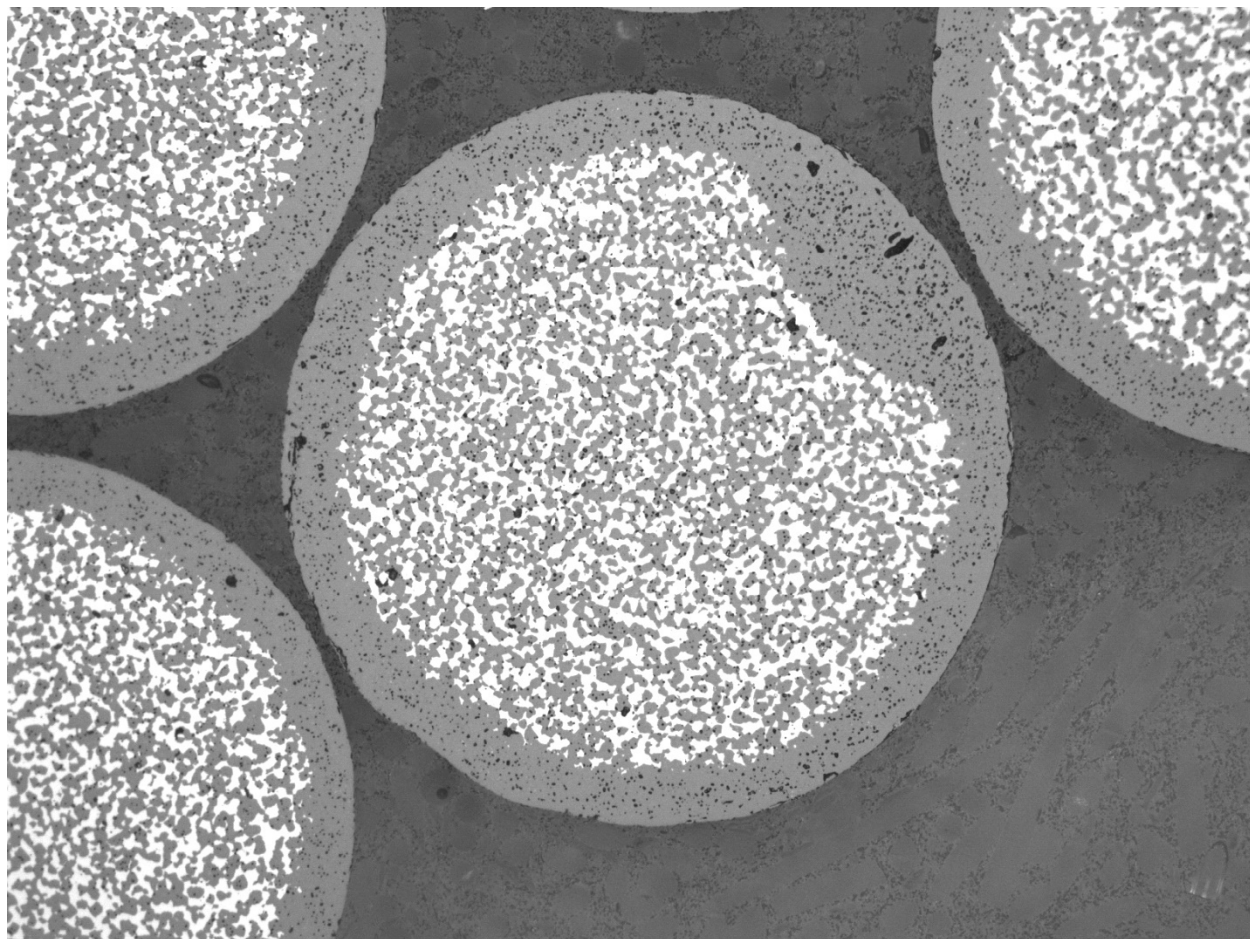
P17030905N237 segmented



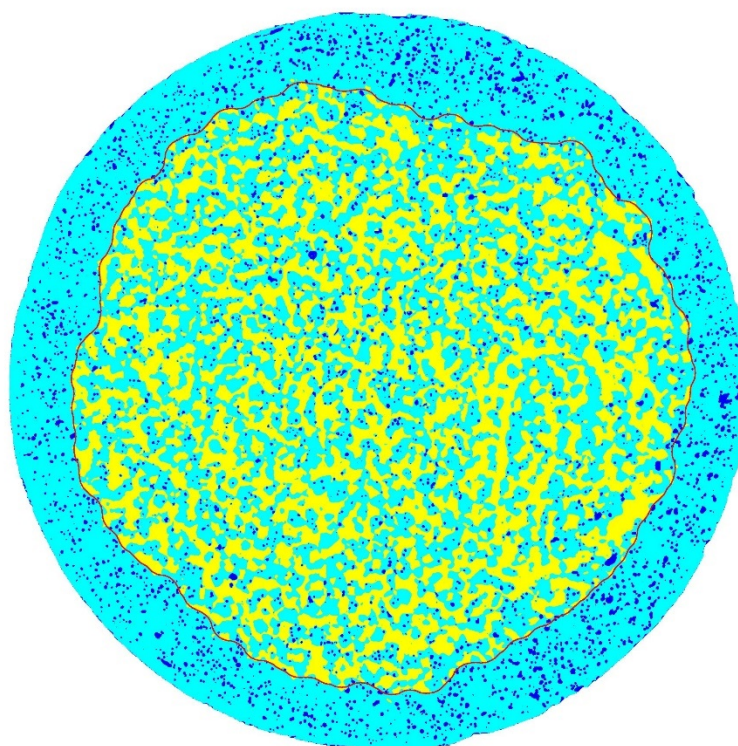
P17030905N237



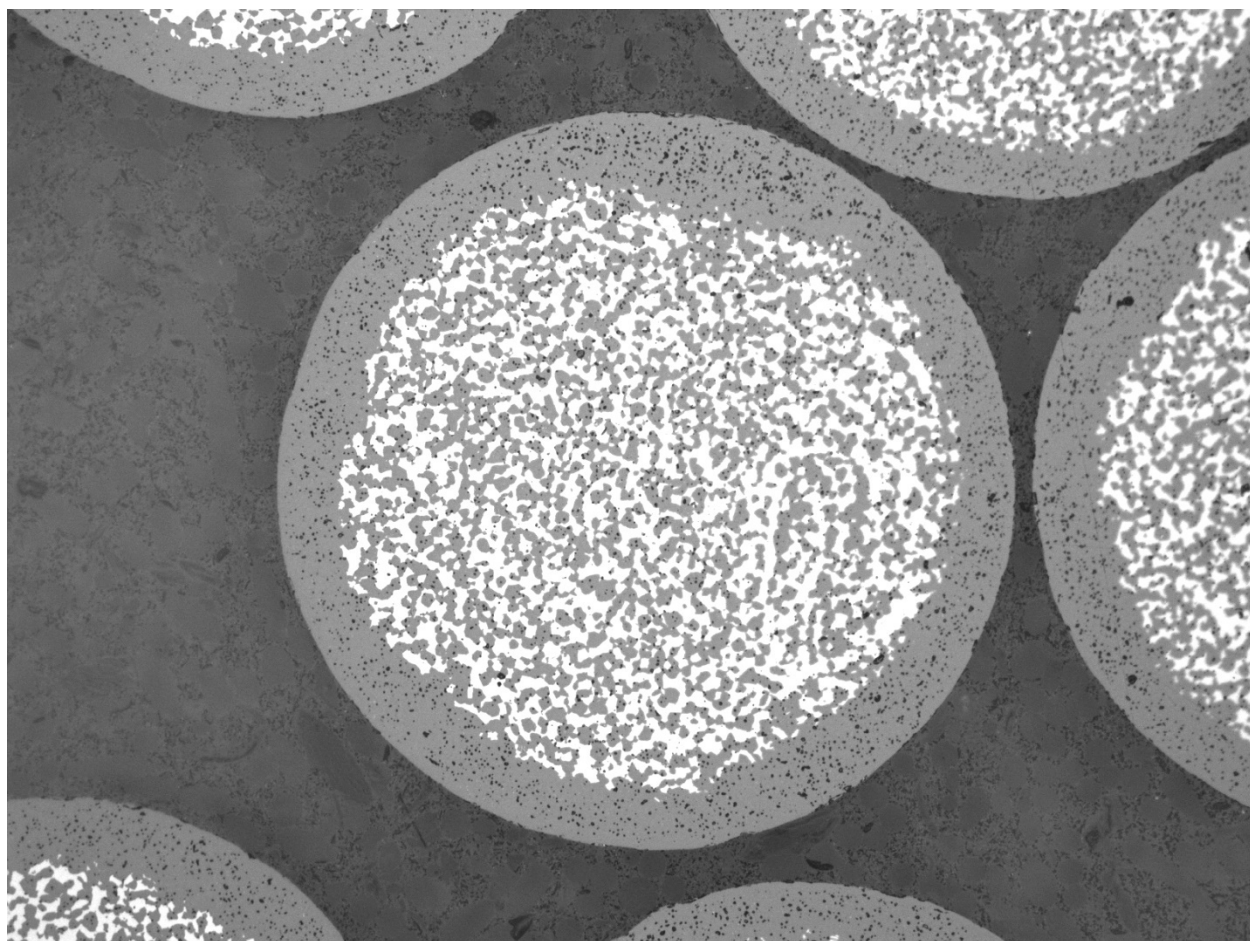
P17030905N239 segmented



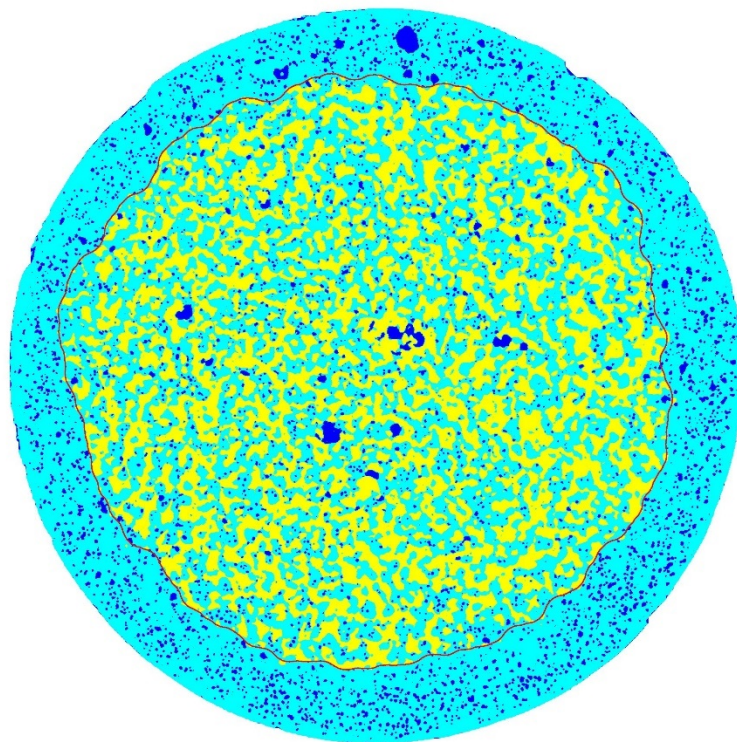
P17030905N239



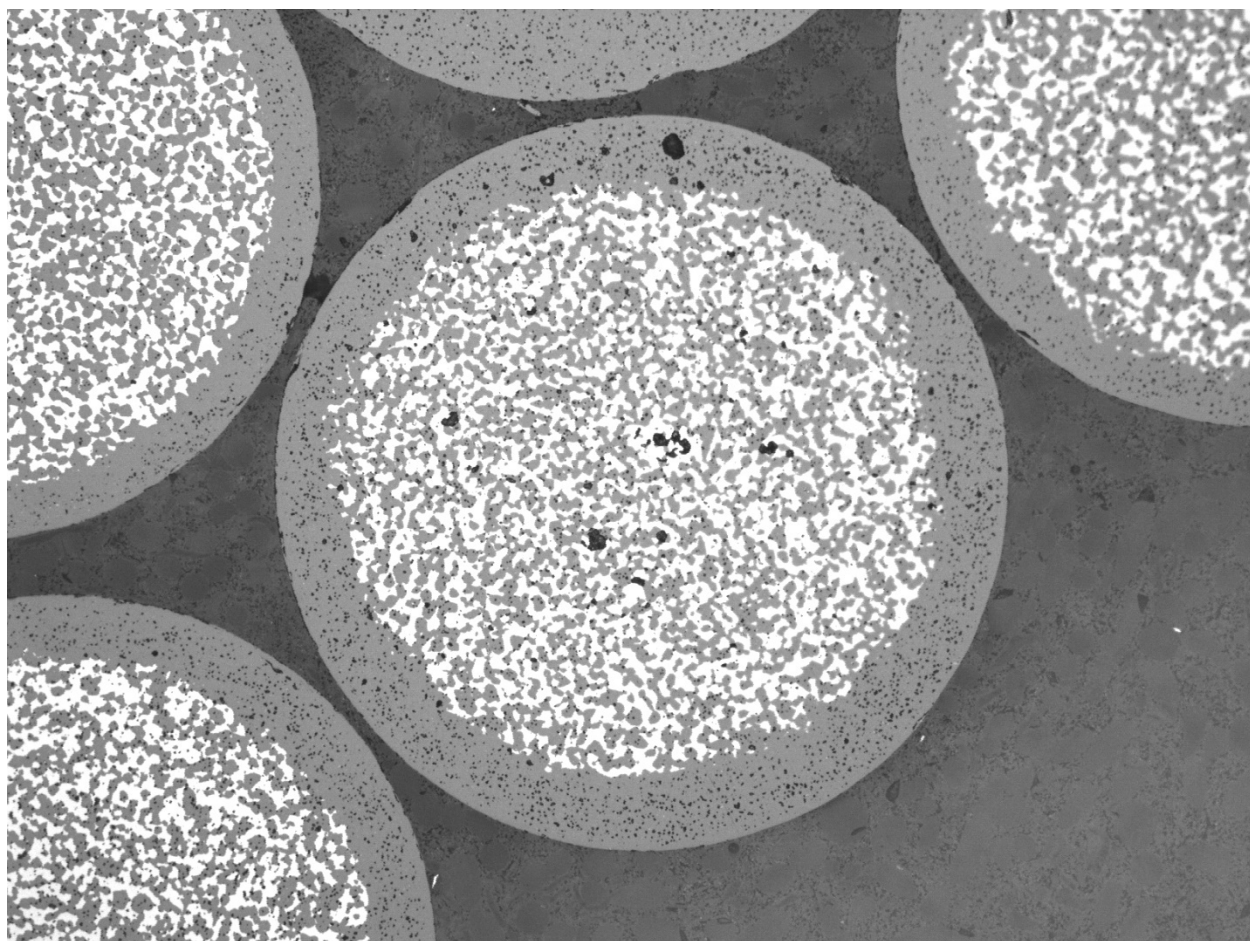
P17030905N240 segmented



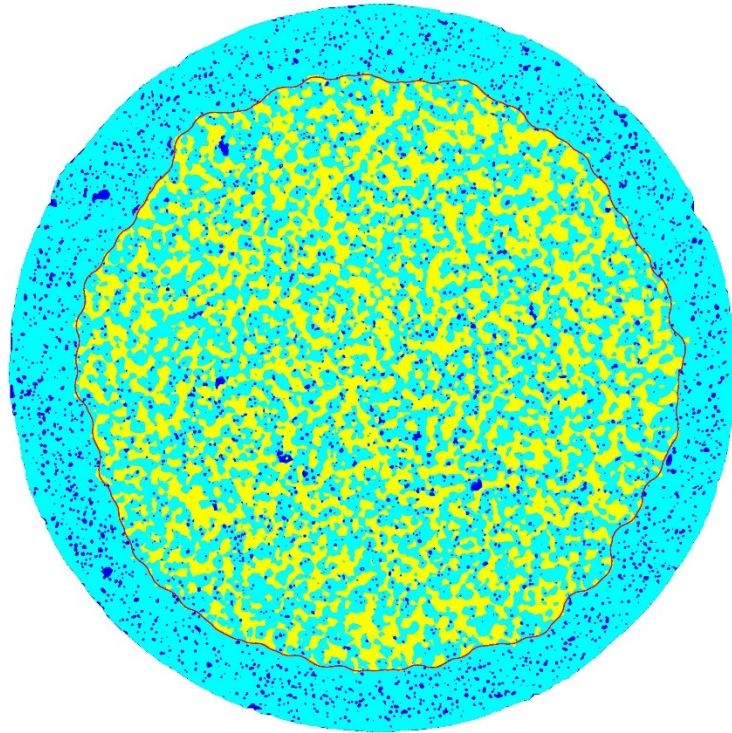
P17030905N240



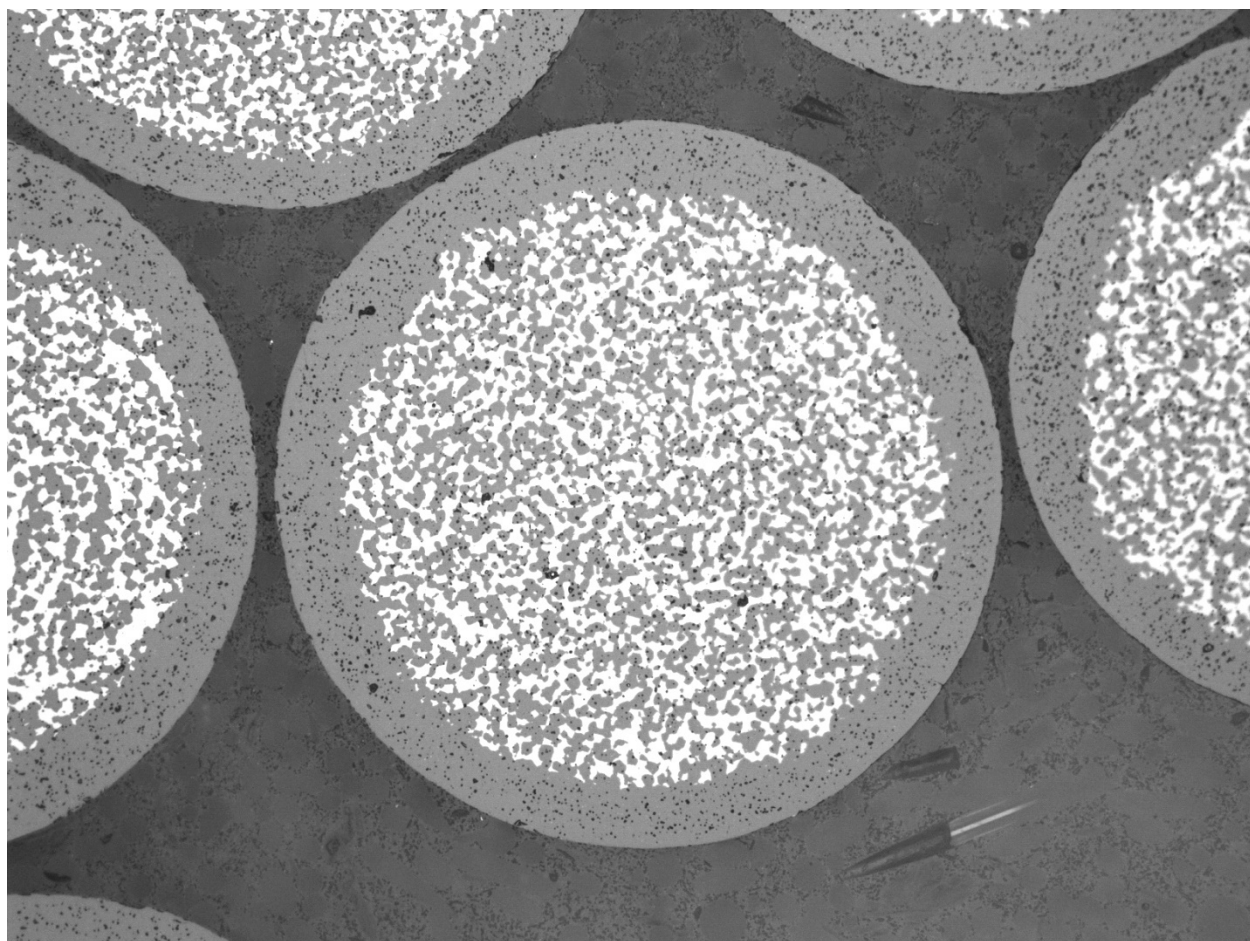
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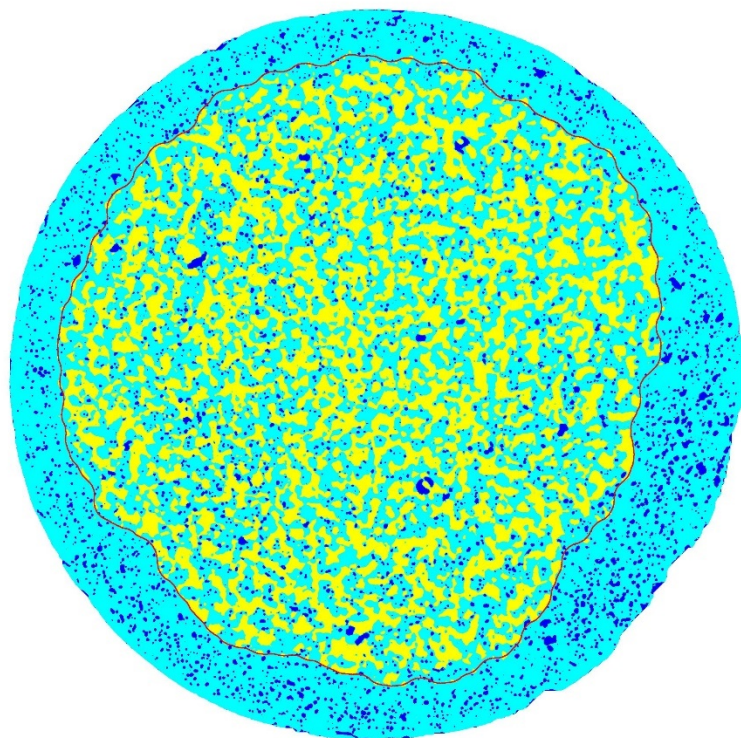
P17030905N241



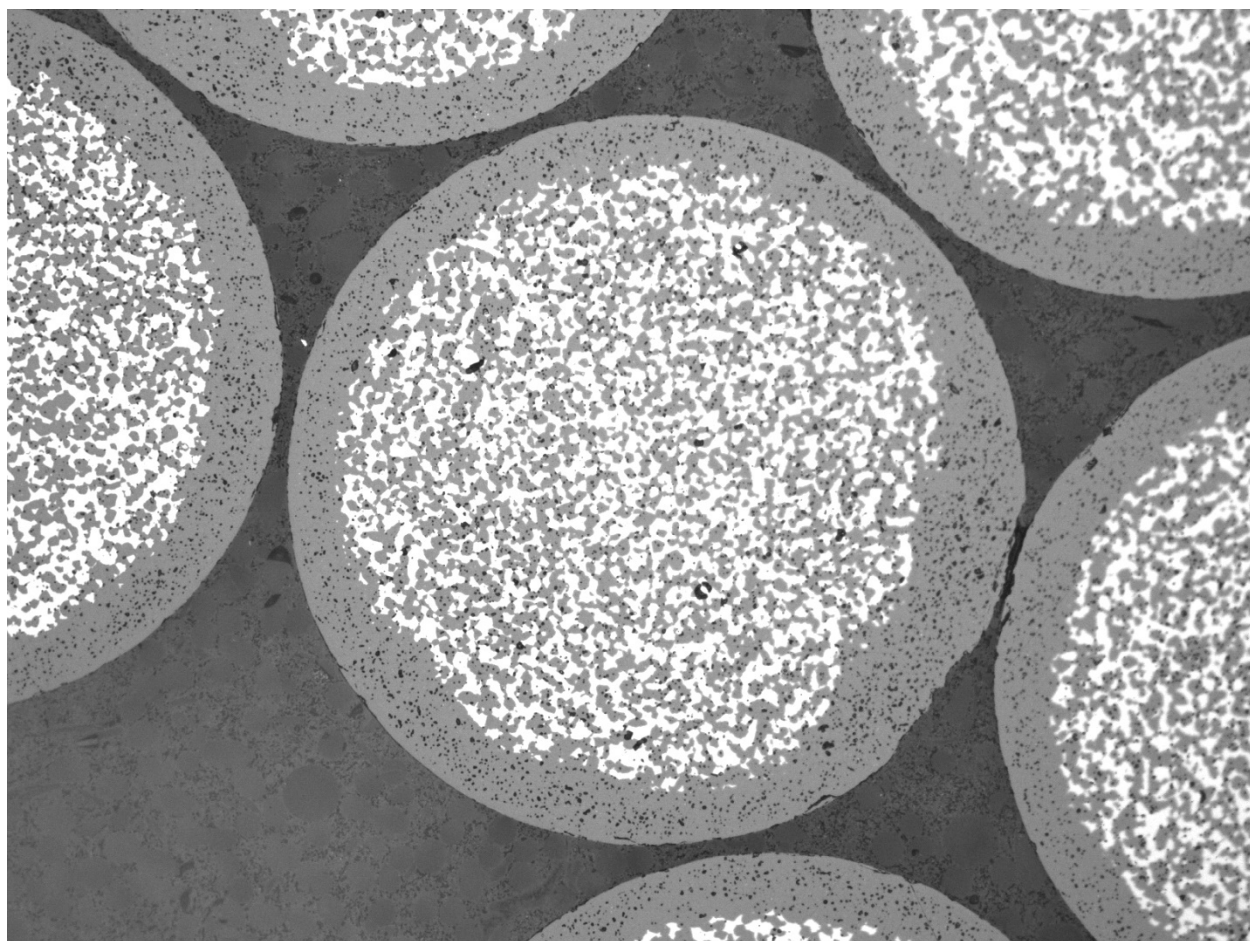
P17030905N242 segmented



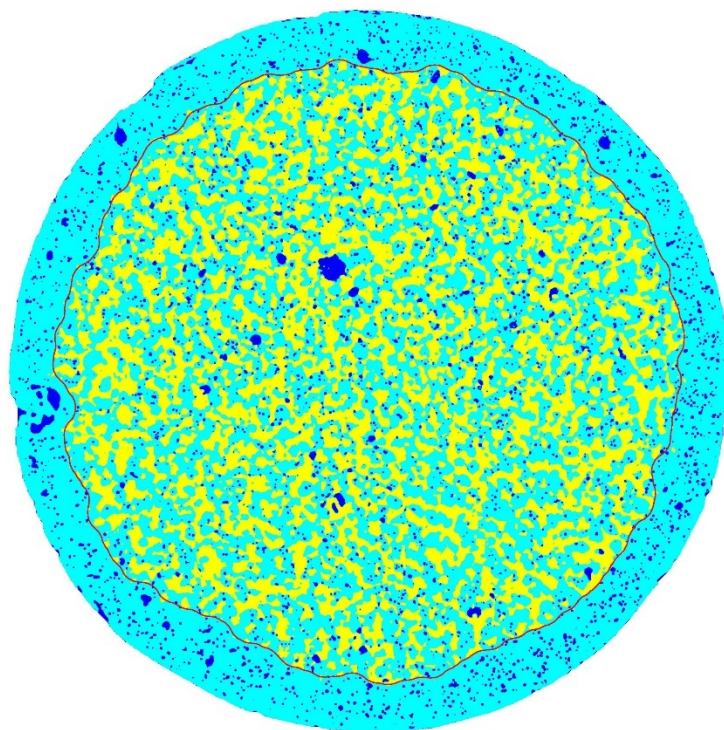
P17030905N242



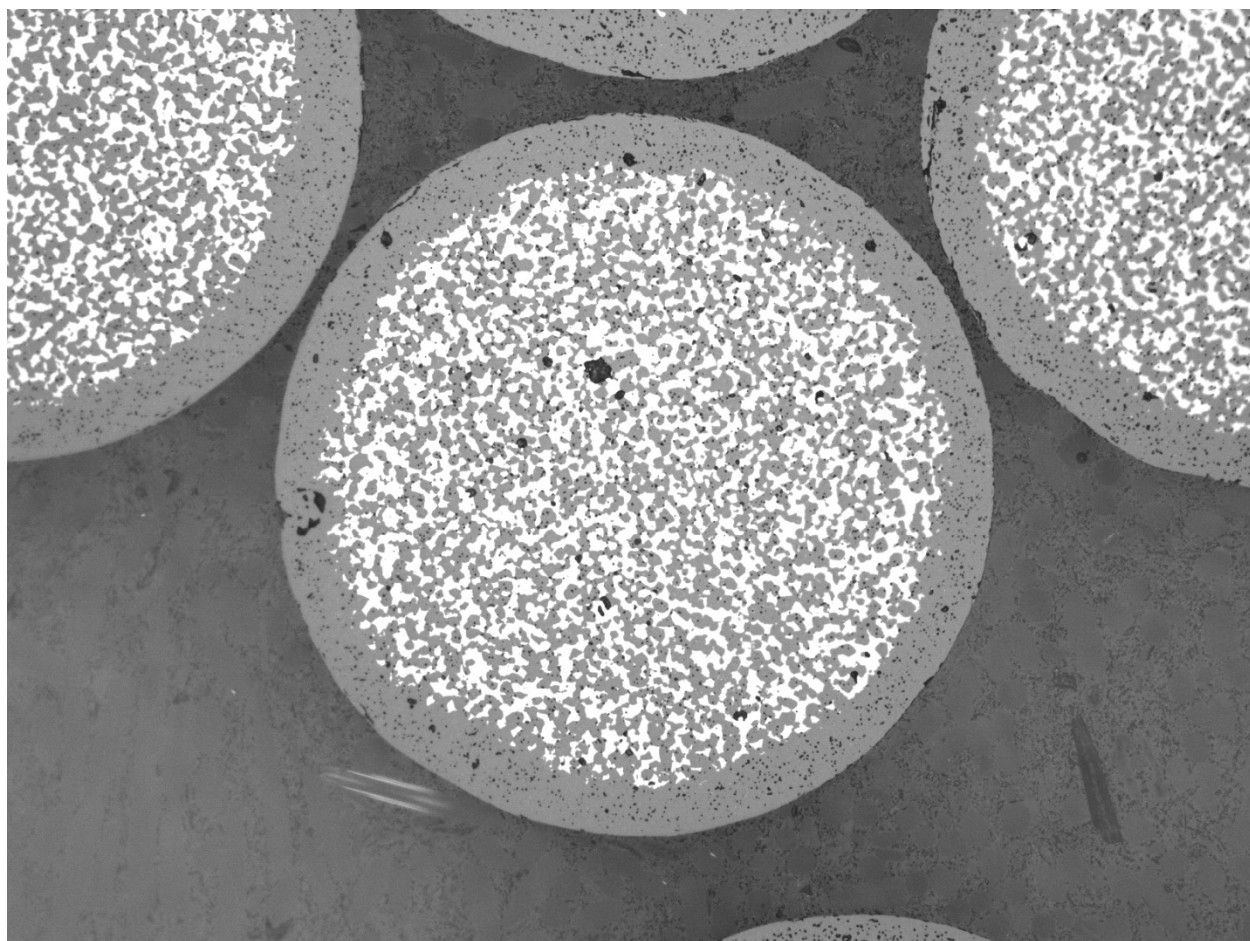
P17030905N243 segmented



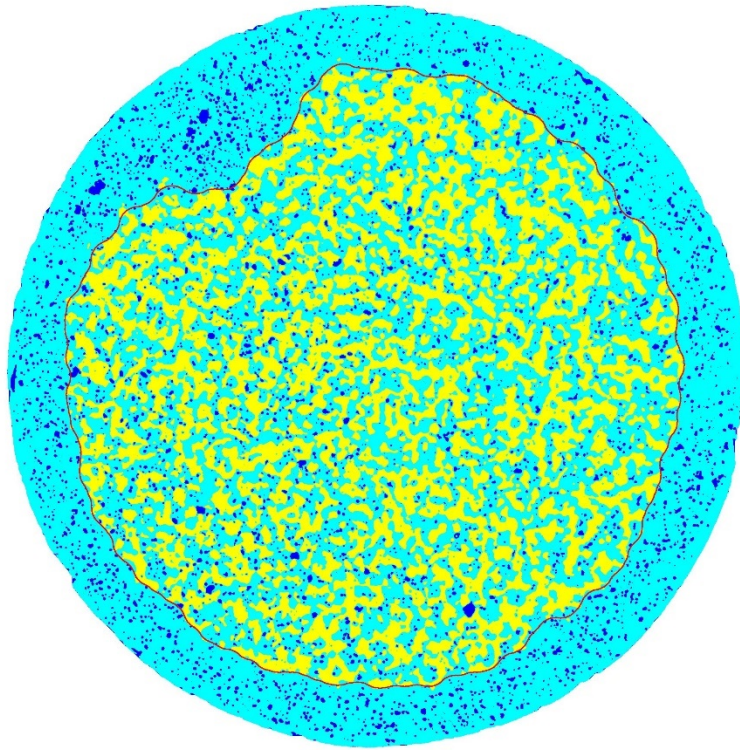
P17030905N243



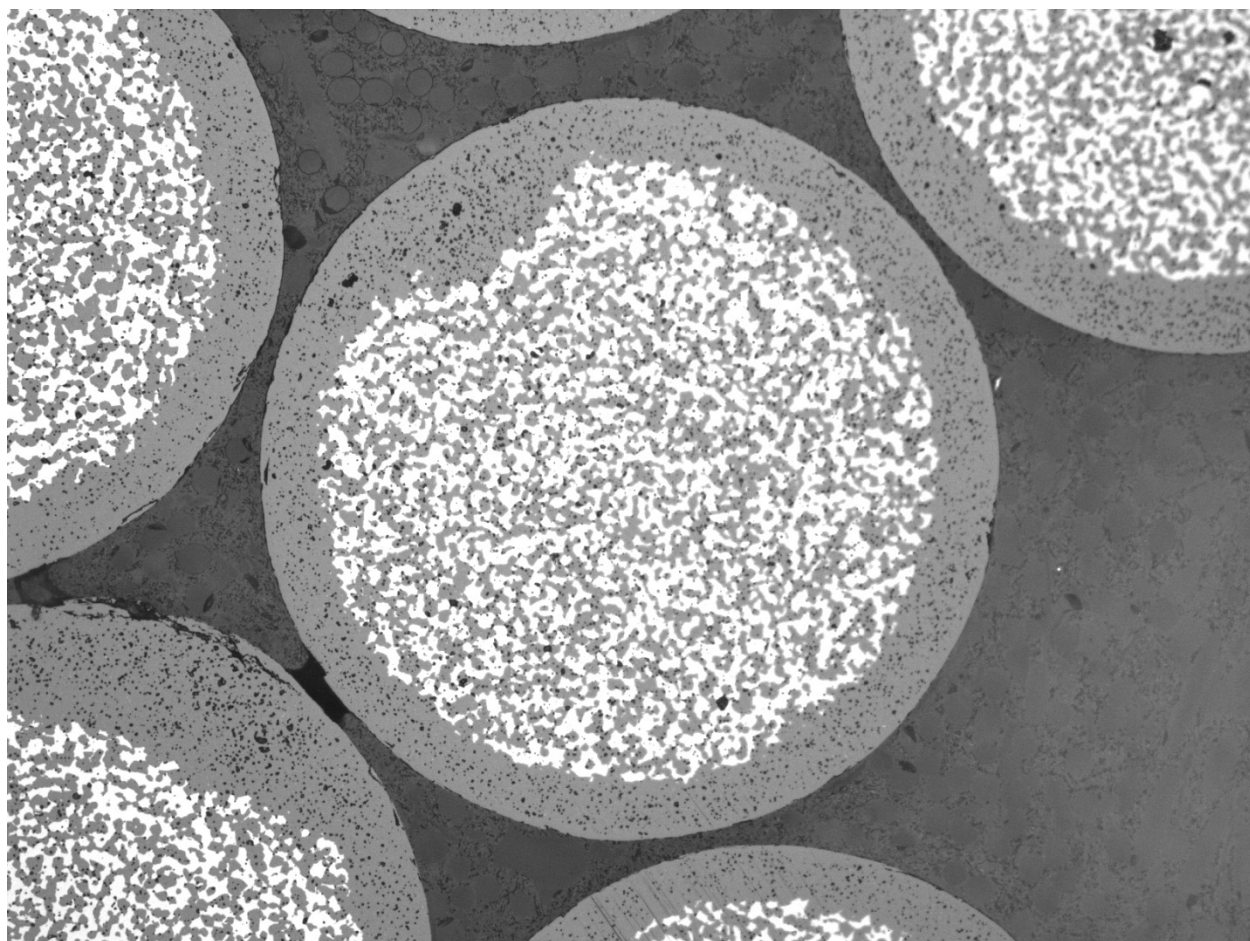
P17030905N245 segmented



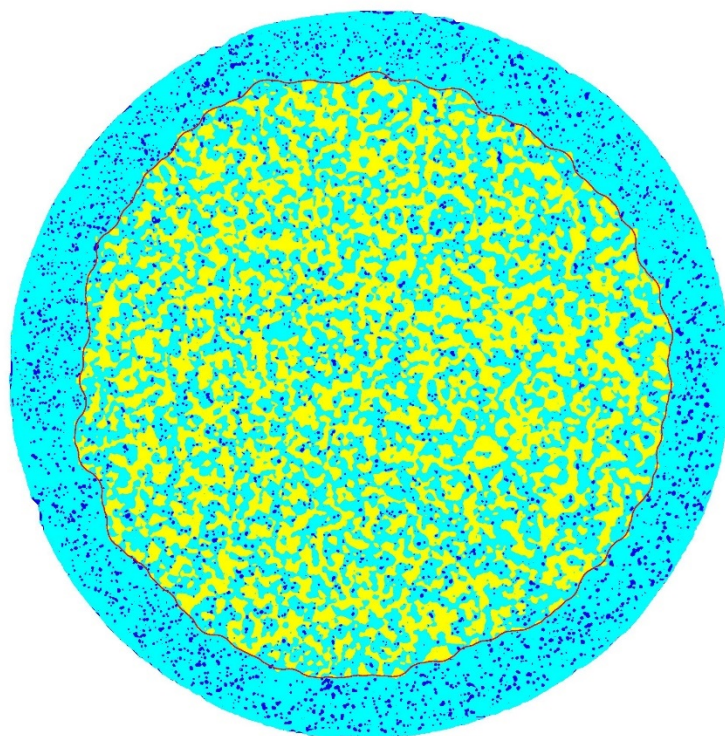
P17030905N245



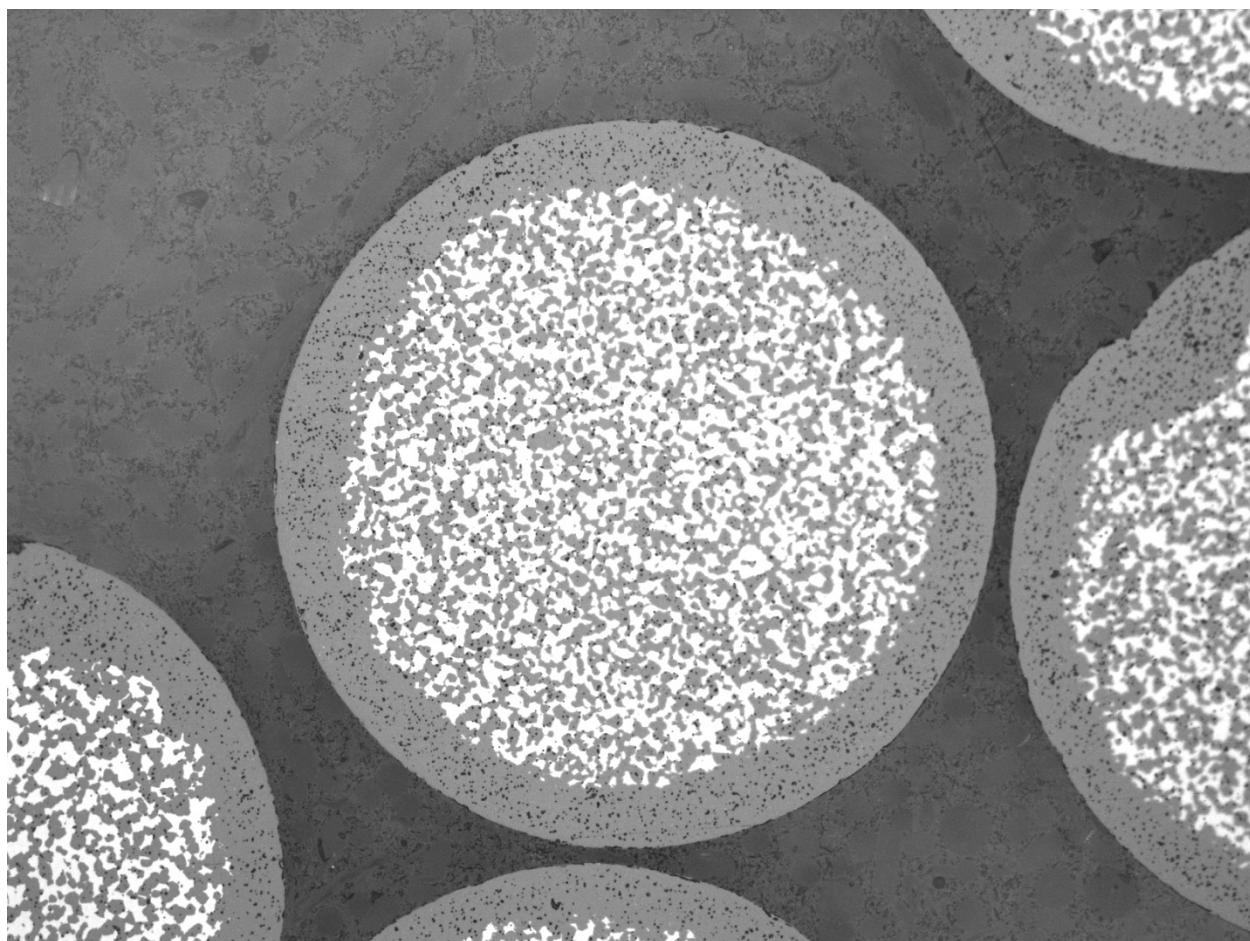
P17030905N246 segmented



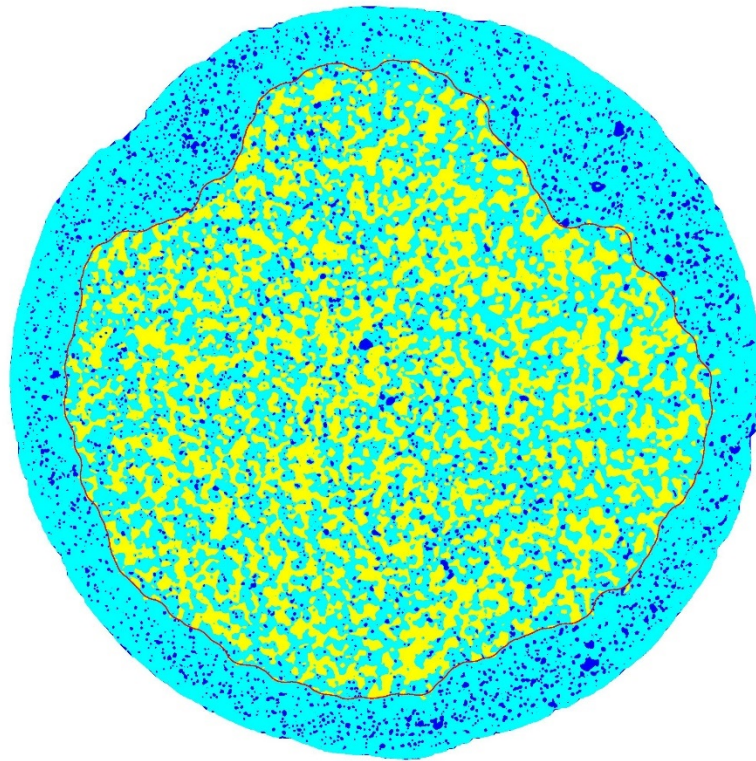
P17030905N246



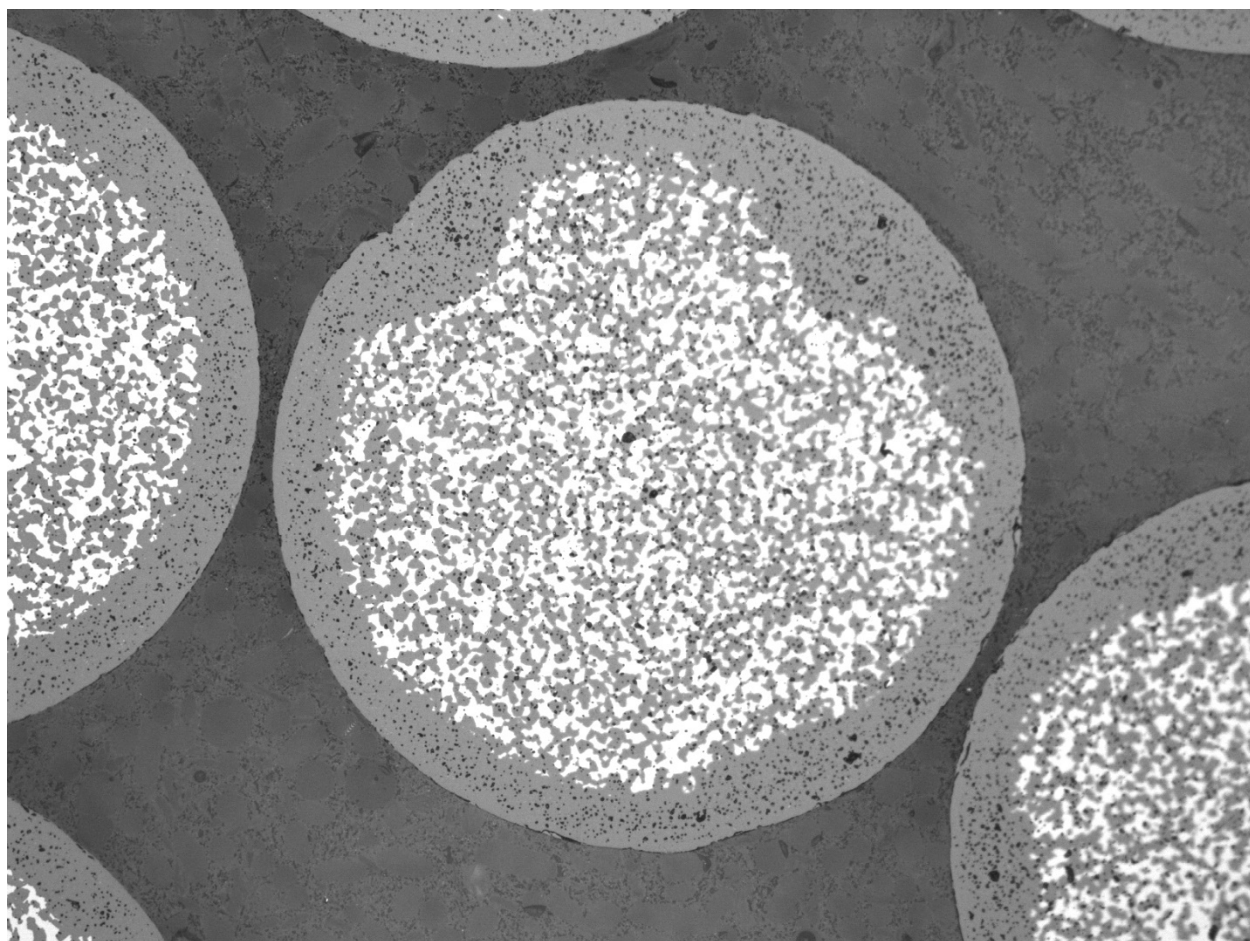
P17030905N247 segmented



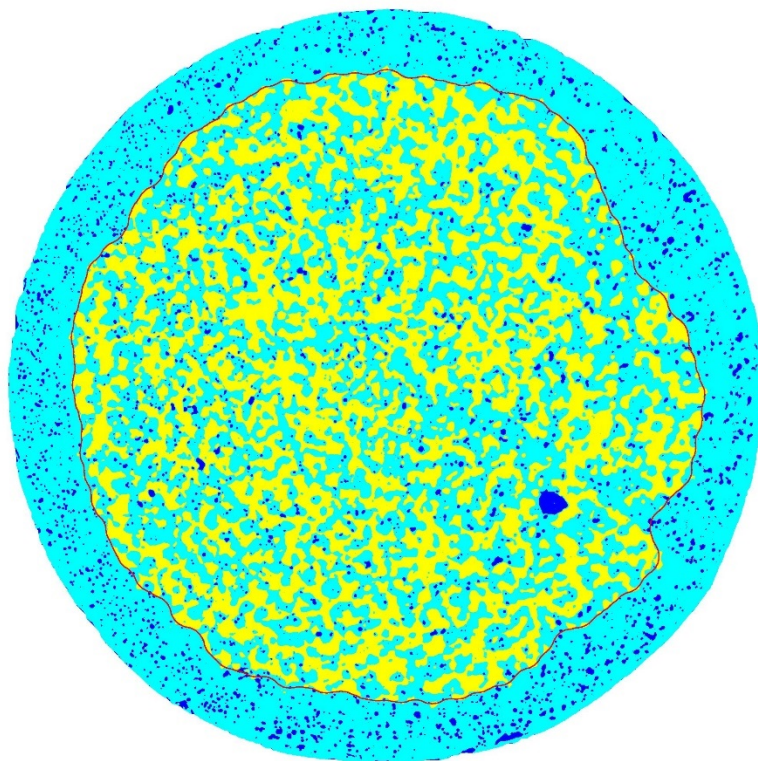
P17030905N247



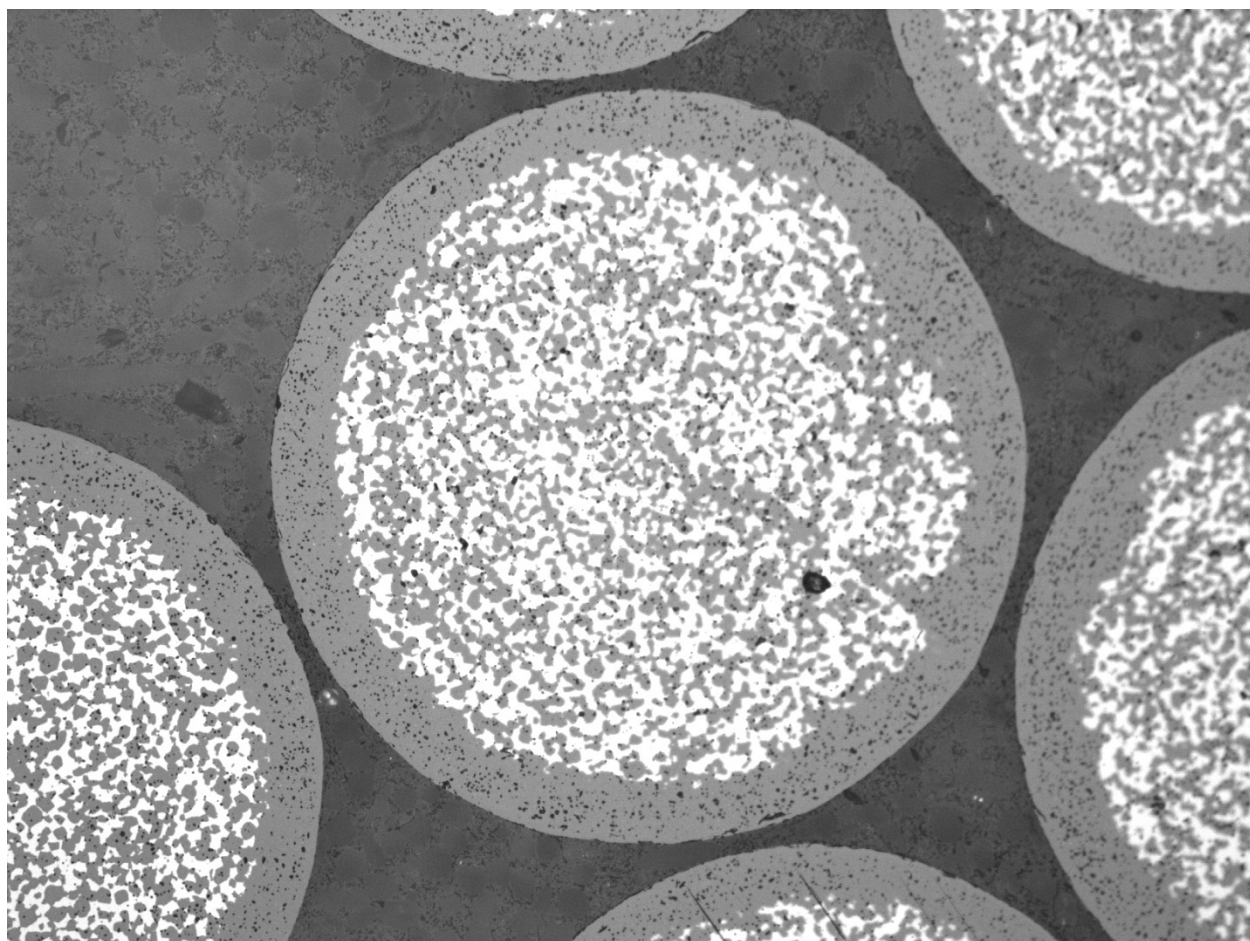
P17030905N248 segmented



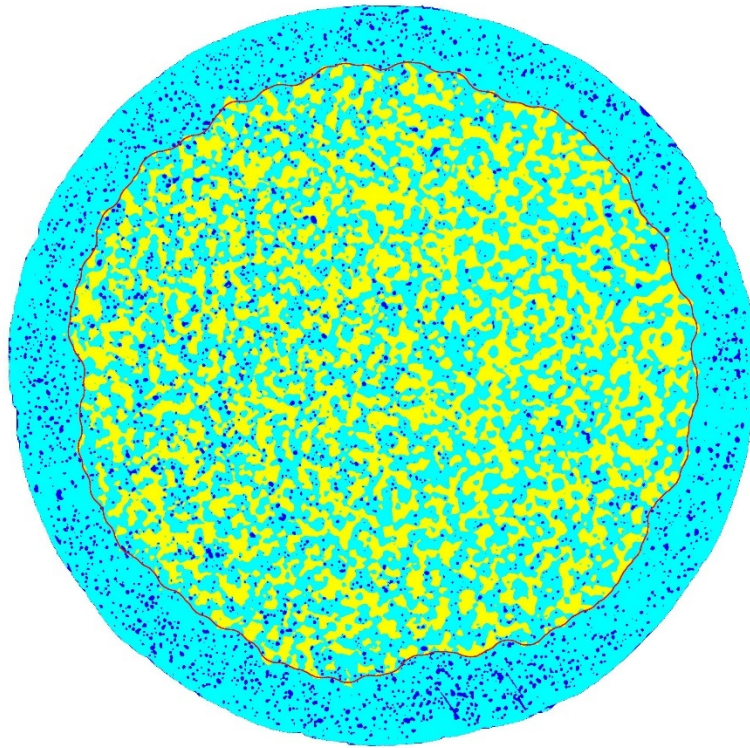
P17030905N248



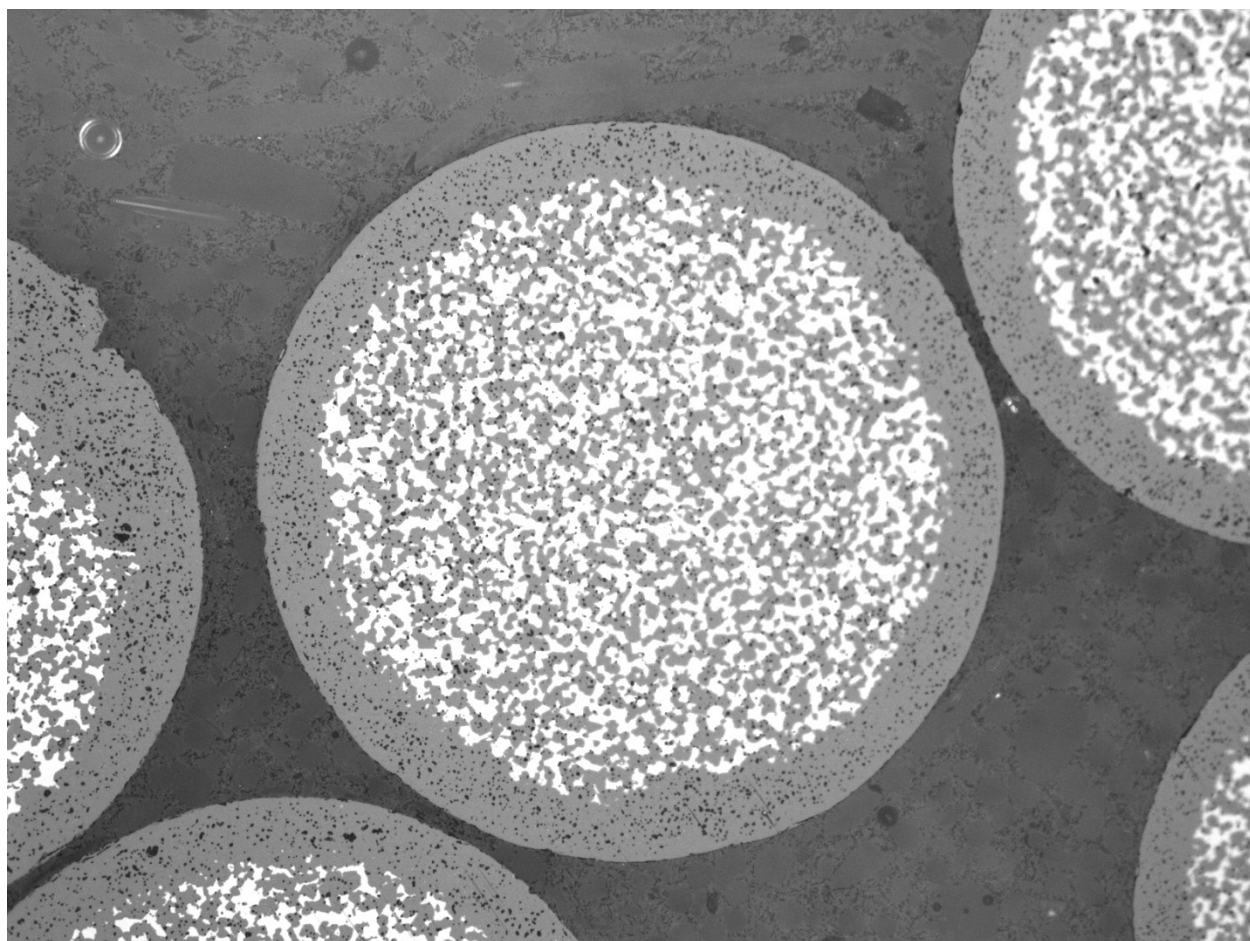
P17030905N249 segmented



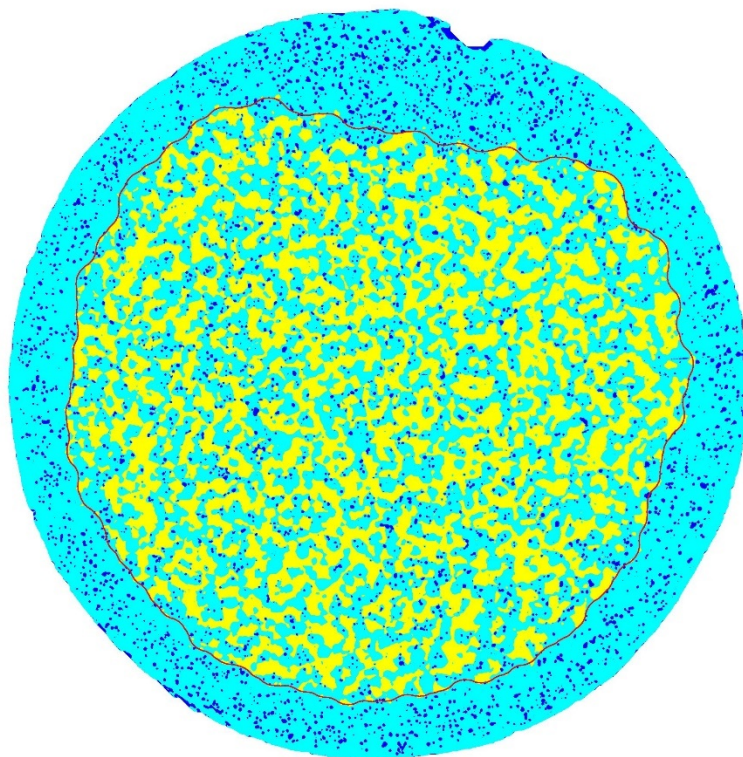
P17030905N249



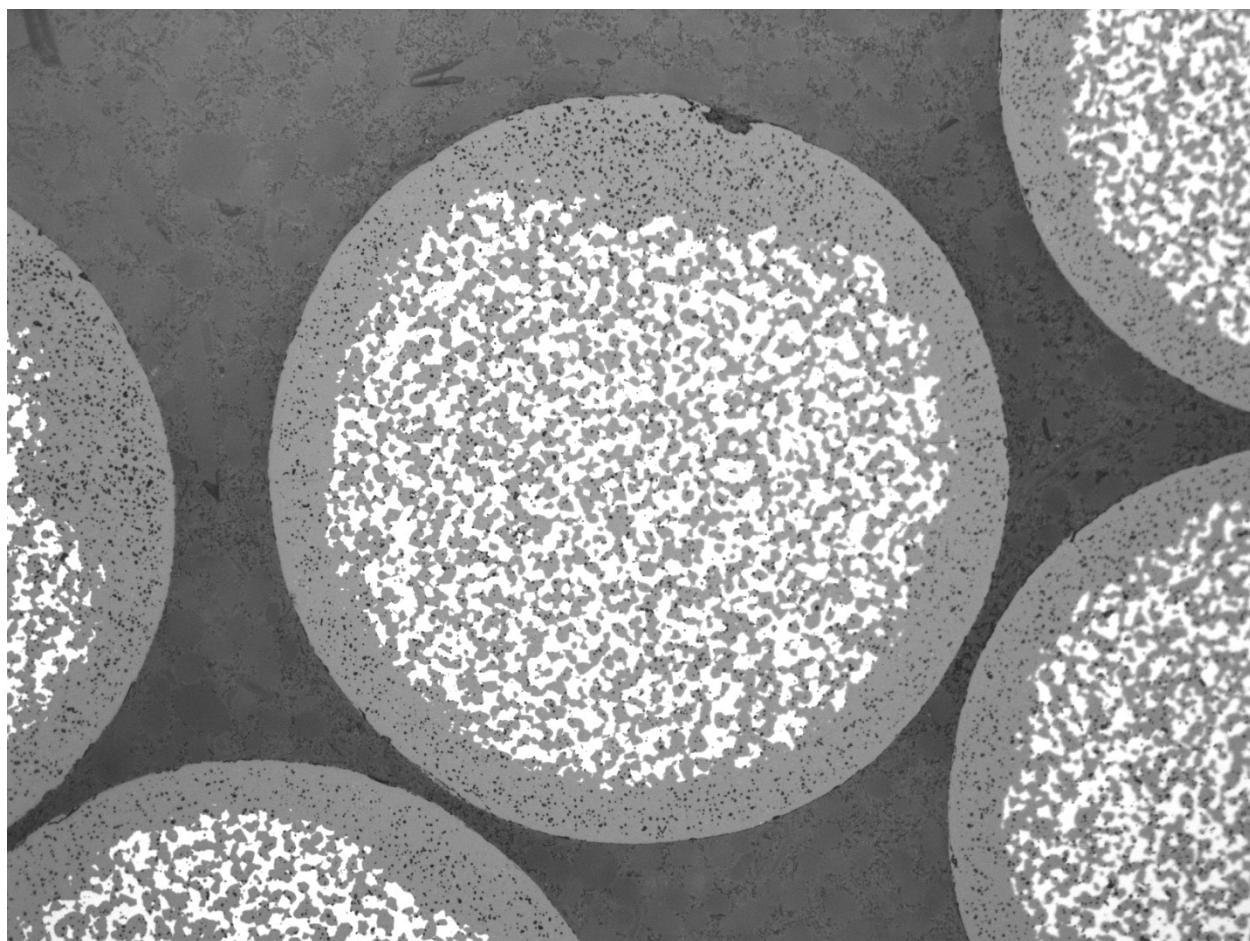
P17030905N251 segmented



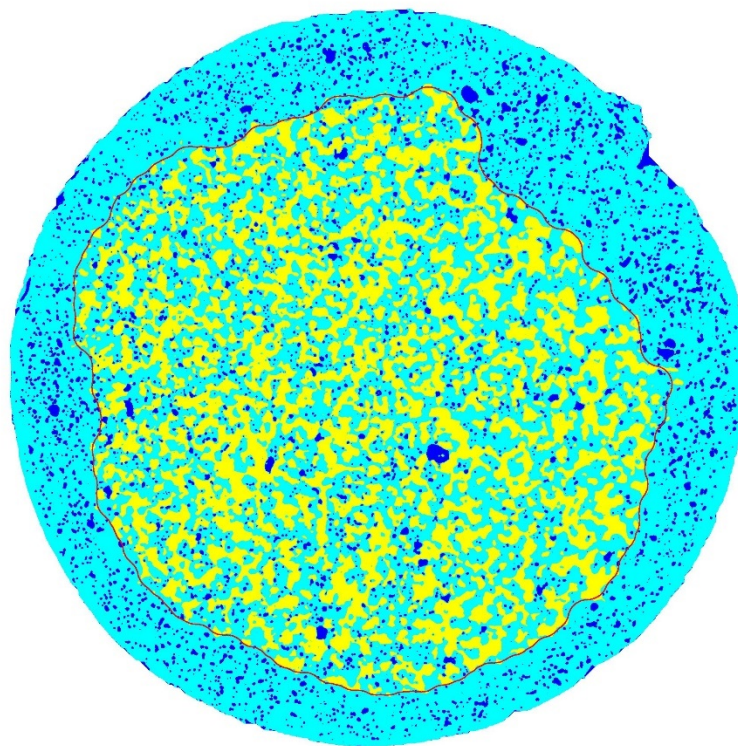
P17030905N251



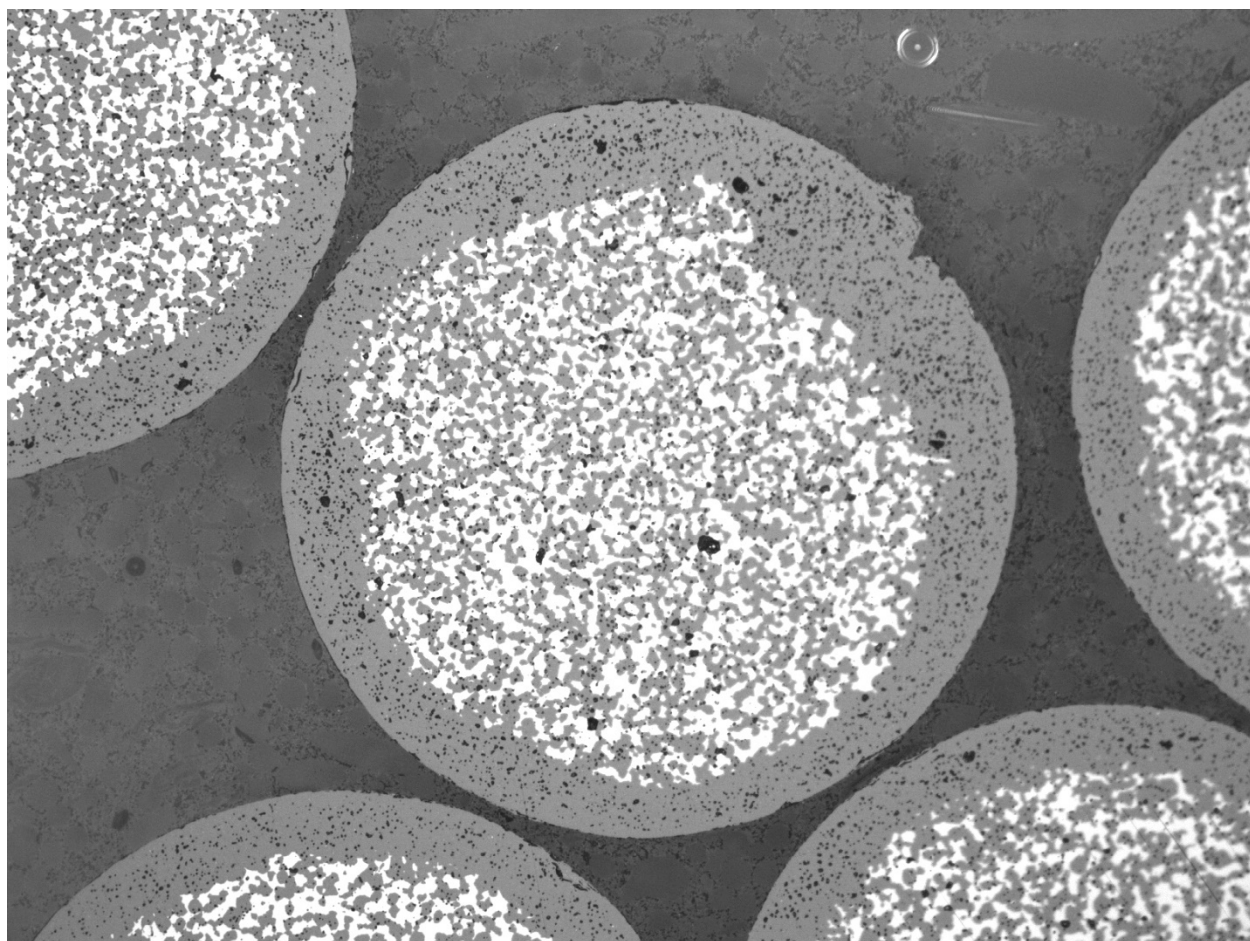
P17030905N252 segmented



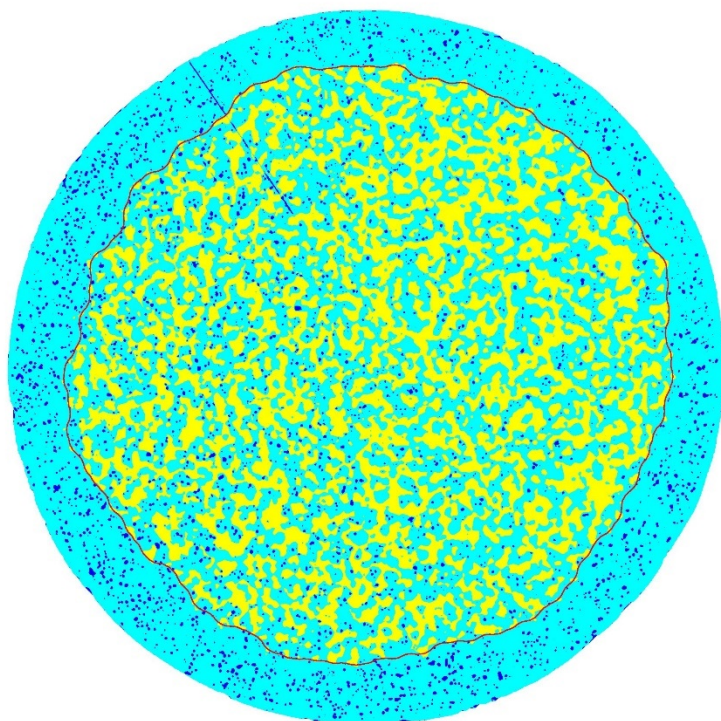
P17030905N252



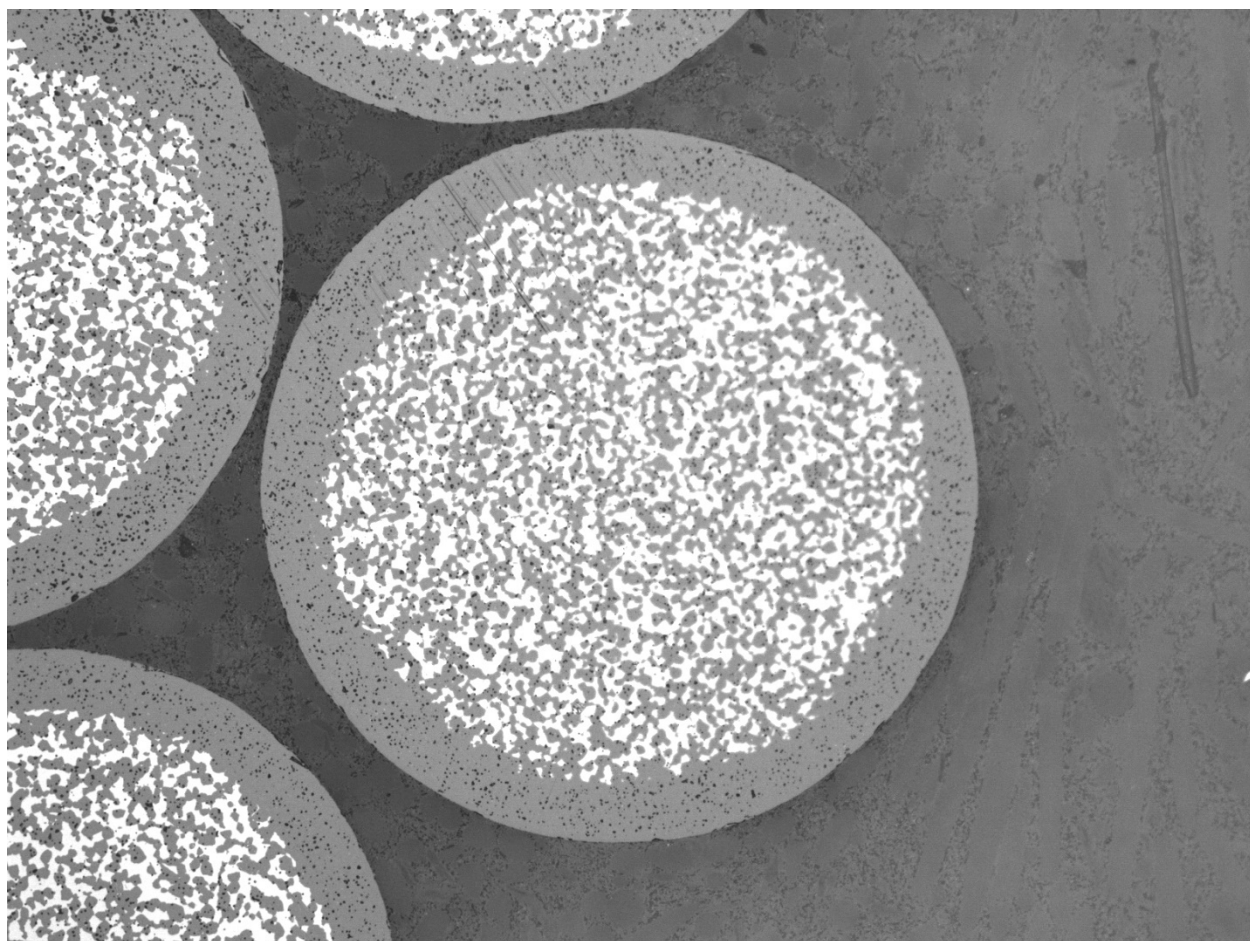
P17030905N254 segmented



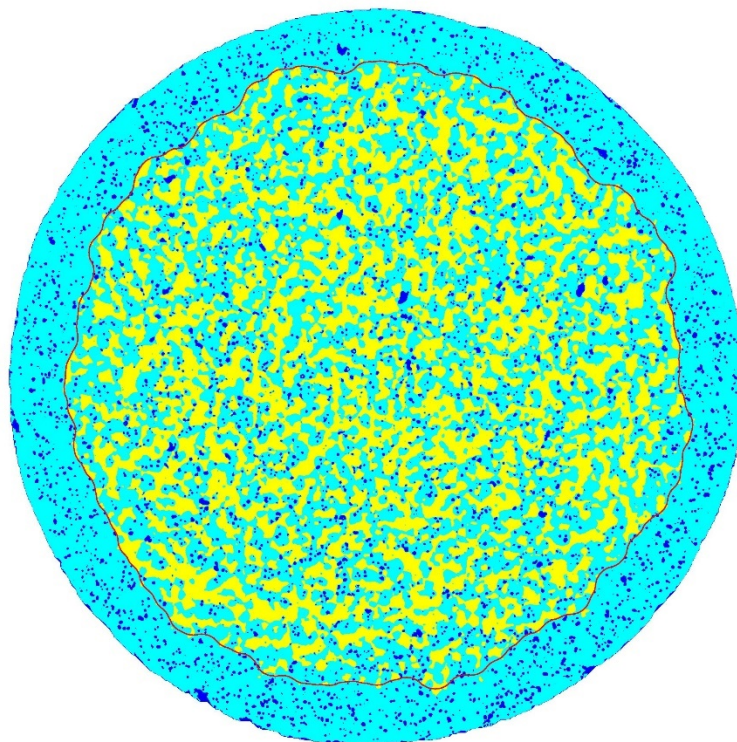
P17030905N254



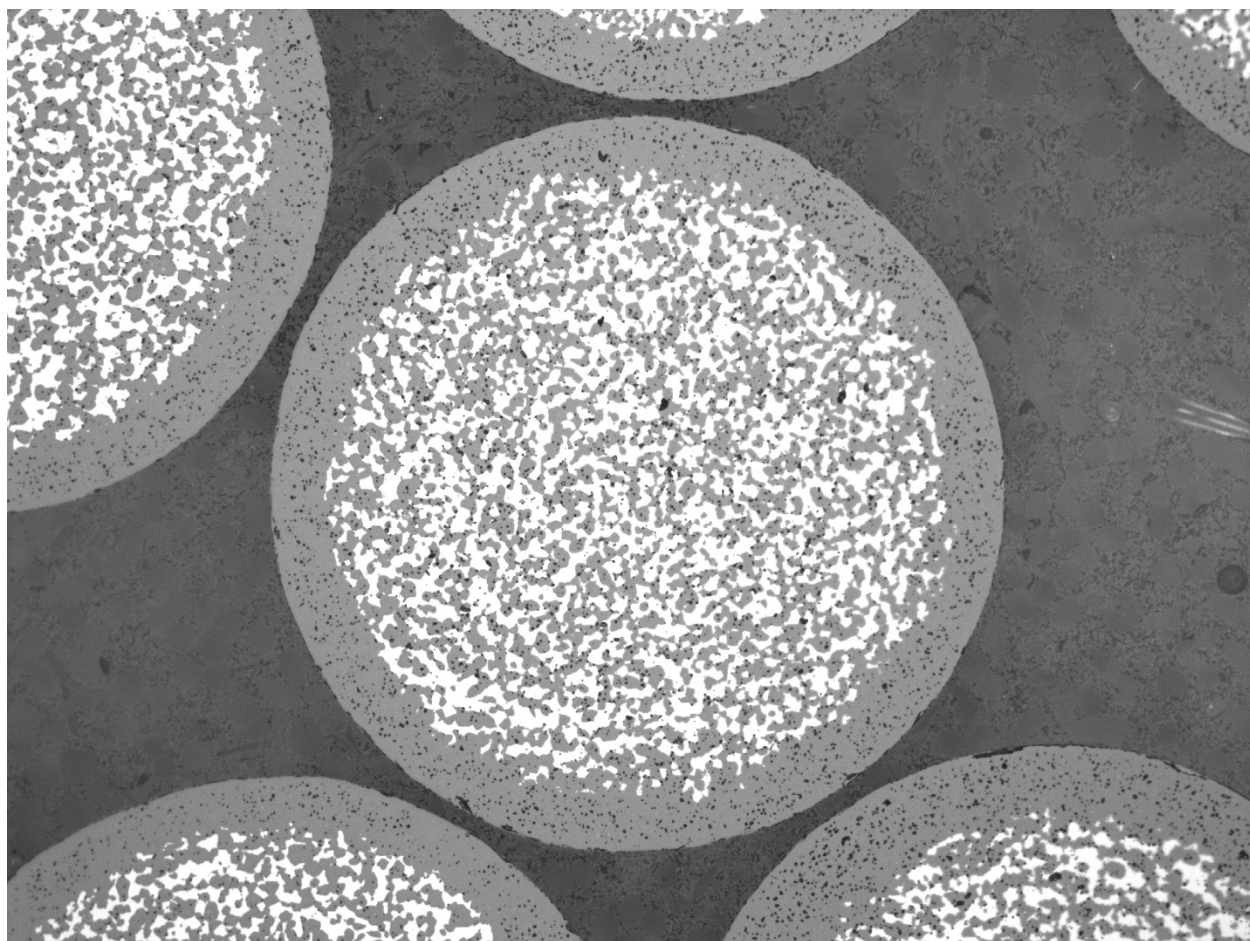
P17030905N255 segmented



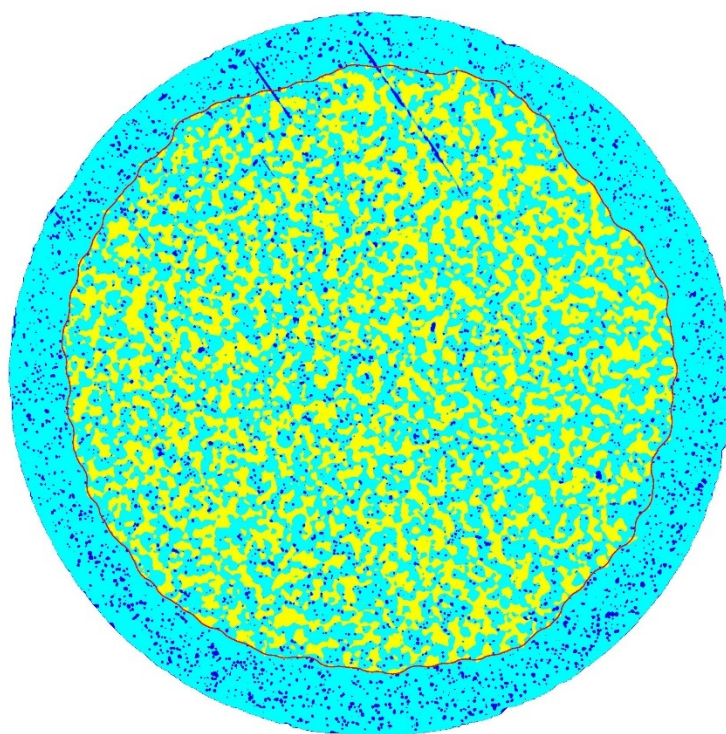
P17030905N255



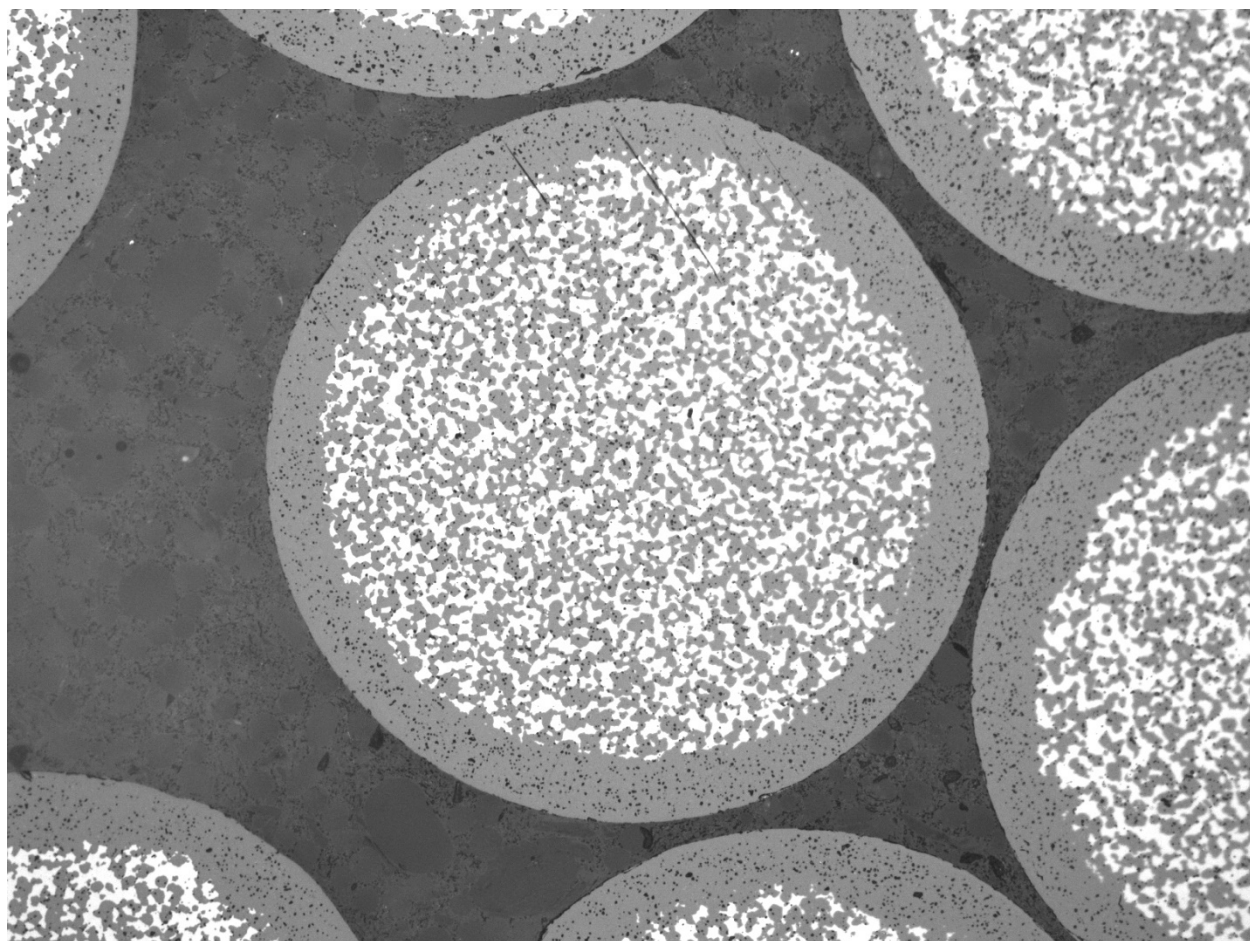
P17030905N256 segmented



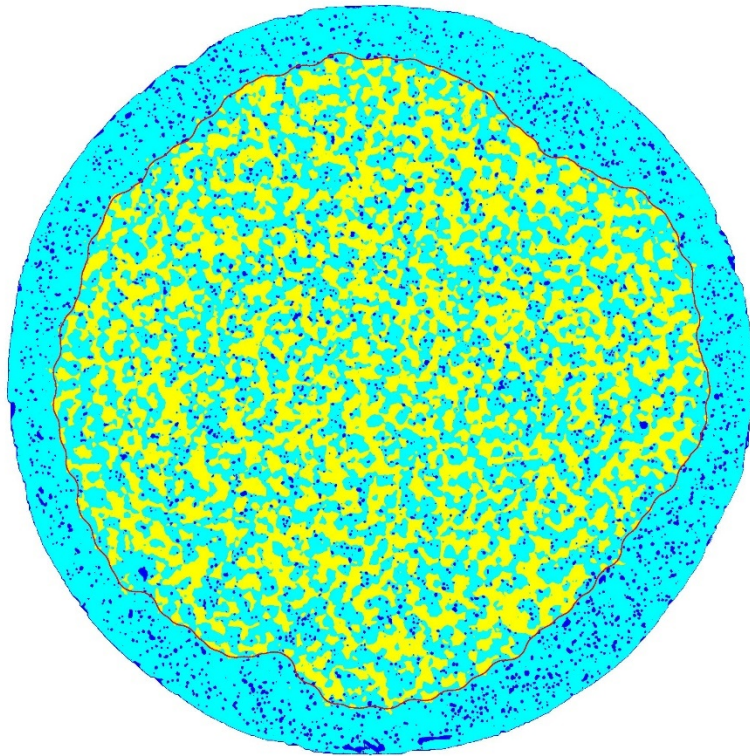
P17030905N256



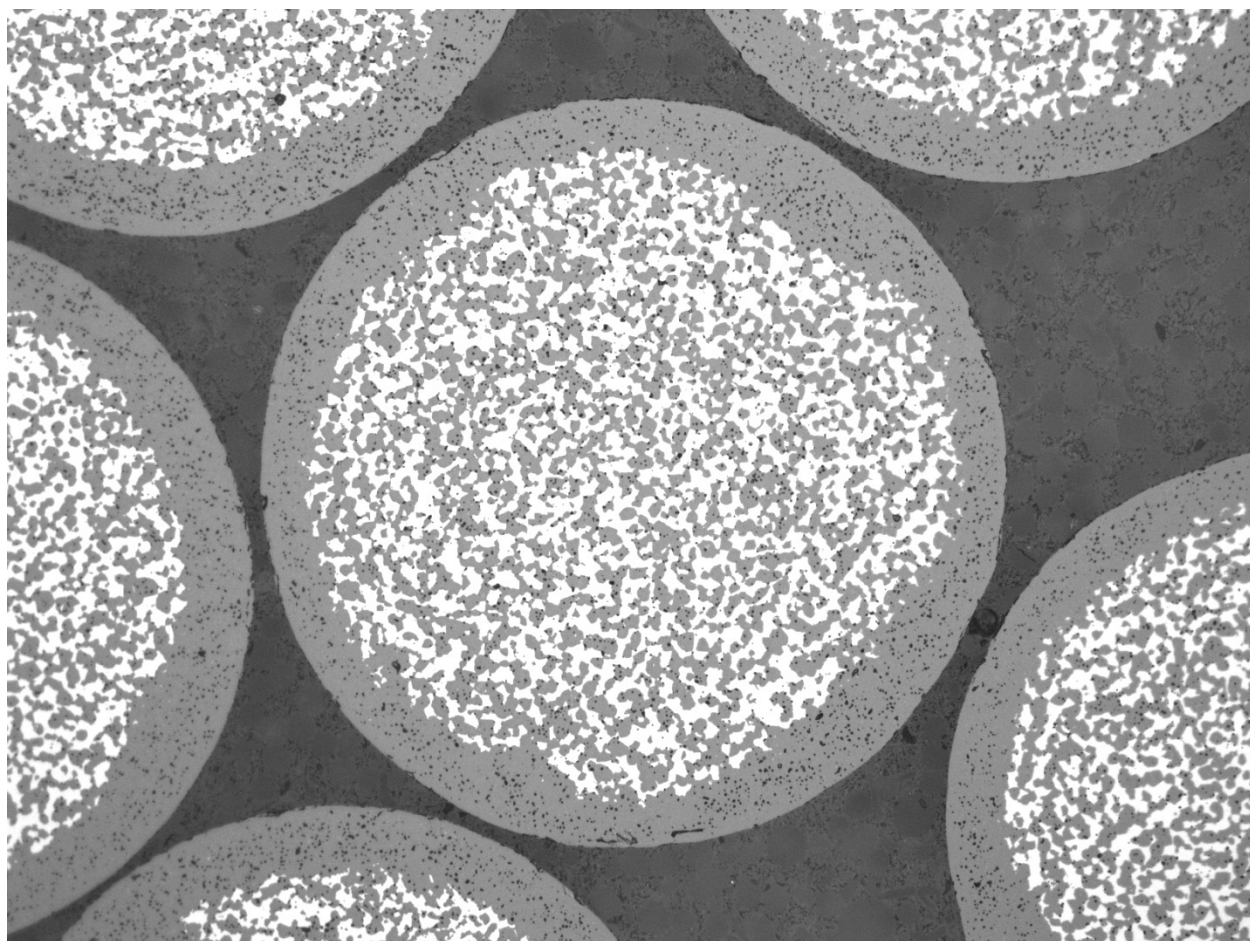
P17030905N257 segmented



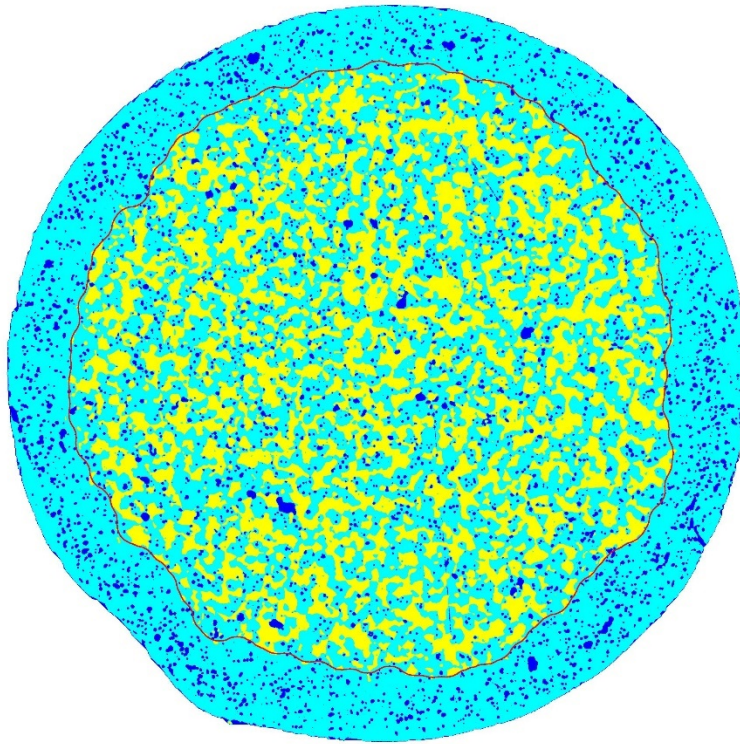
P17030905N257



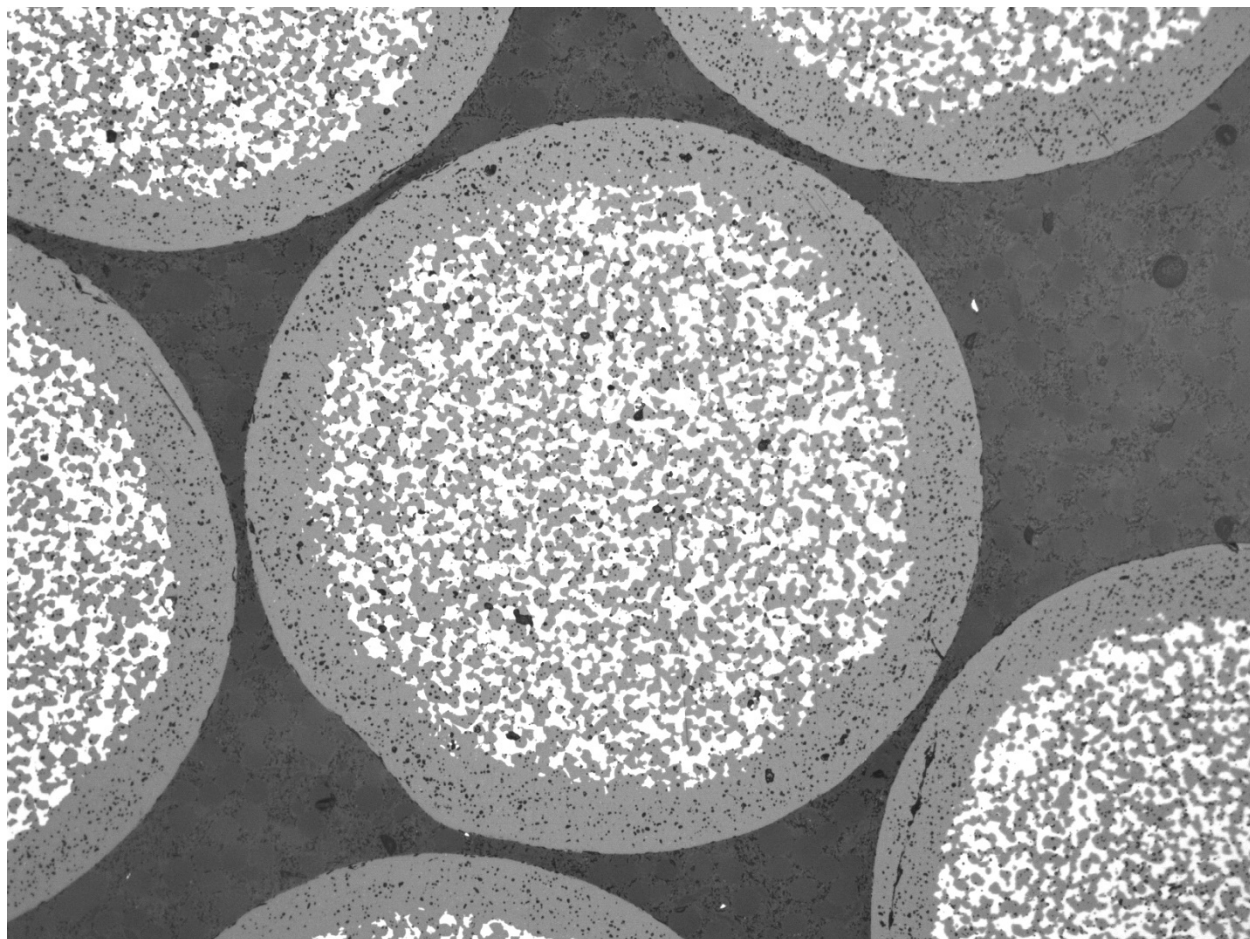
P17030905N258 segmented



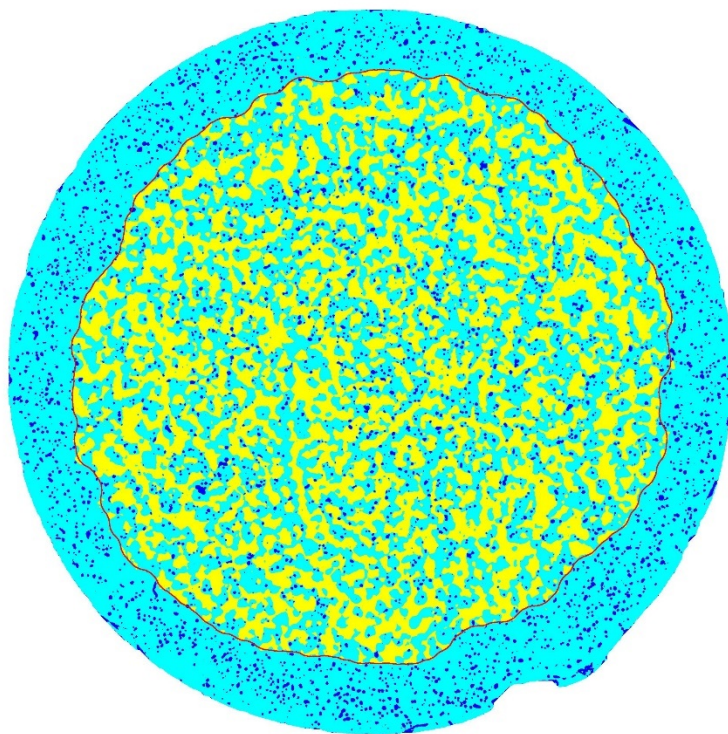
P17030905N258



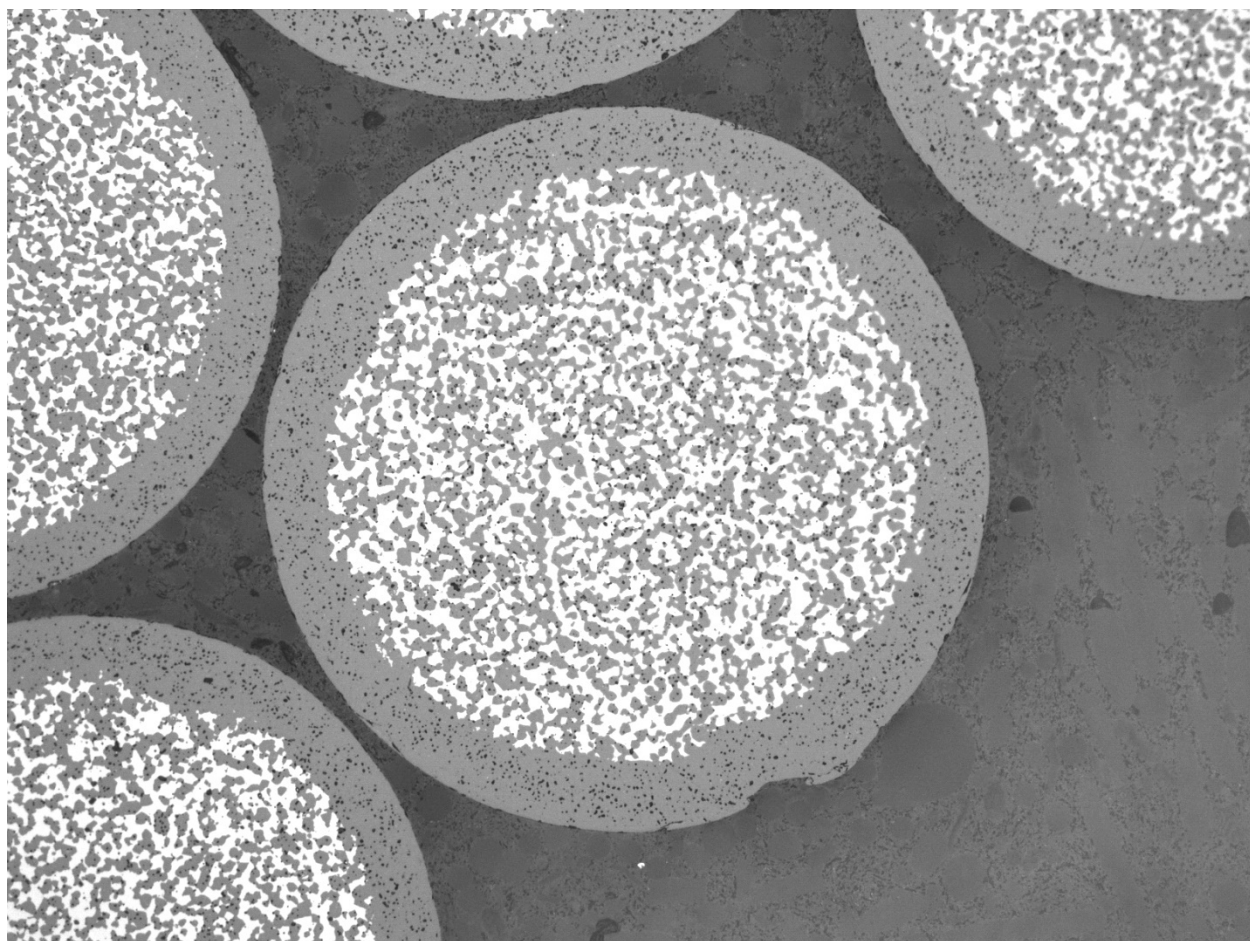
P17030905N259 segmented



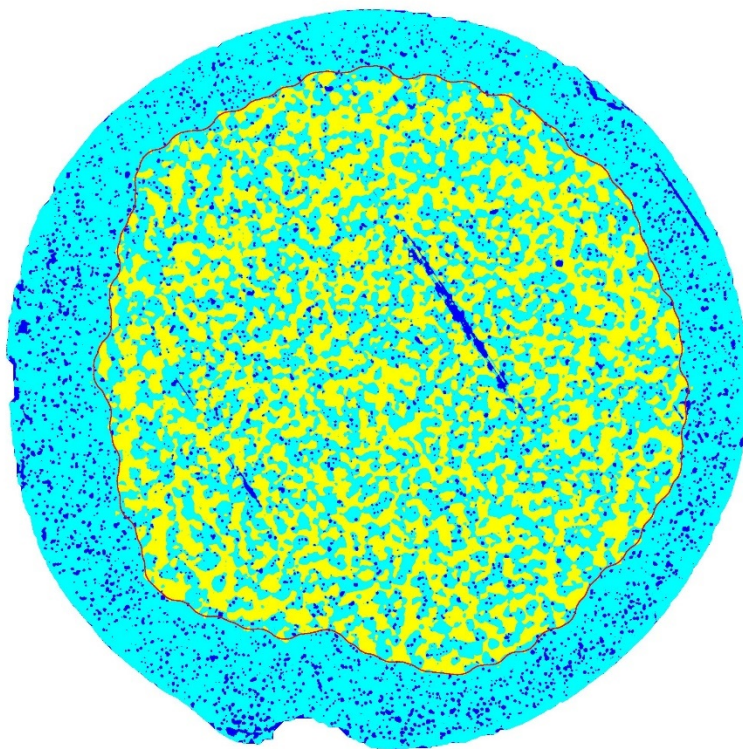
P17030905N259



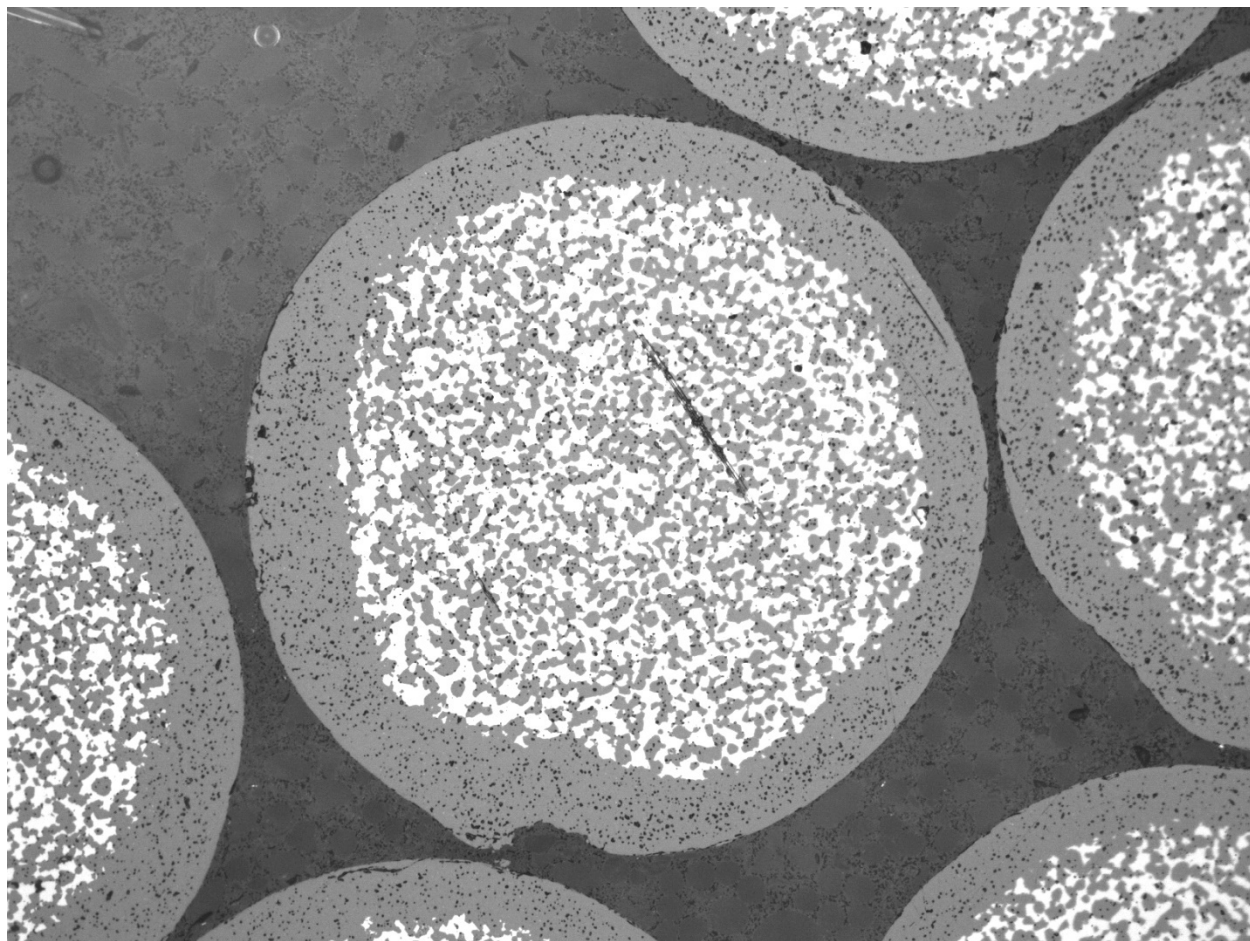
P17030905N260 segmented



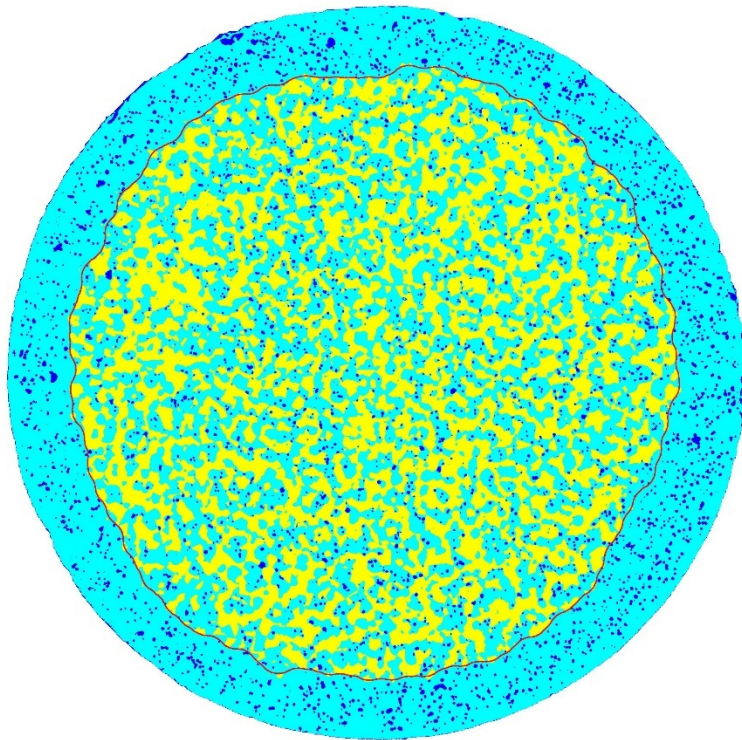
P17030905N260



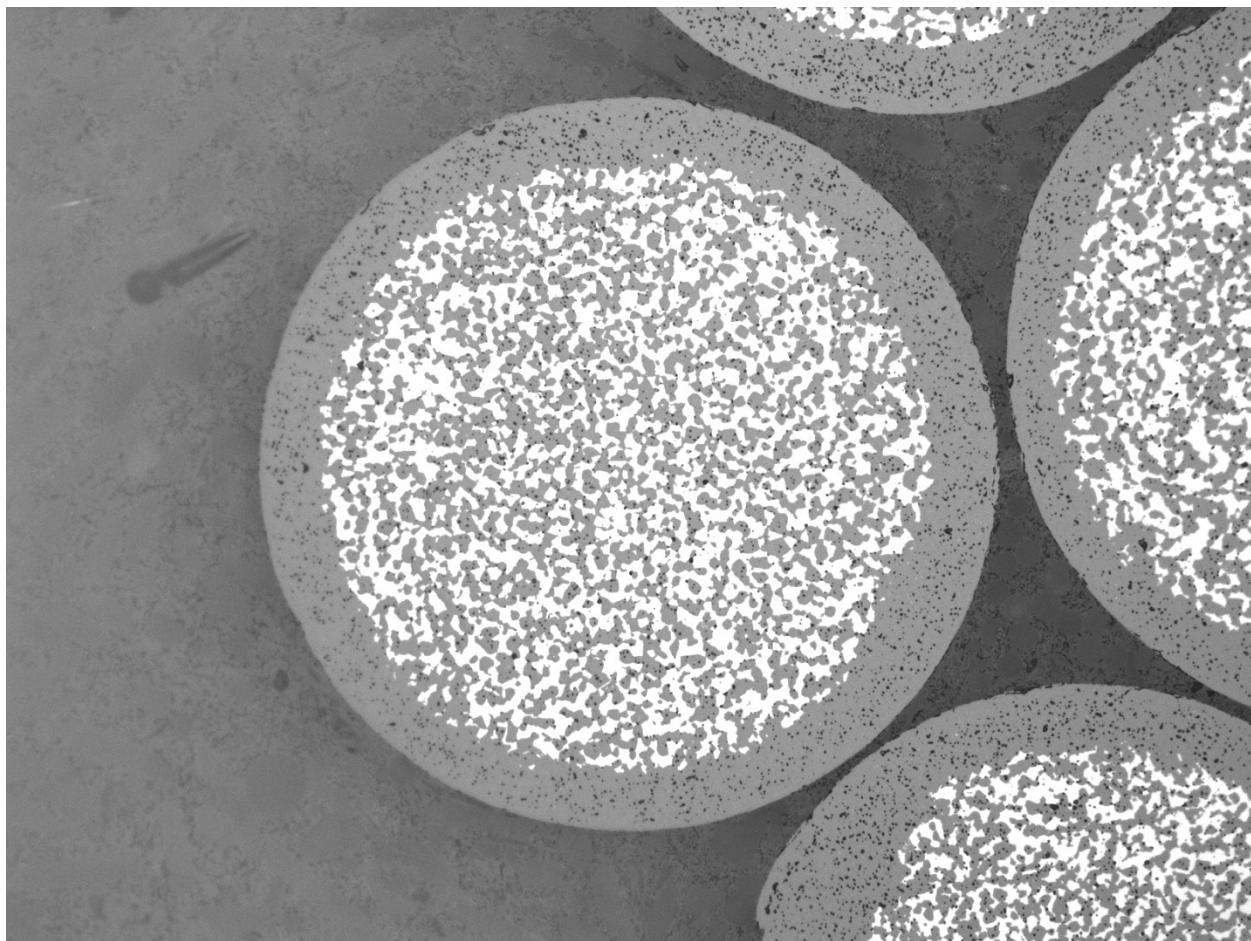
P17030905N261 segmented



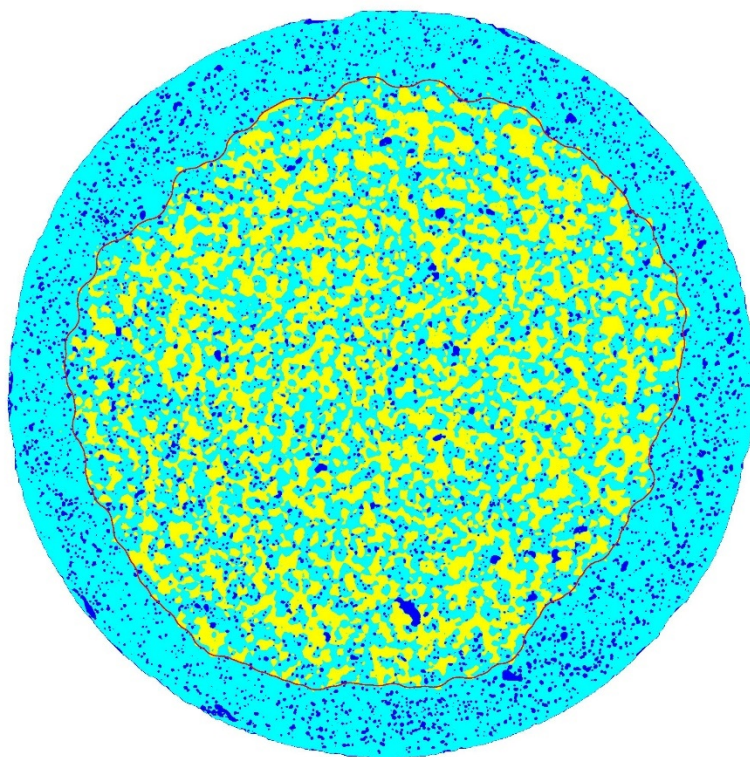
P17030905N261



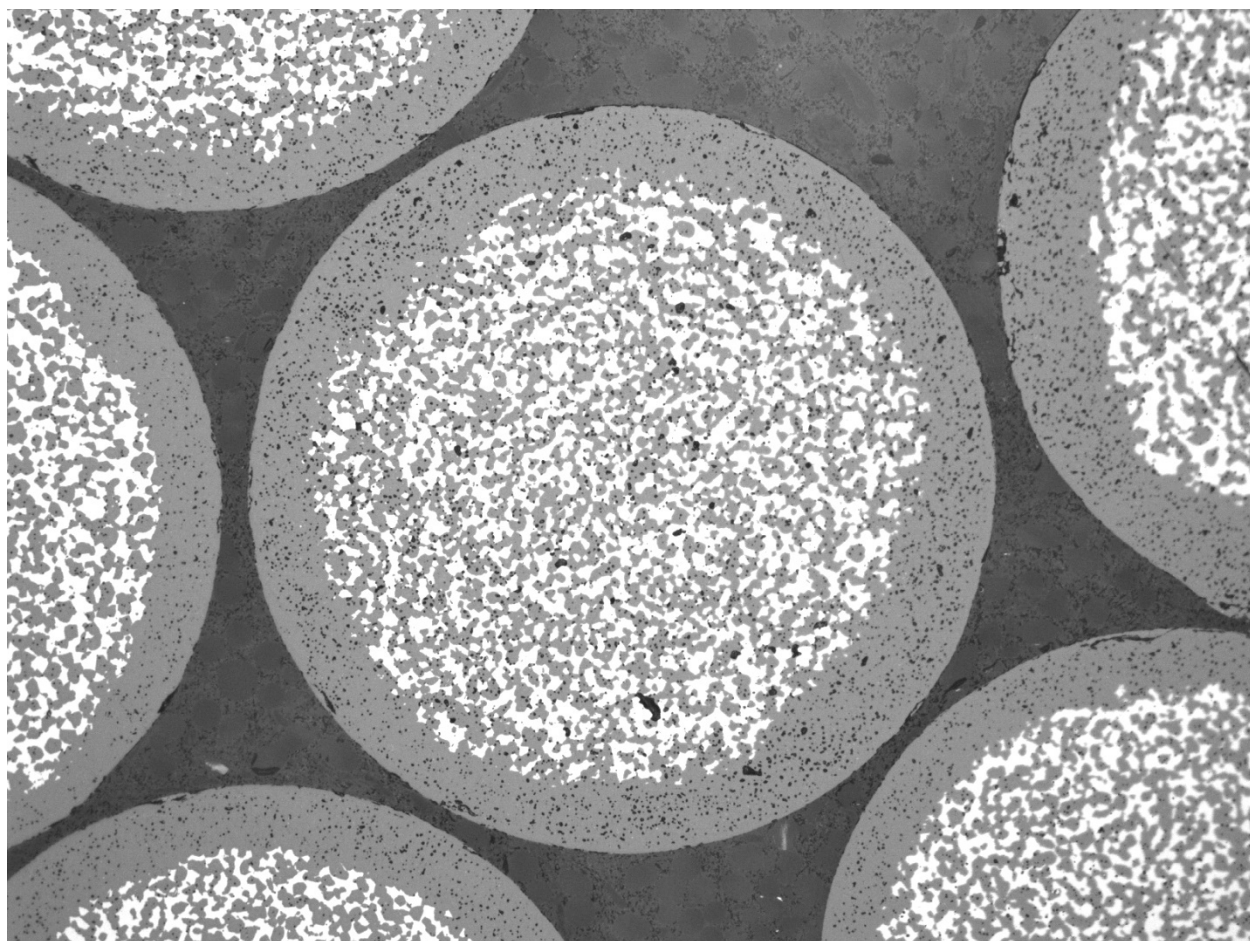
P17030905N262 segmented



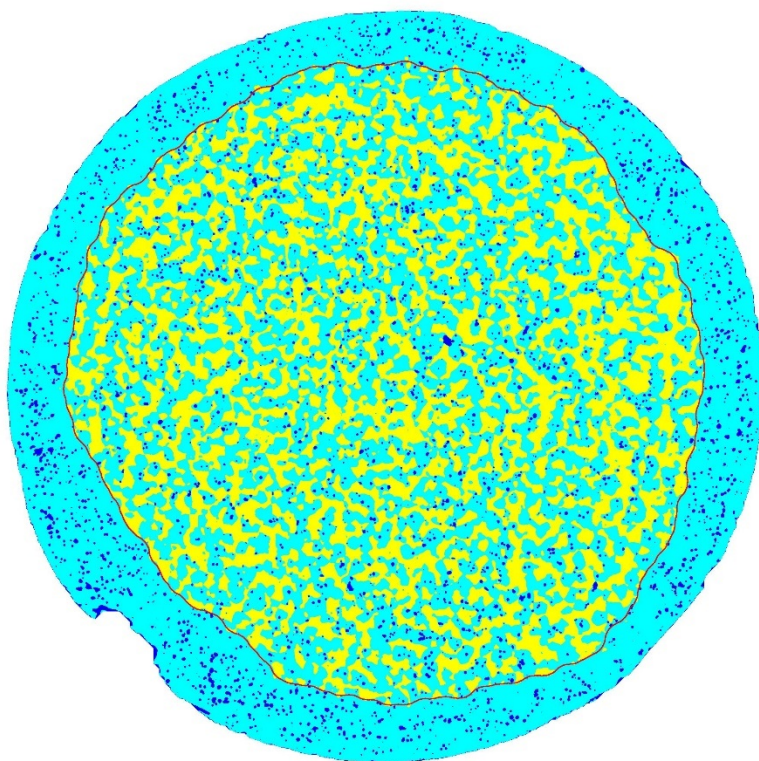
P17030905N262



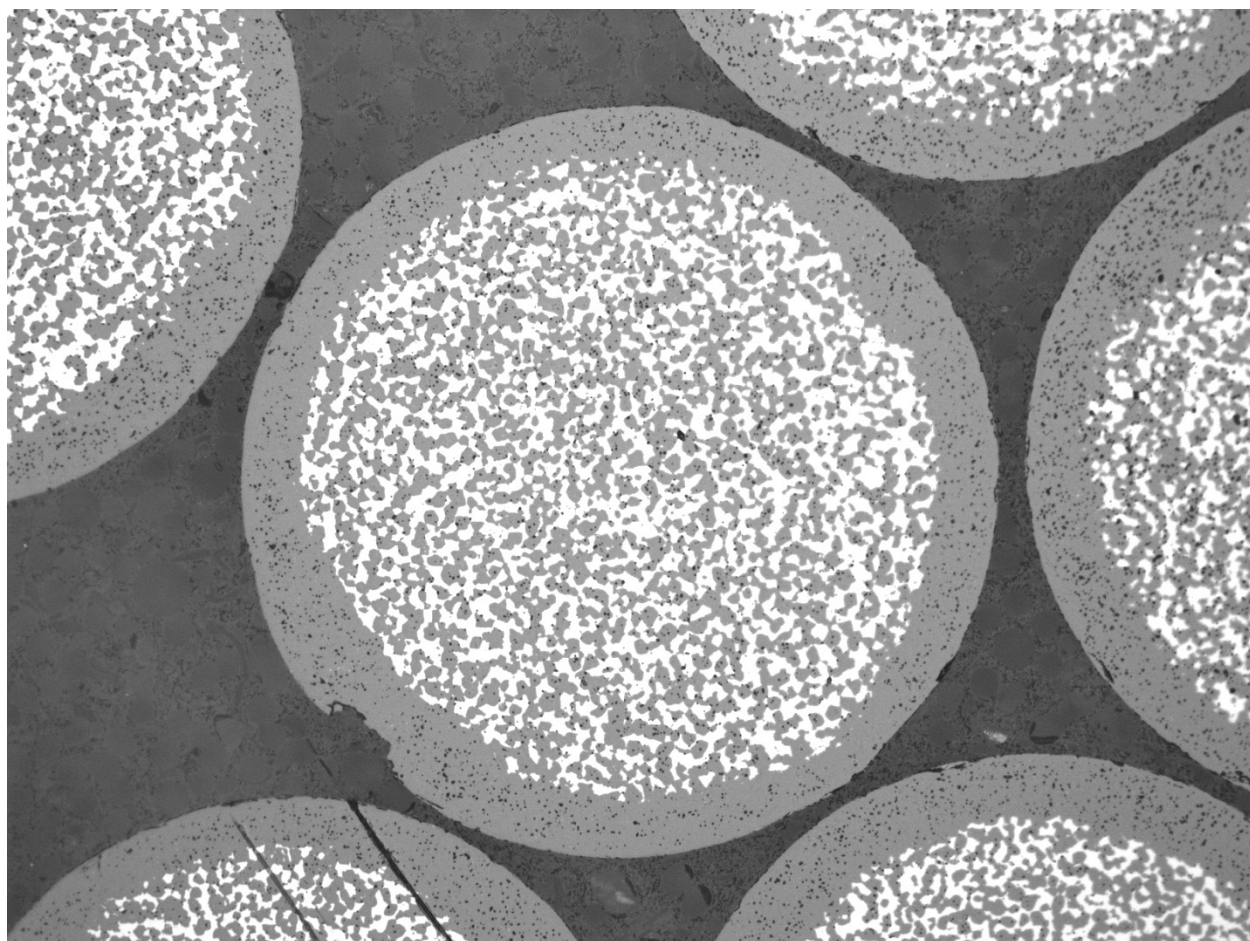
P17030905N263 segmented



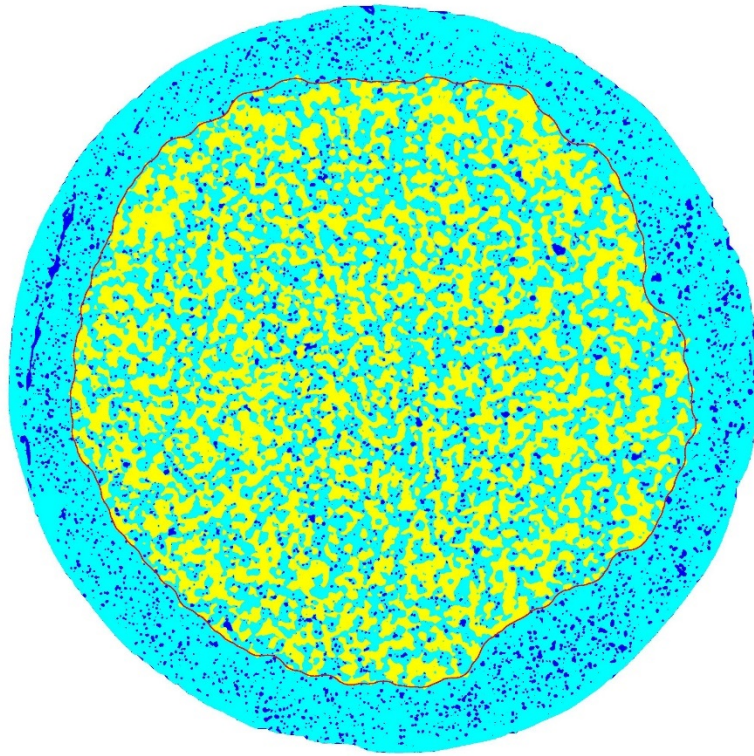
P17030905N263



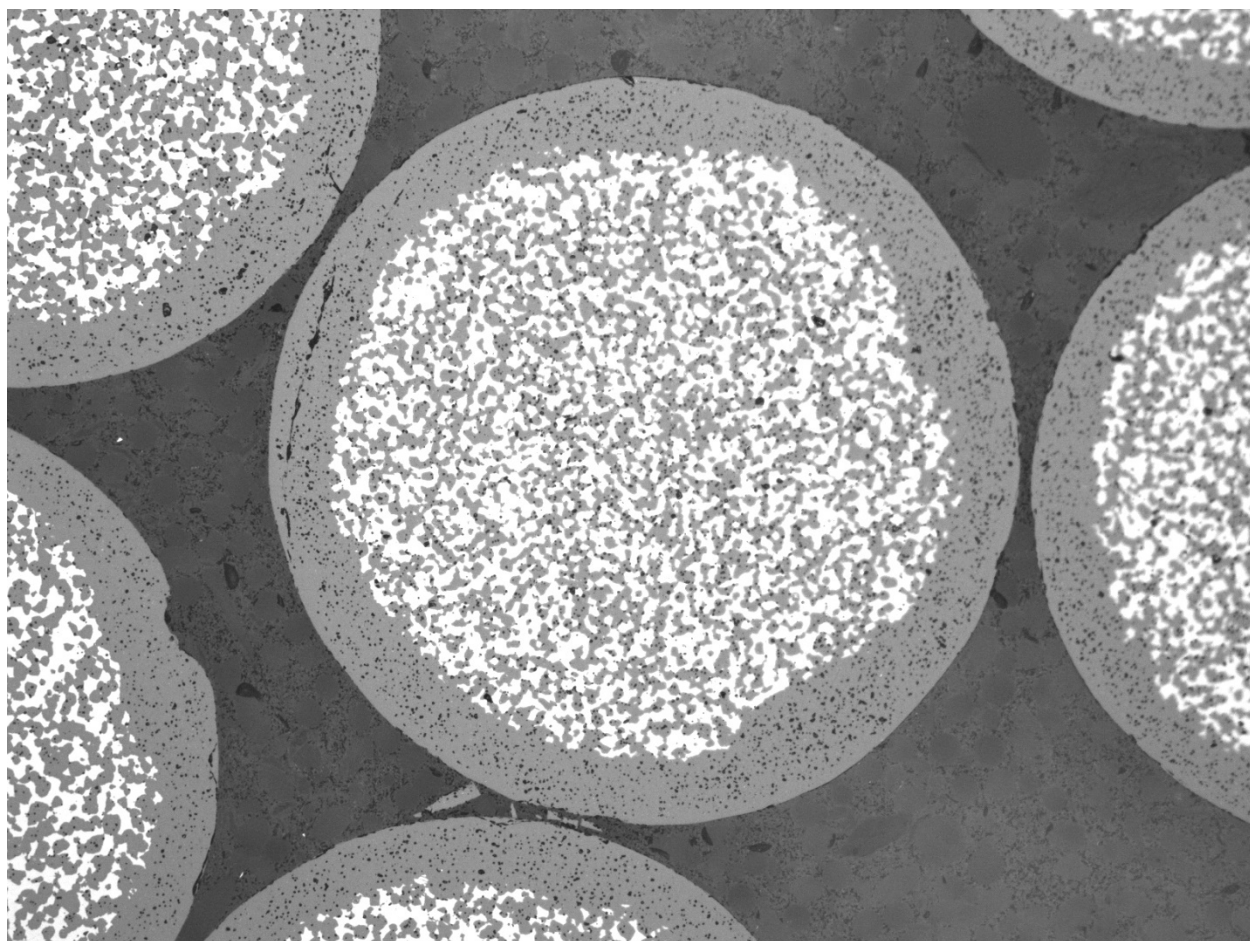
P17030905N264 segmented



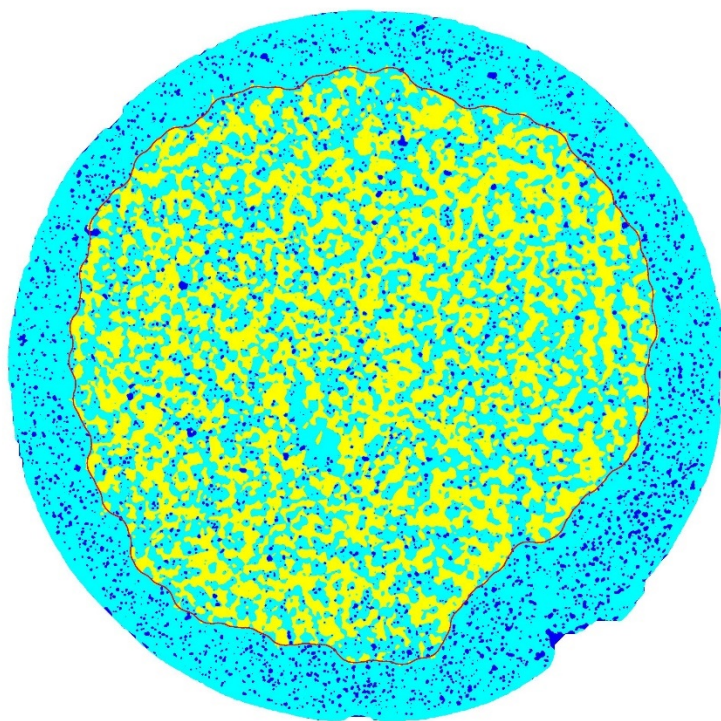
P17030905N264



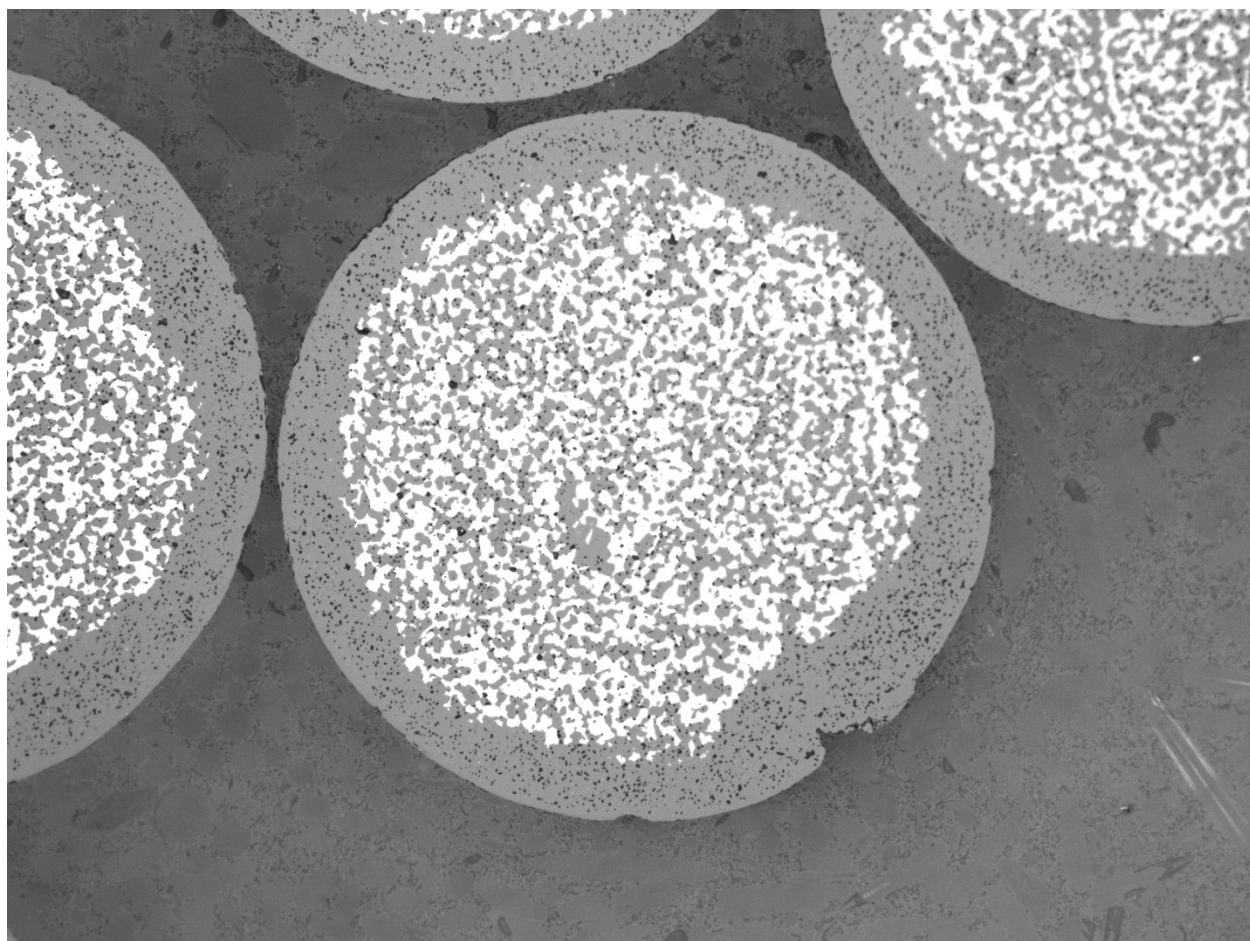
P17030905N265 segmented



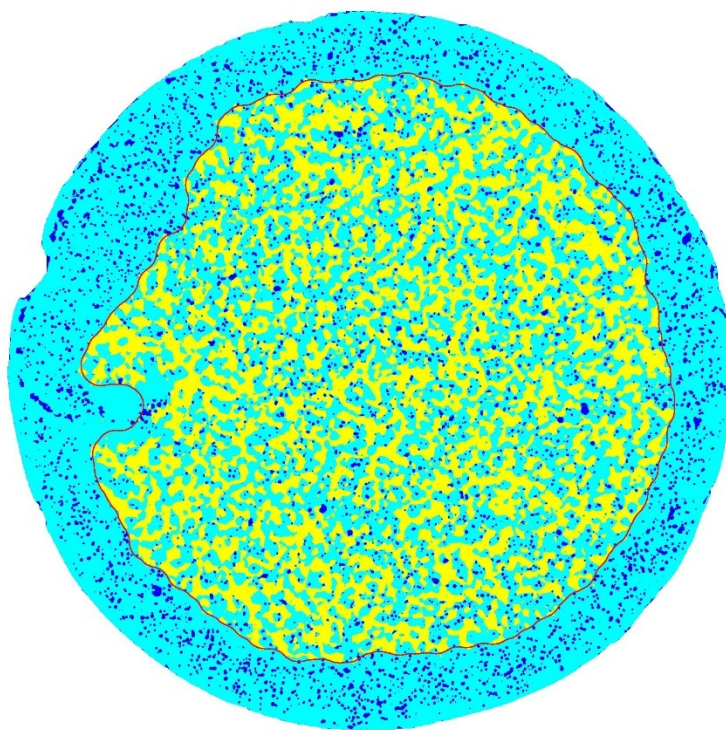
P17030905N265



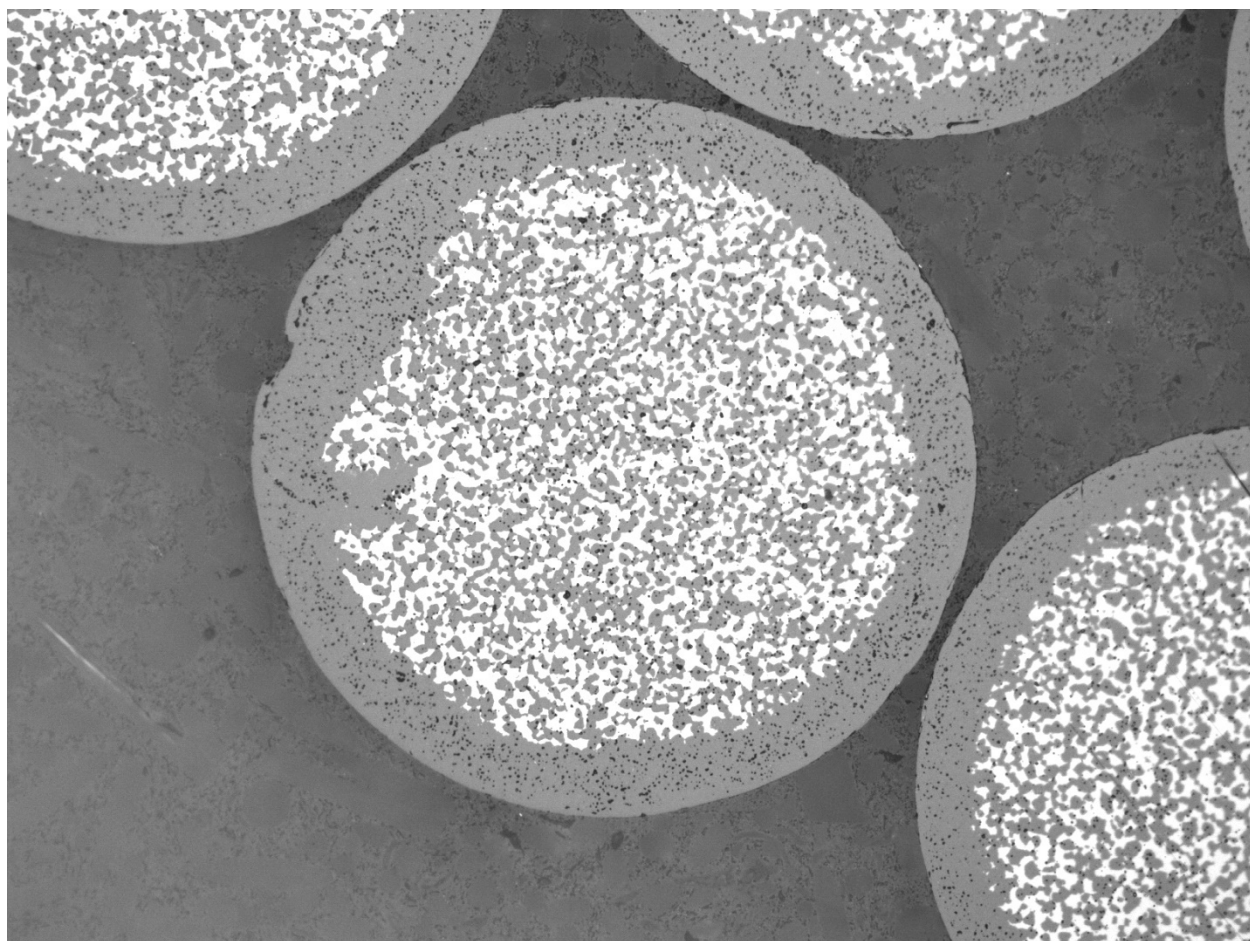
P17030905N266 segmented



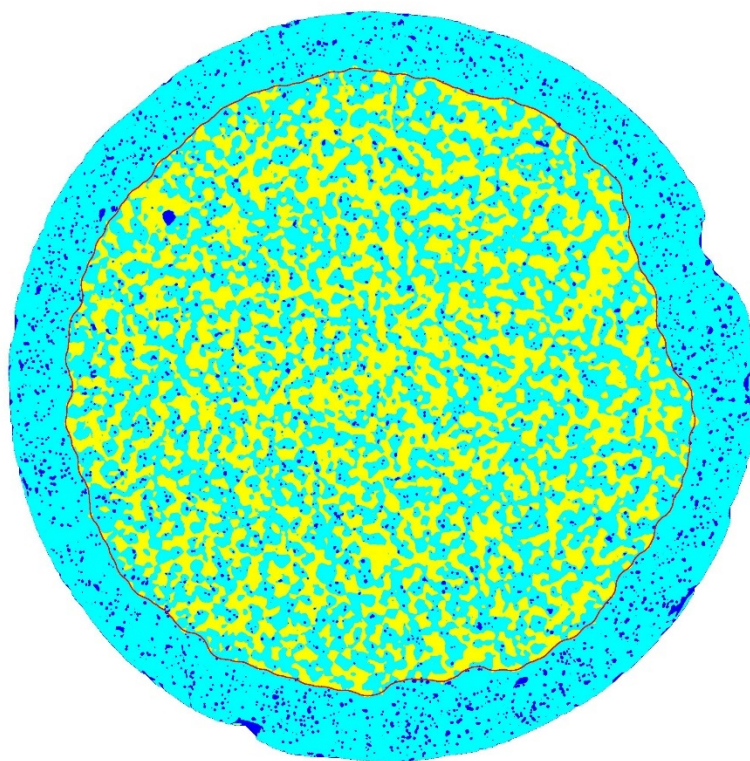
P17030905N266



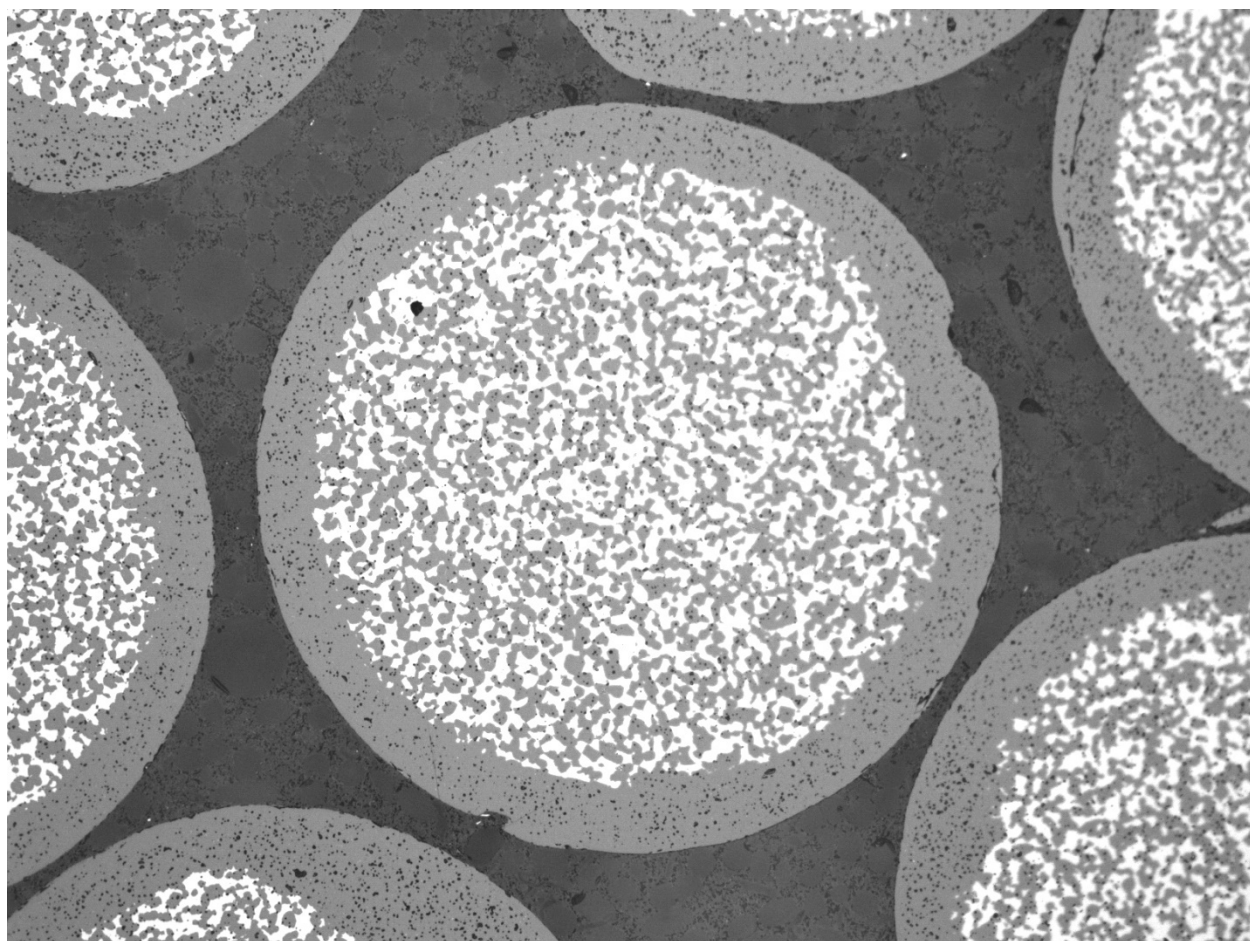
P17030905N267 segmented



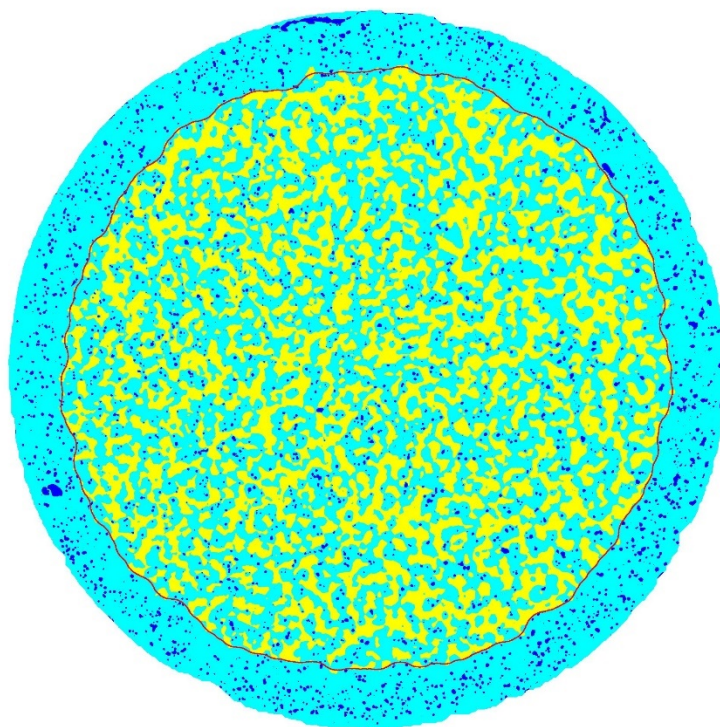
P17030905N267



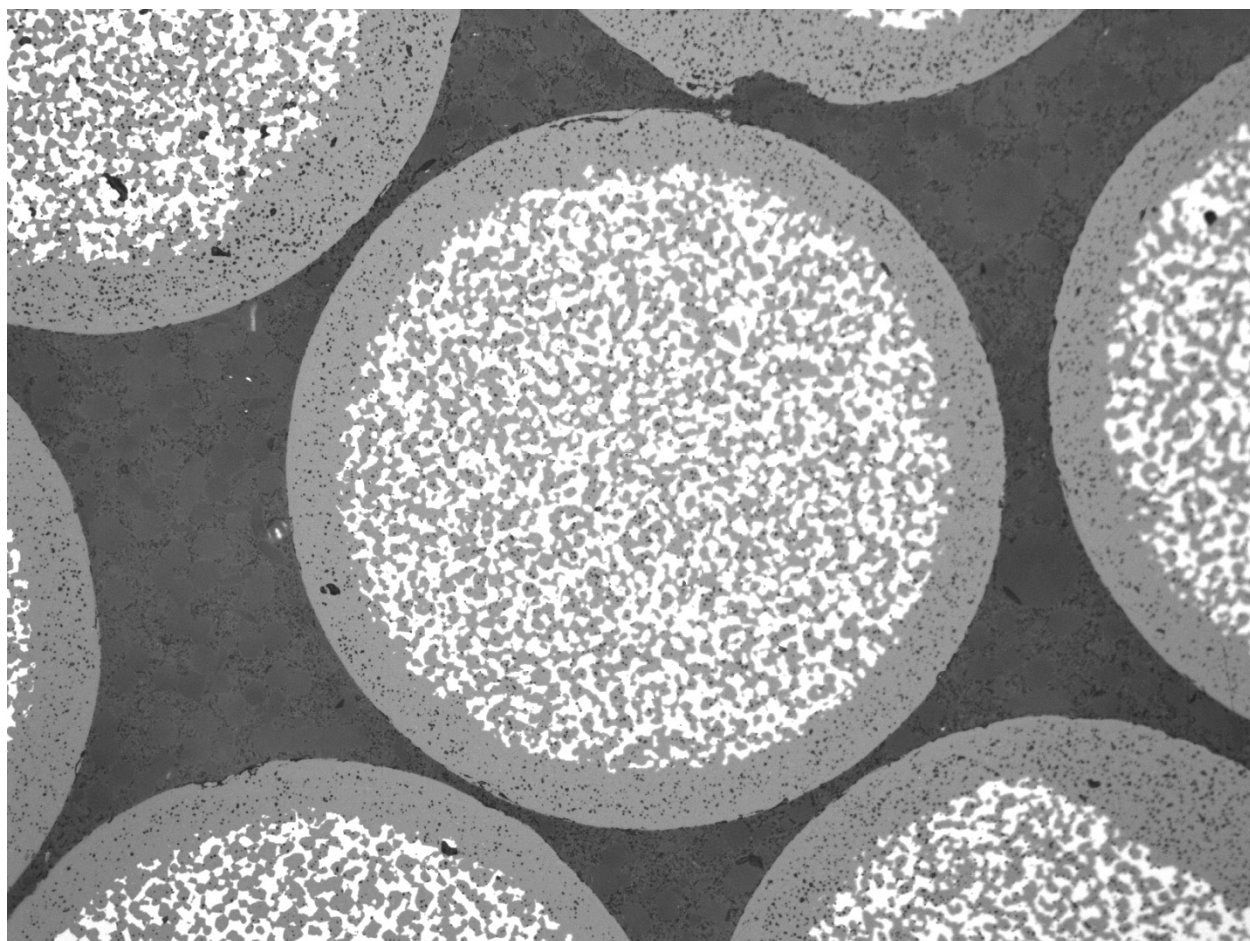
P17030905N268 segmented



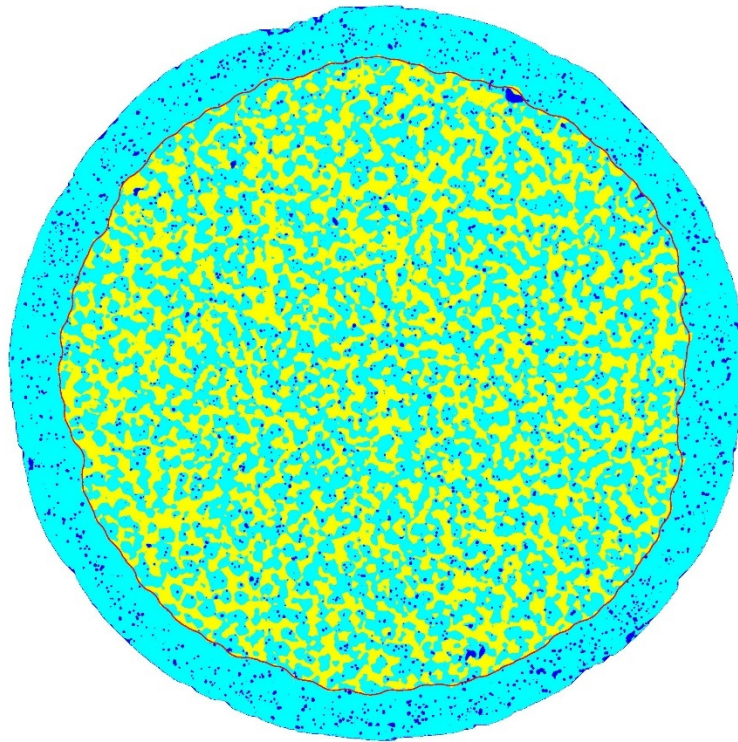
P17030905N268



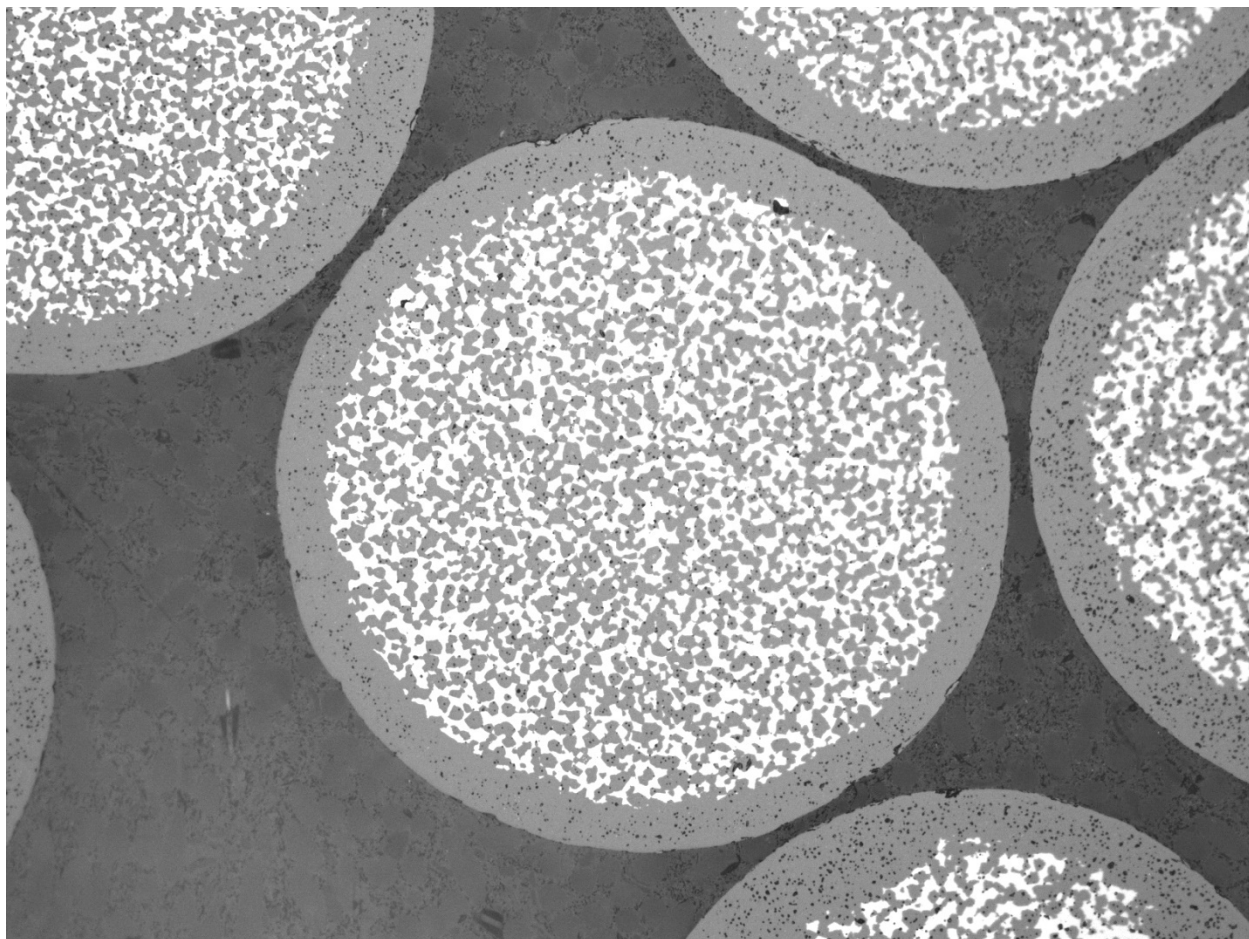
P17030905N269 segmented



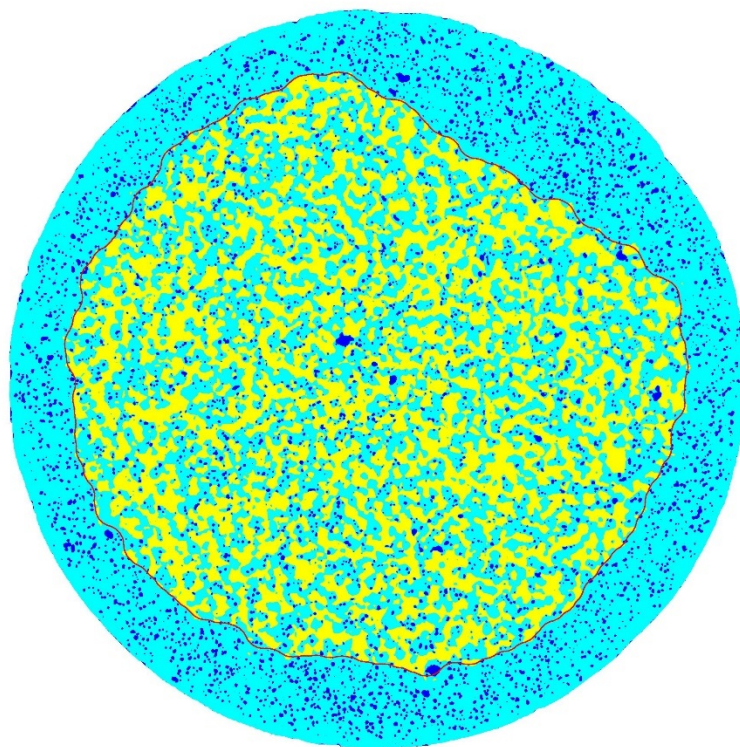
P17030905N269



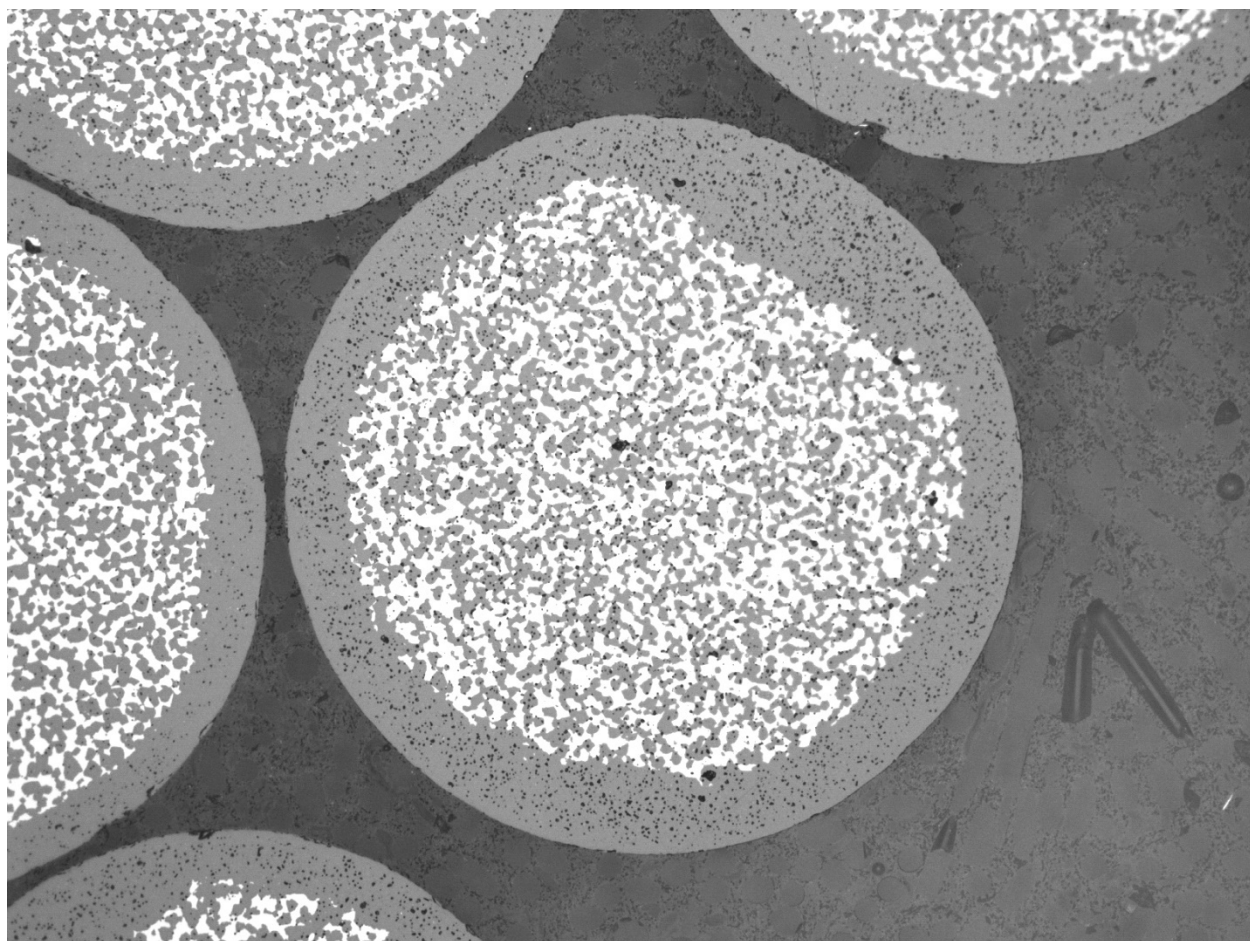
P17030905N273 segmented



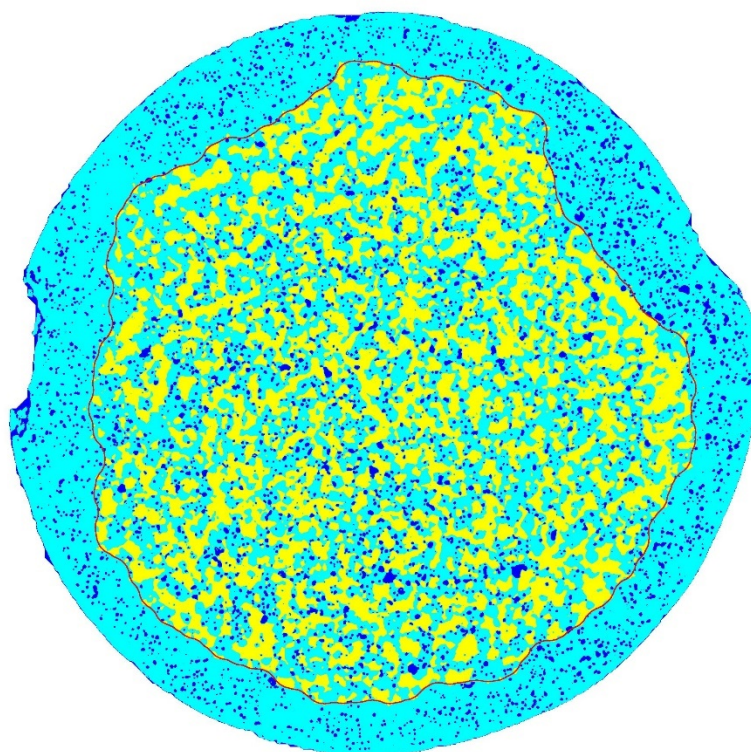
P17030905N273



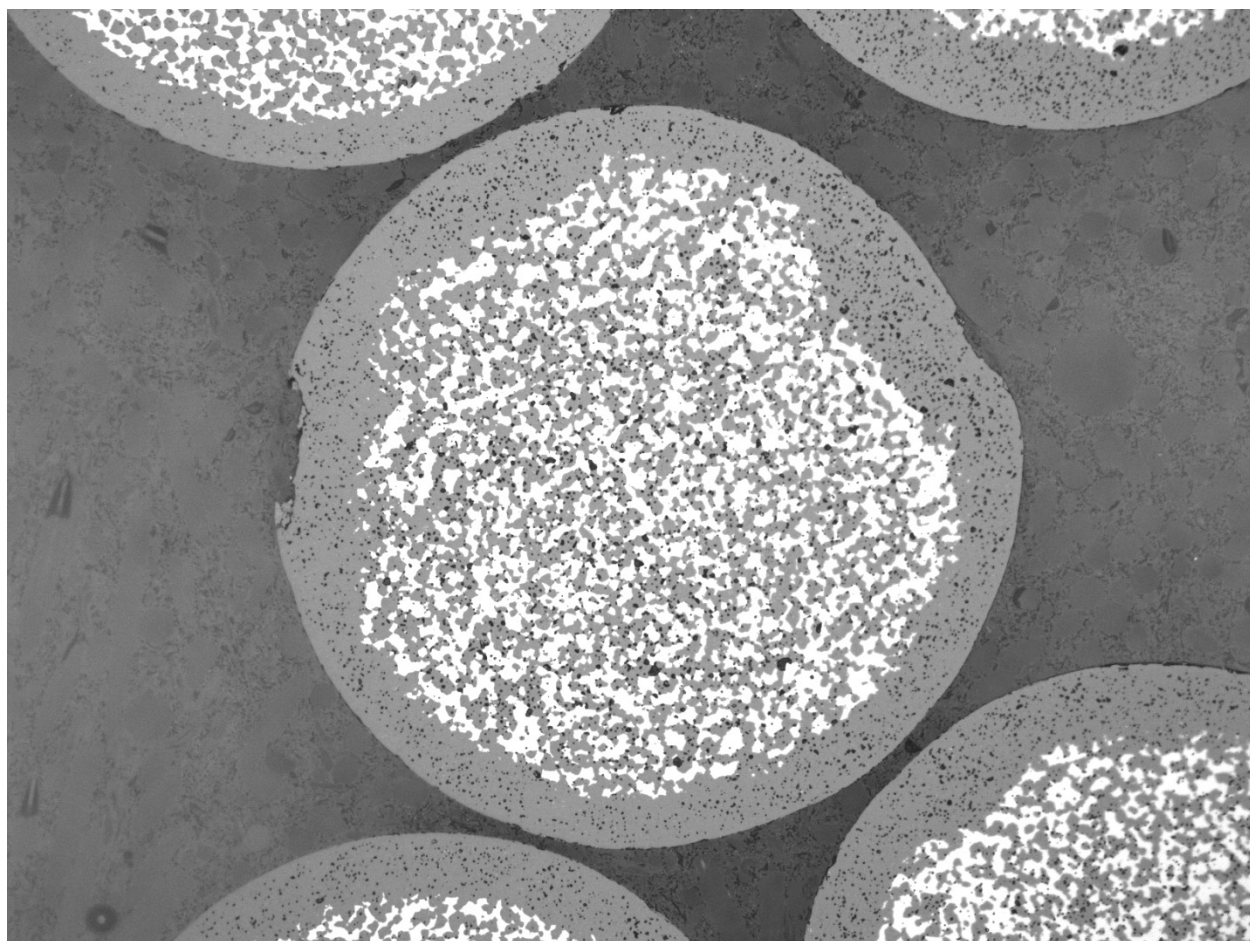
P17030905N274 segmented



P17030905N274



P17030905N276 segmented



P17030905N276

APPENDIX B. MEASURED PHASE FRACTIONS FROM OPTICAL IMAGES

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N001	202.63	64.4%	29.1%	6.4%	69.1%	23.8%	7.0%
P17030905N005	202.00	62.0%	31.6%	6.4%	66.4%	26.6%	7.0%
P17030905N006	202.44	65.8%	30.3%	3.9%	69.9%	25.5%	4.6%
P17030905N007	201.64	63.7%	31.2%	5.1%	68.4%	25.8%	5.9%
P17030905N008	202.63	63.2%	29.4%	7.5%	68.0%	23.7%	8.3%
P17030905N009	201.84	64.2%	30.6%	5.2%	68.9%	25.3%	5.9%
P17030905N011	202.10	62.2%	32.4%	5.4%	67.2%	26.7%	6.1%
P17030905N013	202.29	63.1%	31.8%	5.1%	67.5%	26.9%	5.6%
P17030905N015	203.39	63.3%	32.7%	4.1%	67.5%	27.8%	4.7%
P17030905N016	203.19	61.7%	31.5%	6.8%	66.6%	25.8%	7.6%
P17030905N018	201.55	64.0%	31.0%	5.0%	68.6%	25.9%	5.6%
P17030905N019	202.48	63.5%	31.9%	4.6%	68.9%	26.0%	5.2%
P17030905N020	201.95	63.8%	30.5%	5.7%	68.1%	25.6%	6.3%
P17030905N021	201.75	63.8%	30.5%	5.7%	68.6%	24.9%	6.4%
P17030905N022	202.68	65.5%	30.0%	4.4%	69.8%	25.1%	5.1%
P17030905N023	202.13	64.4%	30.8%	4.8%	68.9%	25.3%	5.8%
P17030905N025	204.15	65.9%	29.0%	5.1%	70.5%	23.7%	5.8%
P17030905N027	202.92	64.3%	29.8%	6.0%	68.8%	24.5%	6.6%
P17030905N028	203.76	66.6%	29.3%	4.1%	71.0%	24.5%	4.6%
P17030905N029	202.32	64.9%	30.9%	4.2%	69.4%	25.6%	5.0%
P17030905N030	201.41	66.7%	30.3%	2.9%	70.9%	25.5%	3.6%
P17030905N032	203.10	63.5%	30.7%	5.8%	68.3%	24.9%	6.8%
P17030905N033	203.97	63.2%	31.6%	5.2%	67.6%	26.4%	5.9%
P17030905N034	201.97	65.8%	29.6%	4.6%	70.0%	24.4%	5.5%
P17030905N036	201.60	64.2%	30.6%	5.1%	69.2%	24.8%	6.0%
P17030905N038	201.04	66.9%	29.6%	3.5%	71.1%	24.8%	4.0%
P17030905N039	203.47	63.2%	29.5%	7.3%	67.8%	24.3%	7.9%
P17030905N040	201.24	65.1%	29.8%	5.1%	69.8%	24.3%	5.9%
P17030905N041	204.14	63.8%	32.2%	4.0%	68.4%	27.0%	4.6%
P17030905N042	202.16	62.4%	30.2%	7.4%	67.5%	24.4%	8.1%
P17030905N043	203.67	63.5%	31.6%	4.9%	68.4%	26.1%	5.5%
P17030905N044	202.92	65.0%	30.2%	4.8%	69.4%	25.0%	5.6%
P17030905N045	201.79	65.4%	30.5%	4.1%	69.2%	26.0%	4.8%
P17030905N046	202.35	63.6%	30.8%	5.6%	68.3%	25.4%	6.3%
P17030905N047	201.41	64.8%	30.3%	4.8%	69.3%	25.2%	5.6%
P17030905N048	203.11	64.3%	30.9%	4.8%	68.9%	25.6%	5.5%
P17030905N050	203.97	62.1%	32.4%	5.5%	67.0%	26.9%	6.1%
P17030905N051	202.58	62.4%	30.6%	7.0%	66.9%	25.1%	8.0%
P17030905N052	203.31	64.3%	30.5%	5.2%	69.0%	25.0%	6.0%

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N054	201.60	64.5%	29.4%	6.1%	68.8%	24.2%	7.0%
P17030905N055	202.78	65.6%	29.4%	5.0%	69.6%	24.7%	5.6%
P17030905N056	203.53	63.4%	29.8%	6.9%	68.1%	24.2%	7.7%
P17030905N058	201.22	64.3%	30.6%	5.1%	69.2%	25.0%	5.8%
P17030905N059	203.73	67.5%	25.4%	7.1%	71.3%	21.0%	7.7%
P17030905N060	202.13	66.3%	29.7%	3.9%	70.6%	25.0%	4.4%
P17030905N061	204.14	64.5%	30.9%	4.7%	69.1%	25.8%	5.1%
P17030905N062	201.77	67.2%	28.7%	4.0%	71.6%	23.6%	4.8%
P17030905N063	202.97	63.6%	31.2%	5.2%	68.3%	25.6%	6.1%
P17030905N064	202.42	67.0%	28.3%	4.7%	71.7%	22.7%	5.6%
P17030905N066	201.04	66.0%	29.8%	4.2%	69.9%	25.0%	5.0%
P17030905N068	203.94	63.3%	32.4%	4.4%	67.4%	27.7%	4.9%
P17030905N069	204.32	62.9%	31.5%	5.5%	67.7%	26.0%	6.3%
P17030905N070	203.37	63.7%	31.1%	5.2%	68.5%	25.7%	5.8%
P17030905N072	201.94	64.8%	29.6%	5.7%	69.1%	24.0%	6.9%
P17030905N073	203.56	64.2%	29.6%	6.3%	69.0%	23.8%	7.2%
P17030905N075	204.51	64.0%	31.3%	4.7%	68.5%	26.1%	5.4%
P17030905N076	202.82	64.8%	28.9%	6.3%	68.9%	23.9%	7.2%
P17030905N078	203.76	66.8%	28.2%	5.0%	70.3%	24.0%	5.7%
P17030905N079	203.01	64.9%	30.2%	4.9%	69.5%	24.8%	5.7%
P17030905N080	201.24	65.1%	29.6%	5.3%	69.5%	24.4%	6.1%
P17030905N081	202.44	63.5%	30.4%	6.0%	67.7%	25.4%	6.9%
P17030905N082	203.21	62.3%	29.6%	8.1%	66.6%	24.2%	9.3%
P17030905N083	201.44	66.8%	28.8%	4.3%	71.2%	23.8%	5.0%
P17030905N084	202.23	64.8%	30.5%	4.7%	69.1%	25.4%	5.5%
P17030905N085	201.03	63.4%	31.3%	5.2%	68.4%	25.7%	5.9%
P17030905N086	201.79	63.3%	31.8%	4.9%	68.1%	26.4%	5.5%
P17030905N087	204.20	62.3%	30.7%	7.0%	67.5%	24.7%	7.8%
P17030905N088	202.03	65.4%	27.9%	6.7%	69.2%	23.4%	7.4%
P17030905N089	203.41	66.0%	29.1%	4.9%	70.0%	24.4%	5.6%
P17030905N090	202.66	61.8%	30.9%	7.3%	66.5%	25.3%	8.2%
P17030905N091	203.99	64.4%	30.6%	5.0%	69.4%	25.1%	5.5%
P17030905N092	204.39	62.8%	31.7%	5.5%	68.0%	25.9%	6.1%
P17030905N093	203.60	64.8%	30.6%	4.6%	68.5%	26.2%	5.3%
P17030905N094	202.86	64.6%	30.6%	4.8%	68.7%	25.8%	5.5%
P17030905N095	201.60	62.1%	31.1%	6.8%	67.1%	25.1%	7.8%
P17030905N096	200.84	63.7%	30.5%	5.8%	68.3%	24.9%	6.8%
P17030905N098	203.79	62.1%	30.2%	7.7%	67.1%	24.5%	8.5%
P17030905N099	204.74	65.5%	30.9%	3.6%	70.3%	25.6%	4.1%
P17030905N100	201.17	65.7%	30.0%	4.3%	70.1%	24.9%	4.9%
P17030905N101	202.35	62.3%	30.6%	7.0%	66.8%	25.3%	7.8%
P17030905N102	203.10	66.0%	28.4%	5.6%	70.1%	23.5%	6.4%

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N103	201.41	66.8%	29.5%	3.7%	71.1%	24.5%	4.4%
P17030905N104	204.54	66.9%	29.3%	3.7%	71.2%	24.6%	4.2%
P17030905N105	202.15	68.2%	27.3%	4.5%	72.0%	22.8%	5.2%
P17030905N106	204.13	64.2%	30.0%	5.8%	69.0%	24.3%	6.7%
P17030905N107	202.54	64.0%	30.3%	5.7%	68.4%	25.1%	6.5%
P17030905N108	203.30	64.7%	29.7%	5.6%	68.9%	24.6%	6.5%
P17030905N109	201.93	65.7%	30.3%	4.0%	70.3%	25.0%	4.7%
P17030905N112	204.89	66.5%	29.8%	3.6%	70.6%	25.3%	4.1%
P17030905N113	203.50	62.9%	31.2%	5.9%	67.6%	25.6%	6.8%
P17030905N114	203.93	66.3%	26.8%	6.9%	70.3%	21.9%	7.8%
P17030905N115	202.74	62.9%	30.3%	6.8%	67.9%	24.7%	7.4%
P17030905N116	202.94	65.0%	31.7%	3.3%	68.8%	27.3%	3.9%
P17030905N117	204.33	64.3%	30.7%	5.0%	69.5%	24.8%	5.7%
P17030905N118	203.70	63.0%	29.4%	7.6%	68.0%	23.4%	8.6%
P17030905N119	200.60	68.7%	28.9%	2.4%	72.9%	24.3%	2.8%
P17030905N121	201.56	67.8%	29.1%	3.1%	71.9%	24.4%	3.7%
P17030905N122	200.80	65.1%	31.9%	3.0%	69.8%	26.5%	3.8%
P17030905N123	201.76	64.4%	33.2%	2.4%	68.4%	28.7%	2.9%
P17030905N124	202.40	65.9%	29.7%	4.4%	70.8%	24.0%	5.2%
P17030905N125	201.15	65.1%	30.4%	4.5%	70.1%	24.5%	5.4%
P17030905N126	203.15	64.1%	30.0%	5.9%	69.4%	23.8%	6.9%
P17030905N127	205.03	63.1%	32.3%	4.6%	68.0%	26.9%	5.1%
P17030905N128	204.50	64.5%	31.0%	4.5%	69.3%	25.6%	5.1%
P17030905N129	201.38	68.1%	27.8%	4.1%	72.4%	22.7%	4.9%
P17030905N130	202.59	68.6%	28.0%	3.4%	72.3%	23.7%	4.0%
P17030905N131	204.15	64.9%	28.8%	6.3%	69.7%	23.1%	7.2%
P17030905N132	203.36	63.6%	30.2%	6.2%	68.1%	24.9%	7.0%
P17030905N133	202.21	65.4%	30.2%	4.4%	69.8%	25.0%	5.2%
P17030905N134	201.92	65.3%	30.2%	4.5%	70.4%	24.4%	5.2%
P17030905N137	204.83	63.6%	30.2%	6.1%	68.3%	24.9%	6.7%
P17030905N138	203.56	61.9%	32.4%	5.7%	66.6%	26.9%	6.5%
P17030905N139	203.75	62.7%	30.3%	7.0%	67.5%	24.9%	7.6%
P17030905N140	204.32	64.8%	30.0%	5.2%	69.2%	25.0%	5.9%
P17030905N141	200.56	65.6%	29.9%	4.5%	69.7%	25.2%	5.1%
P17030905N142	201.54	63.3%	30.9%	5.7%	68.0%	25.6%	6.4%
P17030905N143	200.76	64.0%	31.5%	4.6%	68.8%	25.9%	5.2%
P17030905N144	201.73	64.7%	28.8%	6.5%	69.0%	23.8%	7.2%
P17030905N145	202.37	63.6%	32.2%	4.2%	68.1%	27.2%	4.7%
P17030905N146	203.01	63.4%	31.9%	4.7%	68.1%	26.5%	5.4%
P17030905N147	203.21	62.7%	30.8%	6.5%	67.6%	24.9%	7.5%
P17030905N148	201.10	66.1%	30.1%	3.9%	70.0%	25.4%	4.6%
P17030905N149	202.08	62.8%	33.6%	3.6%	66.6%	29.3%	4.0%

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N151	201.30	63.5%	31.2%	5.3%	68.8%	25.0%	6.3%
P17030905N152	203.41	62.5%	32.0%	5.4%	67.2%	26.7%	6.1%
P17030905N153	204.08	62.8%	31.1%	6.2%	67.3%	25.5%	7.1%
P17030905N154	202.59	65.9%	26.2%	7.9%	69.8%	21.6%	8.6%
P17030905N155	203.60	65.2%	29.4%	5.4%	69.4%	24.4%	6.2%
P17030905N156	202.80	63.9%	30.2%	5.9%	68.9%	24.4%	6.7%
P17030905N157	204.77	66.6%	29.7%	3.7%	70.8%	24.9%	4.3%
P17030905N158	204.44	64.6%	31.4%	4.0%	69.3%	26.2%	4.5%
P17030905N159	200.90	68.1%	26.9%	4.9%	72.0%	22.4%	5.6%
P17030905N160	201.88	64.6%	29.3%	6.1%	69.4%	23.6%	7.1%
P17030905N161	203.83	61.9%	30.5%	7.6%	66.5%	25.4%	8.2%
P17030905N162	201.47	64.2%	31.8%	4.0%	69.1%	26.3%	4.6%
P17030905N163	204.25	62.4%	30.5%	7.1%	66.9%	25.1%	7.9%
P17030905N164	202.24	67.1%	29.0%	3.9%	70.9%	24.6%	4.5%
P17030905N165	200.71	65.2%	30.6%	4.2%	69.9%	25.1%	4.9%
P17030905N166	201.67	64.4%	32.3%	3.3%	69.3%	26.9%	3.9%
P17030905N167	202.43	67.6%	28.5%	3.9%	71.4%	24.0%	4.5%
P17030905N168	203.27	66.5%	29.4%	4.1%	70.1%	25.1%	4.8%
P17030905N170	204.91	62.5%	31.6%	5.9%	68.0%	25.1%	6.9%
P17030905N171	203.06	63.7%	32.1%	4.2%	68.7%	26.2%	5.1%
P17030905N172	201.28	65.8%	29.8%	4.4%	70.9%	23.8%	5.3%
P17030905N173	204.05	62.9%	30.9%	6.2%	67.1%	26.0%	7.0%
P17030905N175	203.67	64.4%	28.4%	7.2%	69.3%	22.3%	8.4%
P17030905N176	202.84	67.1%	29.5%	3.4%	71.0%	25.0%	4.0%
P17030905N177	204.51	65.9%	28.2%	6.0%	70.2%	23.0%	6.8%
P17030905N178	202.59	65.9%	30.8%	3.3%	70.4%	25.8%	3.9%
P17030905N179	201.97	65.6%	29.9%	4.5%	70.3%	24.4%	5.3%
P17030905N180	203.86	64.2%	30.8%	5.0%	68.7%	25.6%	5.7%
P17030905N181	201.45	63.8%	32.7%	3.6%	68.5%	27.4%	4.1%
P17030905N182	204.22	61.6%	30.8%	7.6%	66.5%	24.9%	8.6%
P17030905N183	204.74	61.8%	33.6%	4.7%	66.0%	28.6%	5.3%
P17030905N184	202.31	63.4%	30.3%	6.3%	68.2%	24.7%	7.1%
P17030905N185	201.64	63.9%	31.1%	5.0%	68.6%	25.8%	5.6%
P17030905N186	203.17	62.5%	30.4%	7.1%	67.3%	24.5%	8.2%
P17030905N187	200.67	64.9%	30.5%	4.5%	69.5%	25.4%	5.1%
P17030905N188	200.96	66.9%	28.1%	5.0%	71.0%	23.2%	5.8%
P17030905N189	201.16	63.5%	32.6%	3.9%	68.2%	27.3%	4.4%
P17030905N190	202.97	64.8%	28.7%	6.5%	69.1%	23.4%	7.4%
P17030905N192	203.37	65.2%	29.7%	5.0%	69.3%	25.1%	5.6%
P17030905N193	204.39	64.3%	29.5%	6.2%	68.8%	24.2%	7.0%
P17030905N195	202.12	64.9%	30.6%	4.5%	68.9%	25.9%	5.2%
P17030905N196	202.76	64.3%	29.8%	5.9%	68.1%	25.2%	6.7%

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N197	203.65	63.2%	31.3%	5.5%	67.7%	26.0%	6.3%
P17030905N198	204.58	64.6%	30.5%	4.8%	69.5%	25.0%	5.5%
P17030905N199	202.55	64.3%	31.6%	4.1%	68.6%	26.7%	4.8%
P17030905N200	201.32	64.0%	32.3%	3.7%	68.6%	27.1%	4.3%
P17030905N201	203.85	66.9%	26.4%	6.8%	70.8%	21.5%	7.6%
P17030905N202	201.94	64.9%	30.5%	4.5%	69.8%	25.0%	5.3%
P17030905N203	204.21	63.9%	29.9%	6.3%	68.7%	24.6%	6.7%
P17030905N204	201.52	64.7%	31.9%	3.4%	69.3%	26.7%	4.0%
P17030905N205	204.78	63.1%	31.2%	5.7%	67.8%	25.9%	6.3%
P17030905N207	201.74	66.1%	29.6%	4.3%	70.4%	24.7%	4.9%
P17030905N208	203.09	63.4%	31.0%	5.5%	68.5%	25.1%	6.4%
P17030905N209	203.48	62.5%	31.3%	6.2%	67.6%	25.5%	6.9%
P17030905N211	202.88	64.9%	30.5%	4.6%	69.6%	25.1%	5.3%
P17030905N212	203.28	63.7%	30.3%	6.0%	67.9%	25.5%	6.6%
P17030905N213	204.42	63.8%	31.1%	5.1%	68.6%	25.6%	5.8%
P17030905N214	202.69	62.9%	29.3%	7.8%	68.1%	23.3%	8.7%
P17030905N215	204.02	67.3%	25.0%	7.7%	70.9%	20.5%	8.6%
P17030905N217	203.65	65.5%	29.3%	5.1%	69.3%	24.8%	5.9%
P17030905N218	204.62	62.5%	31.3%	6.2%	67.2%	26.1%	6.8%
P17030905N219	202.47	64.3%	30.1%	5.7%	69.2%	24.4%	6.4%
P17030905N220	204.90	64.5%	29.9%	5.6%	69.3%	24.3%	6.4%
P17030905N221	201.91	66.2%	30.8%	3.0%	70.4%	26.1%	3.6%
P17030905N222	203.83	63.4%	31.0%	5.5%	67.8%	25.9%	6.3%
P17030905N223	204.19	63.5%	31.6%	4.8%	68.1%	26.5%	5.4%
P17030905N225	203.48	65.2%	29.9%	4.9%	69.8%	24.5%	5.7%
P17030905N226	203.08	64.9%	28.8%	6.2%	70.3%	22.6%	7.0%
P17030905N227	202.86	64.2%	31.3%	4.5%	69.1%	25.7%	5.2%
P17030905N228	203.28	64.5%	30.7%	4.8%	68.8%	25.5%	5.7%
P17030905N229	204.37	64.4%	31.3%	4.3%	68.9%	26.3%	4.9%
P17030905N230	202.65	63.8%	31.8%	4.5%	68.6%	26.2%	5.2%
P17030905N231	203.66	62.8%	31.8%	5.4%	67.3%	26.7%	6.0%
P17030905N232	202.08	65.4%	30.2%	4.4%	69.7%	25.4%	4.9%
P17030905N233	204.01	66.2%	27.2%	6.6%	70.6%	22.1%	7.3%
P17030905N234	204.56	65.5%	29.9%	4.6%	70.6%	24.1%	5.3%
P17030905N235	202.42	64.1%	31.7%	4.2%	68.2%	27.1%	4.8%
P17030905N236	204.85	65.3%	31.2%	3.5%	70.1%	25.9%	4.0%
P17030905N237	202.97	62.5%	30.6%	6.8%	67.2%	25.2%	7.6%
P17030905N239	203.83	64.0%	29.2%	6.8%	68.3%	24.0%	7.7%
P17030905N240	203.37	63.2%	31.2%	5.5%	68.0%	25.6%	6.4%
P17030905N241	202.24	63.6%	29.7%	6.7%	68.2%	24.2%	7.6%
P17030905N242	203.17	64.9%	29.8%	5.3%	69.5%	24.5%	5.9%
P17030905N243	202.78	63.8%	29.6%	6.5%	68.0%	24.6%	7.3%

Image	Polish down (μm)	Raw Phase Fractions			Polish-Down Corrected Phase Fractions		
		Oxide	Carbide	Void	Oxide	Carbide	Void
P17030905N245	204.00	62.8%	31.9%	5.3%	66.8%	27.4%	5.7%
P17030905N246	202.39	63.5%	30.6%	5.8%	68.4%	25.1%	6.5%
P17030905N247	203.52	63.7%	31.2%	5.2%	68.3%	25.7%	6.0%
P17030905N248	203.32	65.4%	28.2%	6.4%	69.8%	23.0%	7.2%
P17030905N249	202.74	63.1%	32.3%	4.5%	68.0%	26.8%	5.2%
P17030905N251	202.92	64.5%	30.3%	5.2%	68.9%	25.2%	5.9%
P17030905N252	203.71	64.0%	30.6%	5.4%	68.7%	25.1%	6.1%
P17030905N254	203.14	65.1%	27.1%	7.9%	69.7%	21.5%	8.8%
P17030905N255	202.34	65.7%	30.4%	3.9%	70.2%	25.4%	4.4%
P17030905N256	203.52	62.7%	31.2%	6.1%	67.0%	26.3%	6.7%
P17030905N257	202.68	64.5%	30.5%	5.0%	68.6%	25.7%	5.6%
P17030905N258	203.80	61.7%	33.0%	5.3%	66.1%	27.9%	6.0%
P17030905N259	203.00	64.7%	28.0%	7.4%	68.8%	23.0%	8.2%
P17030905N260	202.49	63.2%	31.2%	5.6%	68.2%	25.5%	6.2%
P17030905N261	203.20	62.4%	30.9%	6.7%	67.6%	24.8%	7.6%
P17030905N262	204.00	62.7%	32.3%	5.0%	67.5%	26.8%	5.7%
P17030905N263	203.40	65.1%	27.2%	7.7%	69.5%	22.0%	8.4%
P17030905N264	203.61	64.6%	31.2%	4.2%	69.0%	26.3%	4.7%
P17030905N265	202.83	63.1%	31.0%	5.9%	68.1%	25.3%	6.6%
P17030905N266	202.63	62.4%	31.5%	6.1%	67.5%	25.7%	6.9%
P17030905N267	203.87	63.8%	29.3%	6.9%	68.7%	23.6%	7.8%
P17030905N268	203.04	64.4%	31.5%	4.1%	69.0%	26.2%	4.8%
P17030905N269	203.25	65.2%	31.0%	3.8%	69.3%	26.3%	4.4%
P17030905N273	203.33	64.0%	32.8%	3.3%	68.1%	28.2%	3.7%
P17030905N274	203.13	63.0%	30.2%	6.8%	68.2%	24.2%	7.6%
P17030905N276	203.23	62.8%	29.1%	8.1%	67.5%	23.9%	8.6%

