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Fabrication and Characterization of Single-Particle Compacts

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OAK RIDGE National Laboratory

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Nuclear Energy and Fuel Cycle Division

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ABBREVIATIONS

AGR	Advanced Gas Reactor (Fuel Development and Qualification Program)
ALEU	Advanced Low Enrichment Uranium Program
HFIR	High Flux Isotope Reactor
IPyC	inner pyrolytic carbon (TRISO layer)
OPyC	outer pyrolytic carbon (TRISO layer)
ORNL	Oak Ridge National Laboratory
SiC	silicon carbide (TRISO layer)
SPC	single-particle compact
TRISO	tristructural isotropic (coated particles)
UCO	uranium carbide/uranium oxide mixture (fuel kernels)
XCT	x-ray Computed Tomography
Z	Atomic number

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This work was sponsored by the US Department of Energy through the advanced low enrichment uranium fuel Project.

1. INTRODUCTION*

The programmatic objective of the advanced low enriched uranium (aLEU) fuel Project within the Office of Nonproliferation Research and Development (NA-22) is to advance the development of nuclear reactor designs, fuel materials, and fabrication technologies capable of meeting a number of challenging customer requirements, including reactor stability, extended lifetime, and power density without refueling, while using only low-enriched uranium (i.e., less than 20% enrichment of ^{235}U). The tandem requirements of delivering sufficient power density and maintaining fuel performance over the course of a multidecade fuel lifetime tightly constrain the field of potential fuel options. Monolithic fuel forms (e.g., fuel pellets) provide maximized density of fissile material, but they may face challenges in maintaining their structure and performance over the long reactor lifetimes envisioned in this program. Dispersion fuel forms with an inert matrix provide enhanced long-term stability but sacrifice fissile material density, and they may not provide sufficient power density over the reactor lifetime with the limit of low enrichment.

Resolving these challenges and identifying promising fuel forms that have the potential to meet customer requirements are key objectives of the aLEU program. However, any candidate fuel form for this program will likely include heterogeneous geometric features designed to enhance performance, such as internal fins to enhance thermal conductivity, coatings, or high-fissile density dispersions. Inclusion of these geometric features raises the natural question of how they will behave under irradiation for extended periods of time. For example, internal fins designed to channel heat out of the fuel must remain intact and in close contact with the fuel over the design lifetime to deliver their intended benefit. The single-particle irradiation project was initiated to develop and demonstrate a rapid and flexible approach to answer these questions for any candidate fuel form. This project consists of two main enabling components: the MiniFuel irradiation design and quantitative analysis of 3D tomographic data.

The MiniFuel irradiation capsule design developed at Oak Ridge National Laboratory (ORNL) provides an off-the-shelf approach to controlled irradiation testing of small fuel samples in the High Flux Isotope Reactor (HFIR). The standardized MiniFuel capsule design reduces the cost and time associated with designing an irradiation experiment, whereas HFIR's high neutron flux provides accelerated accumulation neutron fluence and burnup. Finally, because of the small volume of the fuel samples used in MiniFuel capsules, fission rate is effectively decoupled from irradiation temperature (which is dominated by gamma heating of the capsule). Thus, if representative samples can be fabricated to the appropriate size, then the Minifuel capsule design provides an effective method for rapid irradiation testing of new fuel concepts.

Quantitative analysis of 3D tomographic data gathered nondestructively using x-ray computed tomography (XCT) enables high-fidelity tracking of heterogeneous geometric parameters before, during, and after irradiation. Contrast in XCT images is generated based on variations in x-ray transmission, which is dependent on material density and mass attenuation (which scales approximately with atomic number). Thus, digital image analysis of XCT images may be used to segregate geometric features provided that they have a sufficient degree of variation in x-ray transmission. This method was successfully applied to the relatively complex geometry of as-fabricated and irradiated tristructural isotropic (TRISO) particles [1]. Because this characterization method is nondestructive, it can be applied to the same samples at multiple points (e.g., before and after irradiation).

These capabilities have been developed and demonstrated within the single particle irradiation project. Individual TRISO particles were overcoated with graphite-based matrix material, pressed into small single-particle compacts (SPCs), and geometrically characterized using XCT. These compacts are now

* This introduction section was taken from a previous report and was revised with minor editorial changes [2]. It is included herein for contextual information and definition of common terminology used throughout this report.

ready for insertion into MiniFuel capsules for irradiation in HFIR. After irradiation, individual particles can again be characterized using XCT to quantify geometric changes caused by irradiation. Irradiated particles can then be further characterized by destructive analysis or prepared for re-irradiation to a higher fluence.

2. PARTICLE SELECTION AND COMPACT FABRICATION*

An existing batch of TRISO particles named NUCO 425-08T from the Advanced Gas Reactor (AGR) Program was identified as a suitable source material for this work. This batch consists of TRISO particles with a nominally 425 µm diameter kernel, 100 µm thick buffer layer, 40 µm thick inner pyrolytic carbon (IPyC) layer, 35 µm thick silicon carbide (SiC) layer, and 40 µm thick outer pyrolytic carbon (OPyC) layer. The kernels of these particles are composed of a heterogenous mixture of UO_2, UC_2, and UC with natural uranium. Because of stochastic variations in the TRISO coating process, the particles in this batch comprise a statistical distribution in both size and sphericity. Particles from various positions within this statistical distribution were segregated for irradiation.

Particles were sorted by size using a rollermicrometer with a series of bins representing 24 µm increments in particle diameter, resulting in the distribution given in Figure 1. Particles from each bin were then segregated based on sphericity by rolling down a shaking and slightly inclined surface. Approximately 98% of the particles in each bin rolled freely down the surface and were classified as round, whereas the remaining ~2% in each bin stopped because of significant surface facets and were classified as faceted. Based on these segregating steps, four subsamples of material were selected for fabrication of irradiation targets: round/small particles (724–748 µm), round/medium particles (796–820 µm), faceted/medium particles (796–820 µm), and round/large particles (868–892 µm).

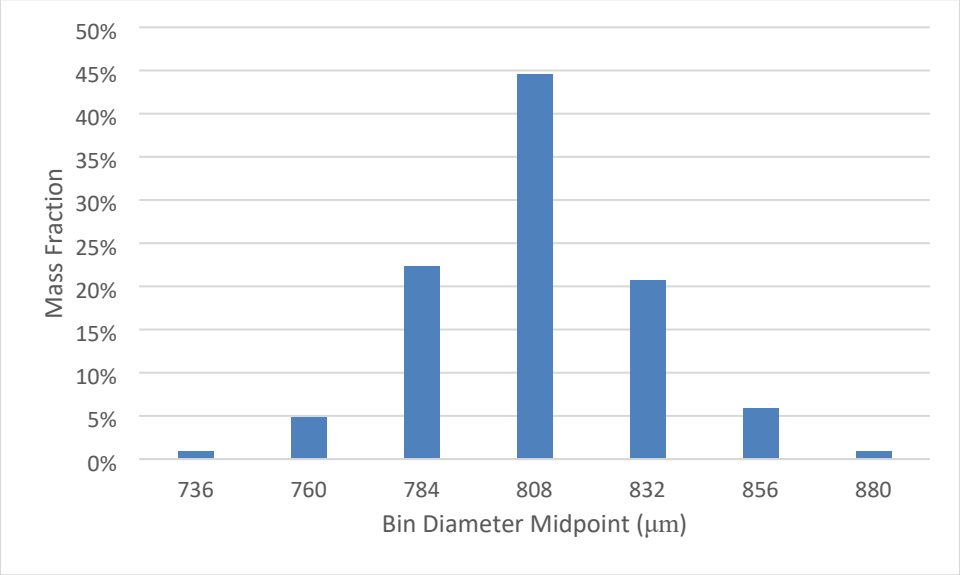

Figure 1. Mass distribution of particles from NUCO 425-08T by diameter.

Dispersion fuels such as TRISO particles are encased in a matrix material, and as such, irradiation of bare particles may not be representative. Therefore, particles selected for irradiation were formed into SPCs with a graphite matrix. This was accomplished by rolling particles in graphite and resin to overcoat them

* This fabrication section is a revised version of a similar section in a previous report [2], and is included herein for contextual information and definition of common terminology used throughout this report.

with matrix material, pressing the overcoated particles into cylindrical compacts, and finally, heat treating to carbonize the resin.

Matrix material for overcoating consisted of a blend of natural flake graphite, synthetic graphite, and phenolic resin. These components were weighed to maintain a target composition and were added to a mixing bottle with ethanol and ball mill grinding media. The blend was mixed to homogenize the suspension, then poured into a large shallow pan in a fume hood and left exposed to allow the ethanol to evaporate over the course of several days. Once dry, the blend was fed into a pulverizer 2–3 times, resulting in a fine powder blend referred to as *graphite matrix*.

Charges of TRISO particles were overcoated by adding them to a motorized rotating drum while agitating with a lab spatula to force the particles to the edge of the cylinder. A small charge of graphite matrix material (less than or equal to the volume of TRISO particles in the drum) was then added to the drum. The blend was then agitated to homogenize the particles and matrix and to break apart any matrix agglomerates. A syringe infusion pump was then used to spray methanol in short increments (10–45 seconds) through an ultrasonic nozzle to initiate overcoating while preventing methanol oversaturation. The turbulence of the particles and matrix along with the methanol allows the matrix to compact onto the surface of the particles forming the overcoat. Additional matrix material and methanol were then added as needed until the particles approached the target diameter as measured using a roller micrometer.

The time required for the overcoating process varies depending on the charge size and target diameter. As the particle batch size gets smaller (< 2–3g), particles will not typically overcoat under their own weight or will overcoat relatively slowly. Because of the length of time required to accumulate a sufficient thickness of overcoat for SPC fabrication, particles of each of the four subsamples were composited for overcoating. After overcoating was completed, particles were loaded into a membrane box with internal separations to track individual particles and were radiographed using a ZEISS Versa 520, as shown in Figure 2. Individual radiographs of each particle were processed with image analysis software to quickly identify whether each particle was small, average, or large and either faceted or round based on the shape and size of the SiC shell, as shown in Figure 3. Based on these results, an appropriate number of each subtype was selected from the overcoated particles for fabrication into SPCs, with some margin to account for malformed compacts or misidentified particles.

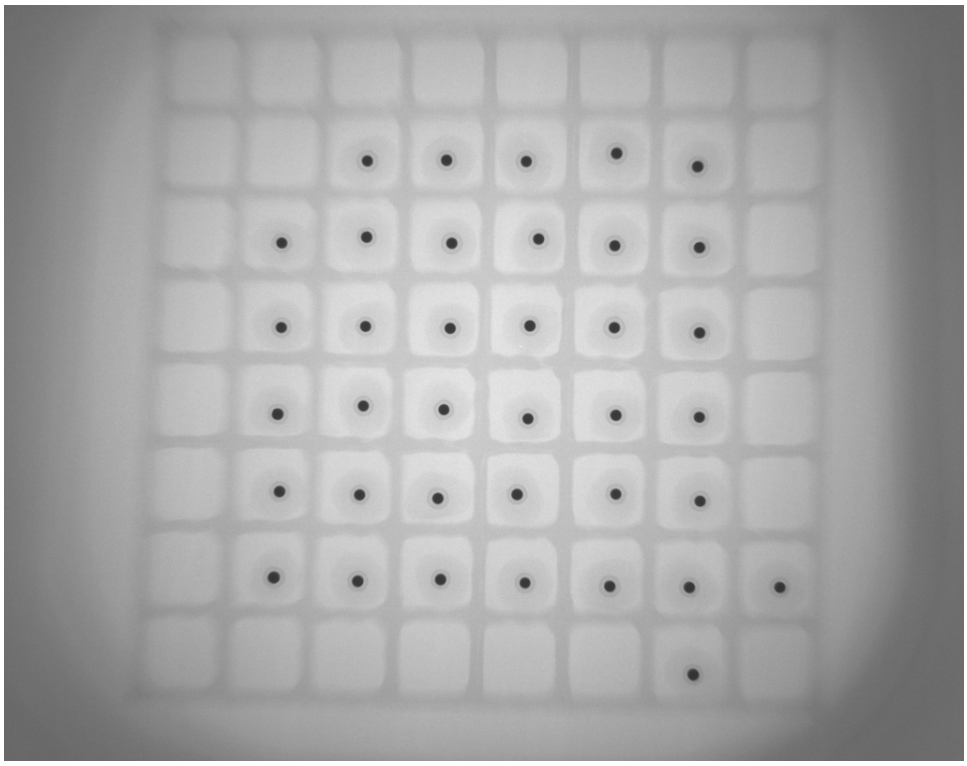

Figure 2. Low-resolution radiograph of sample holder filled with overcoated particles.

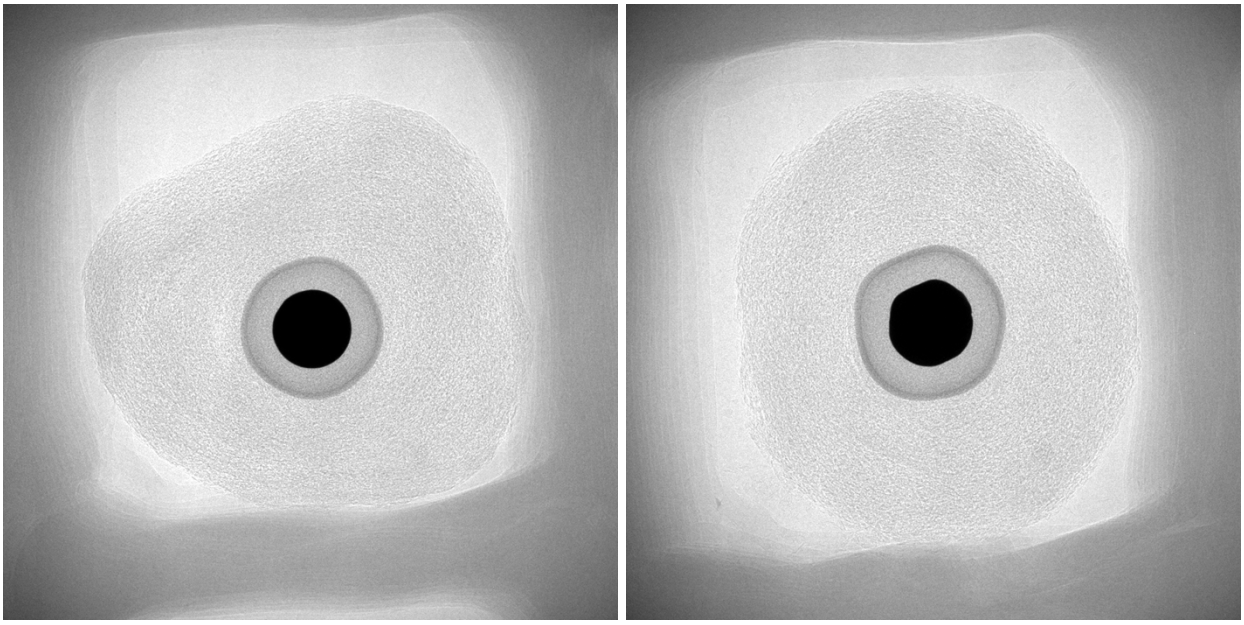

Figure 3. High-resolution radiographs of a round particle (left) and a faceted particle (right).

After identification of overcoated particle types by radiography, individual particles were warm pressed using a single-action punch and die heated to 60°C with a 0.5 mm preposition gap, 5 s preposition delay, 30 s final position delay, and 1 mm/s speed. Parameters for average/round, small/round, average/faceted, and large/round particle compacts are given in Table 1–Table 4.

Table 1. Parameters for compacts with average-sized round particles

SPC ID	SPC wt. (g)	Height (mm)	Diameter (mm)	Peak Force (lbs)	Green Density (g/cc)	Est. Matrix Density (g/cc)
NUCO425-08T-SP02J	0.0078	1.18	2.26	16	1.648	1.546
NUCO425-08T-SP03J	0.0083	1.21	2.27	20	1.695	1.601
NUCO425-08T-SP04J	0.0070	1.18	2.26	9	1.479	1.364
NUCO425-08T-SP08J	0.0076	1.17	2.27	18	1.605	1.500
NUCO425-08T-SP13J	0.0078	1.2	2.28	18	1.592	1.490
NUCO425-08T-SP16J	0.0066	1.14	2.28	11	1.418	1.296
NUCO425-08T-SP22J	0.0067	1.2	2.27	9	1.380	1.260
NUCO425-08T-SP25J	0.0072	1.24	2.27	11	1.435	1.324
NUCO425-08T-SP27J	0.0065	1.22	2.27	7	1.316	1.195
NUCO425-08T-SP30J	0.0069	1.19	2.27	11	1.433	1.316
NUCO425-08T-SP31J	0.0077	1.21	2.28	16	1.559	1.455
NUCO425-08T-SP33J	0.0076	1.22	2.27	13	1.539	1.434
NUCO425-08T-SP36J	0.0077	1.23	2.28	15	1.533	1.430
NUCO425-08T-SP37J	0.0063	1.2	2.27	8	1.297	1.172
NUCO425-08T-SP38J	0.0070	1.23	2.28	10	1.394	1.280
NUCO425-08T-SP39J	0.0070	1.23	2.28	10	1.394	1.280
NUCO425-08T-SP40J	0.0074	1.22	2.28	13	1.486	1.377
NUCO425-08T-SP41J	0.0063	1.20	2.27	8	1.297	1.172
NUCO425-08T-SP42J	0.0071	1.23	2.27	10	1.426	1.314
NUCO425-08T-SP43J	0.0066	1.22	2.28	8	1.325	1.205
NUCO425-08T-SP44J	0.0072	1.22	2.28	12	1.445	1.334
NUCO425-08T-SP45J	0.0069	1.23	2.27	9	1.386	1.270
NUCO425-08T-SP46J	0.0070	1.21	2.28	10	1.417	1.303
NUCO425-08T-SP47J	0.0078	1.23	2.28	17	1.553	1.451
NUCO425-08T-SP48J	0.0083	1.25	2.28	21	1.626	1.531
NUCO425-08T-SP49J	0.0067	1.21	2.27	9	1.368	1.249
NUCO425-08T-SP50J	0.0070	1.22	2.28	10	1.405	1.291
NUCO425-08T-SP51J	0.0077	1.23	2.28	17	1.533	1.430
NUCO425-08T-SP70J	0.0060	1.18	2.27	8	1.256	1.125
NUCO425-08T-SP71J	0.0066	1.19	2.26	8	1.383	1.261
NUCO425-08T-SP72J	0.0064	1.19	2.27	8	1.329	1.205
NUCO425-08T-SP73J	0.0074	1.18	2.27	16	1.550	1.441
NUCO425-08T-SP74J	0.0079	1.20	2.28	19	1.612	1.512
NUCO425-08T-SP75J	0.0072	1.21	2.28	12	1.457	1.346
NUCO425-08T-SP76J	0.0069	1.19	2.28	11	1.420	1.304
NUCO425-08T-SP77J	0.0076	1.21	2.28	15	1.538	1.433
NUCO425-08T-SP78J	0.0071	1.21	2.28	12	1.437	1.324

Table 2. Parameters for compact with small-sized round particles

SPC ID	SPC wt. (g)	Height (mm)	Diameter (mm)	Peak Force (lbs)	Green Density (g/cc)	Est. Matrix Density (g/cc)
NUCO425-08T-SP52J	0.0079	1.24	2.29	16	1.547	1.446
NUCO425-08T-SP53J	0.0078	1.19	2.28	17	1.605	1.503
NUCO425-08T-SP54J	0.0074	1.21	2.28	14	1.498	1.390
NUCO425-08T-SP55J	0.0082	1.23	2.29	22	1.619	1.522
NUCO425-08T-SP56J	0.0087	1.25	2.29	25	1.690	1.600
NUCO425-08T-SP85J	0.0065	1.17	2.28	9	1.361	1.238
NUCO425-08T-SP86J	0.0072	1.17	2.28	14	1.507	1.396
NUCO425-08T-SP87J	0.0068	1.18	2.28	10	1.411	1.294
NUCO425-08T-SP88J	0.0059	1.16	2.28	7	1.246	1.113
NUCO425-08T-SP89J	0.008	1.21	2.29	21	1.605	1.506
NUCO425-08T-SP90J	0.0077	1.21	2.29	17	1.545	1.441
NUCO425-08T-SP91J	0.0071	1.16	2.29	15	1.486	1.373
NUCO425-08T-SP92J	0.0091	1.22	2.29	40	1.811	1.728

Table 3. Parameters for compacts with average-sized faceted particles

SPC ID	SPC wt. (g)	Height (mm)	Diameter (mm)	Peak Force (lbs)	Green Density (g/cc)	Est. Matrix Density (g/cc)
NUCO425-08T-SP07J	0.0072	1.18	2.26	11	1.521	1.410
NUCO425-08T-SP12J	0.0075	1.20	2.28	15	1.531	1.424
NUCO425-08T-SP18J	0.0066	1.19	2.28	10	1.358	1.238
NUCO425-08T-SP24J	0.0079	1.26	2.28	14	1.536	1.435
NUCO425-08T-SP32J	0.0078	1.23	2.28	15	1.553	1.451
NUCO425-08T-SP34J	0.0084	1.24	2.27	21	1.674	1.580
NUCO425-08T-SP57J	0.0063	1.17	2.28	8	1.319	1.193
NUCO425-08T-SP58J	0.0074	1.18	2.28	14	1.536	1.428
NUCO425-08T-SP59J	0.0084	1.21	2.29	22	1.686	1.592
NUCO425-08T-SP60J	0.0070	1.18	2.28	12	1.453	1.338
NUCO425-08T-SP61J	0.0079	1.22	2.29	16	1.572	1.471
NUCO425-08T-SP62J	0.0077	1.23	2.29	16	1.520	1.416
NUCO425-08T-SP63J	0.0095	1.28	2.29	41	1.802	1.722
NUCO425-08T-SP79J	0.0066	1.21	2.28	7	1.336	1.216
NUCO425-08T-SP80J	0.0064	1.19	2.28	8	1.317	1.193
NUCO425-08T-SP81J	0.0083	1.21	2.28	24	1.680	1.586
NUCO425-08T-SP82J	0.0086	1.24	2.28	30	1.699	1.608

Table 4. Parameters for compacts with large-sized round particles

SPC ID	SPC wt. (g)	Height (mm)	Diameter (mm)	Peak Force (lbs)	Green Density (g/cc)	Est. Matrix Density (g/cc)
NUCO425-08T-SP09J	0.0064	1.18	2.27	9	1.340	1.216
NUCO425-08T-SP11J	0.0077	1.16	2.28	20	1.626	1.523
NUCO425-08T-SP14J	0.0079	1.18	2.28	22	1.640	1.540
NUCO425-08T-SP17J	0.0083	1.20	2.28	24	1.694	1.600
NUCO425-08T-SP19J	0.0070	1.16	2.28	11	1.478	1.363
NUCO425-08T-SP20J	0.0064	1.15	2.27	9	1.375	1.250
NUCO425-08T-SP21J	0.0086	1.25	2.28	26	1.685	1.594
NUCO425-08T-SP29J	0.0068	1.20	2.27	11	1.400	1.282
NUCO425-08T-SP66J	0.0066	1.21	2.28	10	1.336	1.216
NUCO425-08T-SP67J	0.0083	1.25	2.29	23	1.612	1.517
NUCO425-08T-SP68J	0.0082	1.25	2.29	22	1.593	1.496
NUCO425-08T-SP69J	0.0069	1.21	2.29	11	1.385	1.269
NUCO425-08T-SP83J	0.0074	1.19	2.29	16	1.510	1.402
NUCO425-08T-SP84J	0.0065	1.16	2.28	10	1.372	1.249

Pressed compacts were carbonized by heat treatment for 1 hour at 1,800°C in an Astro furnace. Before carbonization, several SPCs were imaged using XCT. These SPCs were imaged again after the 1 hour carbonization and again after an additional 9 hours of heat treatment at 1,800°C to see whether there were any changes to the particle geometry (particularly densification of the buffer layer). However, no sign of buffer densification was observed, and the geometric parameters for the kernel and coating layers did not substantially change in any of the compacts imaged before and after heat treatment.

3. X-RAY TOMOGRAPHY OF SINGLE-PARTICLE COMPACTS

XCT and subsequent automated quantitative image analysis were completed for a total of 81 SPCs. Each SPC was imaged using a ZEISS Xradia MicroXCT-400 operating at 8 W with an accelerating voltage of 40 kV and an exposure time of 40 s. Low-resolution images with a wide enough field of view to capture the full compact were acquired at two orthogonal angles for each SPC, as shown in Figure 4. This was followed by high-resolution tomography of the particle using 1,600 images over a span of 182° with a reconstructed voxel size of ~1.1 μm. An example of a single tomograph through the midsection of a particle is given in Figure 5.

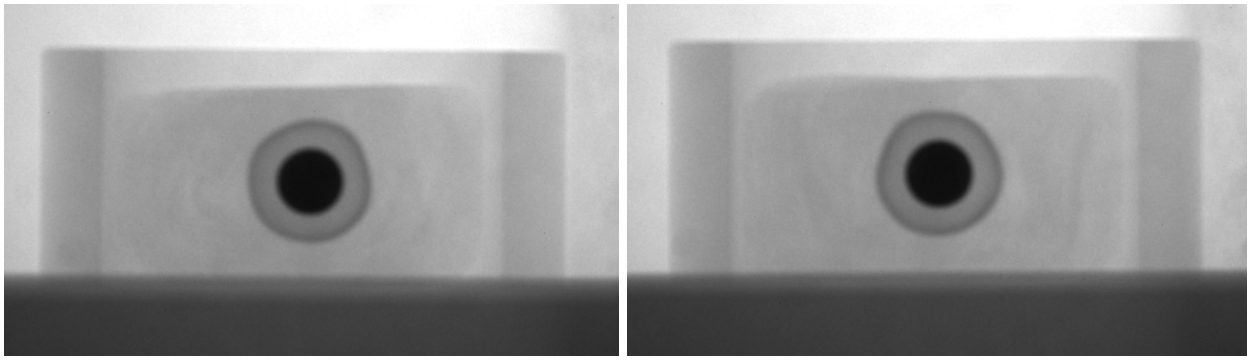

Figure 4. Pair of low-resolution radiographs of a SPC acquired at orthogonal angles.

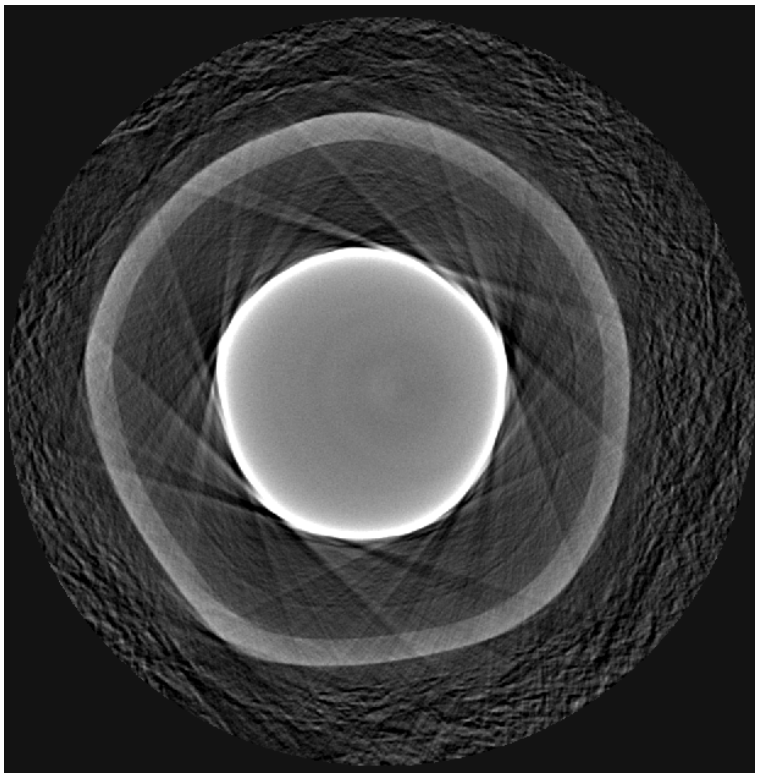

Figure 5. Tomographic slice through the midsection of a particle.

Each tomographic dataset was analyzed to extract quantitative parameters for layer thicknesses and curvatures using previously developed image analysis software [1]. Parameters extracted for each particle included the radius of the kernel and thickness of each of the four coating layers at 5,000 equidistant points around the particle, as well as the local gaussian curvature of the kernel and four coating layers measured at 500 equidistant points around the particle. These data may be used, for example, to generate three-dimensional plots of variations in curvature, as shown in Figure 6. Summaries of the three-dimensional quantitative geometric data for each particle are given as an appendix in Section 6; full datasets for each particle were archived for future use. Key geometric parameters for all particles in SPCs are given in Table 5. Kernel radius, layer thicknesses, and particle diameter can be used to segregate particles based on size, whereas curvature parameters for the SiC layer can be used to sort round particles from faceted particles. The SiC layer is likely the most relevant for considering faceted particles: stress concentration within the SiC is the nominal failure mechanism of concern for aspherical particles. The two parameters included in Table 5 are the mean absolute deviation (the mean of the absolute difference between the curvature at each point and the expected curvature based on the layer radius) and the maximum curvature (the highest curvature value for the layer). Mean absolute deviation will be high for particles with a “lumpy” SiC layer and low for particles with a round SiC layer. Maximum curvature will be high for particles with a singular sharp point in the SiC and low for particles with no particularly sharp points in the SiC.

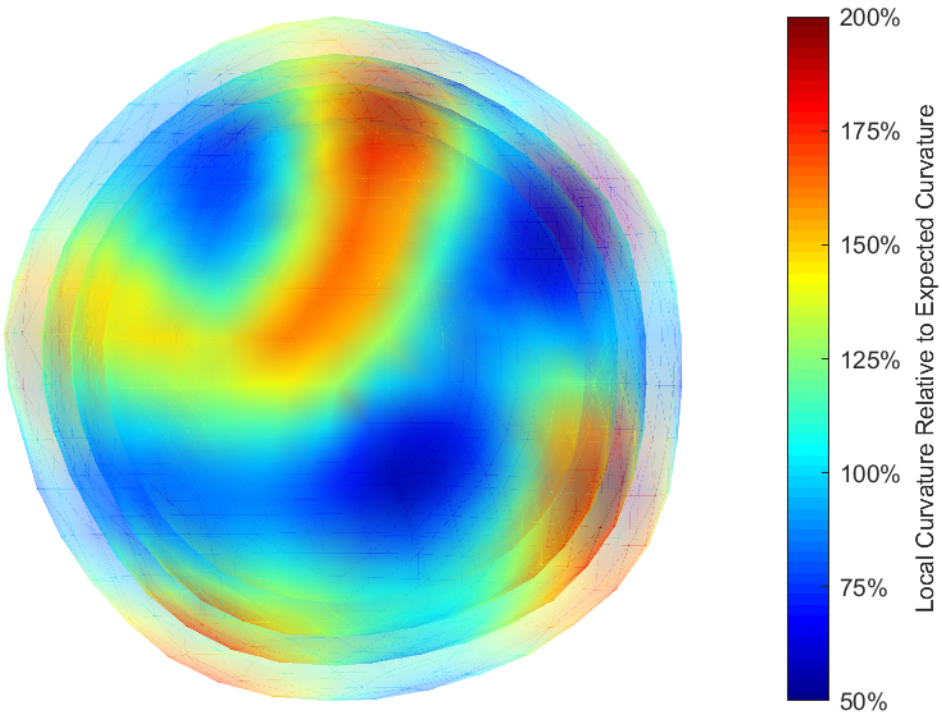

Figure 6. Variations in local curvature relative to expected curvature for the kernel (solid) and coating layers (transparent) of a particle as measured by XCT image analysis.

Table 5. Mean geometric parameters for particles within all SPCs.

SPC ID	Kernel Radius (µm)	Buffer Thickness (µm)	IPyC Thickness (µm)	SiC Thickness (µm)	OPyC Thickness (µm)	Particle Diameter (µm)	SiC Mean Absolute Deviation (mm^{-2})	SiC Max Curvature (mm^{-2})
SP02J	214.76	90.41	42.06	36.25	47.30	861.56	1.75	14.35
SP03J	214.55	104.94	43.09	37.05	46.21	891.68	1.46	13.77
SP04J	210.73	93.74	42.30	36.49	45.93	858.39	1.78	13.63
SP07J	212.54	94.79	44.67	38.90	46.78	875.36	2.01	16.86
SP08J	214.30	99.47	40.25	36.87	47.25	876.28	1.53	12.49
SP09J	212.20	129.73	37.97	38.17	44.00	924.14	1.51	12.47
SP11J	214.89	126.42	41.32	36.42	44.85	927.79	1.63	12.61
SP12J	215.56	102.36	39.44	36.67	46.24	880.53	1.60	12.85
SP13J	212.04	86.15	42.69	37.14	43.14	842.33	1.75	15.43
SP14J	215.88	124.31	40.41	36.73	44.29	923.25	1.83	12.34
SP16J	214.45	94.62	41.83	37.53	45.98	868.81	1.67	13.09
SP17J	216.26	126.05	43.50	37.39	45.52	937.45	1.53	12.65
SP18J	211.43	129.78	41.30	37.36	46.28	932.28	1.72	13.45
SP19J	220.80	124.56	39.86	36.41	45.98	935.23	1.66	11.59

Table 5. Mean geometric parameters for particles within all SPCs (continued).

SPC ID	Kernel Radius (µm)	Buffer Thickness (µm)	IPyC Thickness (µm)	SiC Thickness (µm)	OPyC Thickness (µm)	Particle Diameter (µm)	SiC Mean Absolute Deviation (mm^{-2})	SiC Max Curvature (mm^{-2})
SP20J	209.49	114.79	42.60	36.16	46.20	898.47	1.48	11.82
SP21J	214.59	126.11	42.32	38.20	44.73	931.90	1.35	11.89
SP22J	215.57	86.55	43.36	37.77	45.14	856.76	1.49	13.03
SP24J	209.95	107.22	42.47	36.54	47.86	888.08	1.61	15.71
SP25J	218.79	103.01	42.52	37.07	47.44	897.66	1.44	10.82
SP27J	209.33	86.81	43.56	38.03	48.26	851.97	1.86	14.07
SP29J	210.27	135.84	40.69	36.00	43.56	932.68	1.43	12.11
SP30J	208.66	86.38	39.51	38.83	45.37	837.49	1.68	15.42
SP31J	215.79	95.16	38.00	39.61	46.39	869.91	1.69	15.44
SP32J	210.51	105.94	41.59	38.18	49.49	891.42	1.86	11.97
SP33J	211.75	93.72	43.91	37.43	46.94	867.50	1.51	12.89
SP34J	231.02	92.03	43.58	38.16	45.99	901.56	2.02	16.01
SP36J	216.65	93.85	40.81	38.93	47.52	875.51	1.55	11.73
SP37J	214.20	100.10	43.76	36.91	45.96	881.86	1.44	12.19
SP38J	209.13	104.18	43.61	38.06	47.60	885.16	1.48	12.13
SP39J	206.26	105.80	37.81	39.13	48.28	874.56	1.63	14.77
SP40J	214.78	93.13	43.09	38.09	46.18	870.55	1.75	14.65
SP41J	216.53	108.54	39.30	36.32	43.99	889.35	1.54	14.05
SP42J	212.87	97.00	41.79	37.44	46.01	870.22	2.64	17.37
SP43J	208.03	93.29	39.74	37.69	44.57	846.64	1.70	15.08
SP44J	210.20	83.48	40.31	39.58	45.16	837.46	2.09	15.90
SP45J	213.63	80.14	44.39	36.94	47.98	846.16	1.52	12.91
SP46J	217.94	75.86	42.41	38.27	44.98	838.92	1.89	16.00
SP47J	213.58	95.67	41.32	37.95	44.69	866.42	1.67	13.98
SP48J	212.04	105.09	39.06	38.44	46.21	881.68	1.79	13.65
SP49J	214.64	102.70	41.26	37.09	47.13	885.64	1.78	13.13
SP50J	218.18	116.82	39.92	37.03	44.95	913.80	1.35	10.51
SP51J	217.48	108.09	41.95	38.48	45.06	902.12	1.47	12.59
SP52J	207.92	81.68	43.28	39.12	47.11	838.21	1.83	13.98
SP53J	211.1	94.01	40.07	36.04	46.21	854.86	1.94	14.90
SP54J	209.30	81.83	41.43	37.41	44.88	829.70	1.66	13.54
SP55J	213.52	74.29	43.25	36.40	45.73	826.38	1.82	15.32
SP56J	210.33	84.10	38.64	39.62	45.36	836.08	1.73	14.80
SP57J	215.96	108.57	37.54	37.03	44.13	886.45	1.60	12.80
SP58J	221.61	103.03	40.64	38.53	47.19	901.99	1.83	14.34
SP59J	215.25	100.11	40.13	37.29	45.89	877.35	1.86	20.02
SP60J	216.10	86.79	42.55	36.13	46.22	855.60	2.50	18.59
SP61J	228.10	87.44	41.99	37.59	45.56	881.36	2.57	14.57
SP62J	217.42	99.51	39.11	37.51	45.81	878.72	1.81	13.67
SP63J	230.27	97.14	40.35	36.78	44.59	898.26	1.90	14.98

Table 5. Mean geometric parameters for particles within all SPCs (continued).

SPC ID	Kernel Radius (µm)	Buffer Thickness (µm)	IPyC Thickness (µm)	SiC Thickness (µm)	OPyC Thickness (µm)	Particle Diameter (µm)	SiC Mean Absolute Deviation (mm^{-2})	SiC Max Curvature (mm^{-2})
SP64J	216.40	91.36	35.67	36.46	45.11	850.00	1.79	15.06
SP65J	218.97	104.36	41.01	37.58	44.96	893.76	1.38	10.35
SP70J	211.48	103.24	41.56	37.46	45.70	878.88	1.65	15.29
SP71J	209.83	87.90	43.92	37.74	46.91	852.60	1.66	13.83
SP72J	219.24	96.19	41.90	36.87	48.04	884.48	1.71	13.36
SP73J	210.23	98.91	39.65	37.52	46.56	865.74	2.09	14.80
SP74J	214.25	94.75	42.62	37.68	44.56	867.72	1.58	15.15
SP75J	214.12	97.72	38.79	38.76	45.46	869.70	1.65	13.63
SP76J	208.42	98.15	44.01	37.44	46.04	868.12	1.88	16.16
SP77J	214.71	93.94	43.73	37.07	45.60	870.10	1.62	12.50
SP78J	213.10	108.23	39.70	37.28	45.10	886.82	1.51	12.56
SP85J	210.12	80.96	36.04	36.59	45.67	818.76	2.35	19.09
SP86J	210.09	71.20	40.40	38.90	46.83	814.84	2.14	18.15
SP87J	207.05	67.72	42.08	38.74	45.74	802.66	1.92	16.02

4. CONCLUSIONS

Particles from the legacy AGR lot NUCO-425-08T were sorted by size (small, average, or large) and shape (round or faceted). These particles were then overcoated to sufficient thickness to press into compacts without the addition of loose matrix material to generate SPCs with a well-attached matrix to accurately represent TRISO irradiation conditions in a MiniFuel irradiation experiment. SPCs were imaged by XCT, and the resulting image sets were analyzed to generate quantitative geometric parameters, including layer thicknesses and curvatures. The resulting database of pre-irradiation characterization will enable high-fidelity tracking of geometric transformations under irradiation on a particle-by-particle basis.

5. REFERENCES

[1] G. Helmreich, D. Richardson, S. Venkatakrishnan and A. Ziabari, "Method for Measurement of TRISO Kernel and Layer Volumes by X-ray Computed Tomography," *Journal of Nuclear Materials,* 2020.

[2] G. Helmreich, T. Gerczak, C. Petrie and A. Nelson, "Experimental Plan for Single-Particle Compact Minifuel Irradiation ORNL/TM-2020/1653," Oak Ridge National Laboratory, Oak Ridge, TN, 2020.

6. SPC PARTICLE DATA

6.1 SP02J

Kernel Volume (mm3):	0.0418

Buffer Volume (mm3):	0.0779
IPyC Volume (mm3):	0.0582
SiC Volume (mm3):	0.0626
OPyC Volume (mm3):	0.1012

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.76	1.86	210.16	223.79
Buffer Thickness (μm):	90.41	4.10	74.98	99.97
IPyC Thickness (μm):	42.06	2.38	34.08	51.12
SiC Thickness (μm):	36.25	1.17	32.94	40.90
OPyC Thickness (μm):	47.30	1.89	42.03	54.53

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.682	3.666	33.824	19.274
Buffer Curvature (mm^{-2}):	10.738	2.279	18.060	5.836
IPyC Curvature (mm^{-2}):	8.294	2.085	17.225	3.520
SiC Curvature (mm^{-2}):	6.800	1.750	14.353	2.844
OPyC Curvature (mm^{-2}):	5.389	1.274	10.950	2.629

6.2 SP03J

Kernel Volume (mm3):	0.0417
Buffer Volume (mm3):	0.0958
IPyC Volume (mm3):	0.0632
SiC Volume (mm3):	0.0679
OPyC Volume (mm3):	0.1042

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.55	2.49	208.23	220.81
Buffer Thickness (μm):	104.94	6.33	90.38	151.02
IPyC Thickness (μm):	43.09	4.86	4.58	51.48
SiC Thickness (μm):	37.05	1.07	33.18	41.19
OPyC Thickness (μm):	46.21	2.50	36.61	54.92

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.724	3.773	33.880	16.643
Buffer Curvature (mm^{-2}):	9.797	2.707	26.400	4.772
IPyC Curvature (mm^{-2}):	7.607	1.766	16.077	4.237
SiC Curvature (mm^{-2}):	6.262	1.461	13.775	3.353
OPyC Curvature (mm^{-2}):	5.031	1.188	11.905	2.490

6.3 SP04J

Kernel Volume (mm3):	0.0395
Buffer Volume (mm3):	0.0794
IPyC Volume (mm3):	0.0567
SiC Volume (mm3):	0.0614
OPyC Volume (mm3):	0.0957

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.73	2.16	205.99	217.50
Buffer Thickness (μm):	93.74	4.63	84.01	113.93
IPyC Thickness (μm):	42.30	2.44	34.52	49.48
SiC Thickness (μm):	36.49	1.17	32.22	40.28
OPyC Thickness (μm):	45.93	1.97	37.98	52.94

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.518	3.822	34.332	18.784
Buffer Curvature (mm^{-2}):	10.787	2.247	21.115	7.282
IPyC Curvature (mm^{-2}):	8.316	2.088	16.731	4.449
SiC Curvature (mm^{-2}):	6.808	1.777	13.628	3.362
OPyC Curvature (mm^{-2}):	5.429	1.385	10.892	2.862

6.4 SP07J

Kernel Volume (mm3):	0.0405
Buffer Volume (mm3):	0.0818
IPyC Volume (mm3):	0.0614
SiC Volume (mm3):	0.0678
OPyC Volume (mm3):	0.1013

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	212.54	2.16	207.16	218.61
Buffer Thickness (μm):	94.79	5.49	81.26	125.90
IPyC Thickness (μm):	44.67	3.02	22.89	52.65
SiC Thickness (μm):	38.90	1.40	34.34	43.49
OPyC Thickness (μm):	46.78	1.87	38.91	52.65

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.138	3.713	33.071	17.706
Buffer Curvature (mm^{-2}):	10.588	2.687	27.511	5.089
IPyC Curvature (mm^{-2}):	8.071	2.413	21.789	2.610
SiC Curvature (mm^{-2}):	6.545	2.007	16.859	1.889
OPyC Curvature (mm^{-2}):	5.220	1.488	12.611	1.807

6.5 SP08J

Kernel Volume (mm3):	0.0416
Buffer Volume (mm3):	0.0886
IPyC Volume (mm3):	0.0567
SiC Volume (mm3):	0.0645
OPyC Volume (mm3):	0.1025

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.30	2.31	209.02	220.38
Buffer Thickness (μm):	99.47	4.76	82.93	115.87
IPyC Thickness (μm):	40.25	2.00	30.67	46.58
SiC Thickness (μm):	36.87	1.14	28.40	40.90
OPyC Thickness (μm):	47.25	2.64	37.49	55.66

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.775	3.684	32.665	18.779
Buffer Curvature (mm^{-2}):	10.157	2.040	18.369	5.515
IPyC Curvature (mm^{-2}):	7.979	1.816	14.945	3.137
SiC Curvature (mm^{-2}):	6.545	1.530	12.491	2.528
OPyC Curvature (mm^{-2}):	5.209	1.251	9.858	2.265

6.6 SP09J

Kernel Volume (mm3):	0.0404
Buffer Volume (mm3):	0.1280
IPyC Volume (mm3):	0.0625
SiC Volume (mm3):	0.0767
OPyC Volume (mm3):	0.1076

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	212.20	2.45	205.33	217.80
Buffer Thickness (μm):	129.73	5.13	113.44	142.93
IPyC Thickness (μm):	37.97	1.98	29.49	44.24
SiC Thickness (μm):	38.17	1.24	34.03	43.11
OPyC Thickness (μm):	44.00	2.72	34.03	52.18

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.207	4.038	34.469	15.424
Buffer Curvature (mm^{-2}):	8.553	1.882	16.559	5.335
IPyC Curvature (mm^{-2}):	6.929	1.742	14.403	3.492
SiC Curvature (mm^{-2}):	5.721	1.506	12.474	2.543
OPyC Curvature (mm^{-2}):	4.684	1.283	10.761	2.055

6.7 SP11J

Kernel Volume (mm3):	0.0419
Buffer Volume (mm3):	0.1255
IPyC Volume (mm3):	0.0684
SiC Volume (mm3):	0.0739
OPyC Volume (mm3):	0.1103

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.89	3.39	203.11	228.35
Buffer Thickness (μm):	126.42	5.33	107.87	140.00
IPyC Thickness (μm):	41.32	2.18	33.28	48.20
SiC Thickness (μm):	36.42	1.25	28.69	40.16
OPyC Thickness (μm):	44.85	2.38	35.57	52.79

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.656	4.000	40.328	13.654
Buffer Curvature (mm^{-2}):	8.584	2.128	18.056	4.164
IPyC Curvature (mm^{-2}):	6.830	1.903	15.423	3.250
SiC Curvature (mm^{-2}):	5.695	1.629	12.611	2.622
OPyC Curvature (mm^{-2}):	4.647	1.291	10.170	2.116

6.8 SP12J

Kernel Volume (mm3):	0.0423
Buffer Volume (mm3):	0.0930
IPyC Volume (mm3):	0.0568
SiC Volume (mm3):	0.0653
OPyC Volume (mm3):	0.1014

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.56	3.71	206.96	224.11
Buffer Thickness (μm):	102.36	4.09	90.33	115.48
IPyC Thickness (μm):	39.44	2.01	33.16	45.74
SiC Thickness (μm):	36.67	1.13	33.16	40.02
OPyC Thickness (μm):	46.24	2.06	38.88	52.60

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.522	4.317	38.007	14.640
Buffer Curvature (mm^{-2}):	9.894	2.136	18.438	6.287
IPyC Curvature (mm^{-2}):	7.831	1.888	15.263	4.440
SiC Curvature (mm^{-2}):	6.441	1.602	12.852	3.348
OPyC Curvature (mm^{-2}):	5.159	1.221	10.226	2.417

6.9 SP13J

Kernel Volume (mm3):	0.0403
Buffer Volume (mm3):	0.0715
IPyC Volume (mm3):	0.0552
SiC Volume (mm3):	0.0607
OPyC Volume (mm3):	0.0869

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	212.04	3.17	203.81	222.13
Buffer Thickness (μm):	86.15	3.98	74.43	108.78
IPyC Thickness (μm):	42.69	2.19	29.77	49.24
SiC Thickness (μm):	37.14	1.18	33.21	42.37
OPyC Thickness (μm):	43.14	2.29	35.50	50.38

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.242	4.233	38.822	16.325
Buffer Curvature (mm^{-2}):	11.246	2.520	22.771	7.683
IPyC Curvature (mm^{-2}):	8.606	2.063	18.952	4.610
SiC Curvature (mm^{-2}):	6.998	1.746	15.430	3.728
OPyC Curvature (mm^{-2}):	5.638	1.381	11.941	3.234

6.10 SP14J

Kernel Volume (mm3):	0.0425
Buffer Volume (mm3):	0.1235
IPyC Volume (mm3):	0.0664
SiC Volume (mm3):	0.0738
OPyC Volume (mm3):	0.1080

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.88	2.63	209.02	225.01
Buffer Thickness (μm):	124.31	6.21	109.65	142.78
IPyC Thickness (μm):	40.41	2.39	33.12	46.83
SiC Thickness (μm):	36.73	1.30	31.98	42.26
OPyC Thickness (μm):	44.29	2.42	36.55	52.54

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.458	3.862	33.634	15.649
Buffer Curvature (mm^{-2}):	8.641	2.423	18.064	4.622
IPyC Curvature (mm^{-2}):	6.903	2.180	15.158	2.986
SiC Curvature (mm^{-2}):	5.742	1.832	12.339	2.352
OPyC Curvature (mm^{-2}):	4.693	1.506	9.851	1.848

6.11 SP16J

Kernel Volume (mm3):	0.0417
Buffer Volume (mm3):	0.0827
IPyC Volume (mm3):	0.0576
SiC Volume (mm3):	0.0648
OPyC Volume (mm3):	0.0982

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.45	2.62	207.15	222.03
Buffer Thickness (μm):	94.62	3.99	83.55	105.29
IPyC Thickness (μm):	41.83	2.31	34.34	50.36
SiC Thickness (μm):	37.53	1.11	33.19	41.20
OPyC Thickness (μm):	45.98	2.23	38.91	53.79

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.744	3.911	33.094	16.607
Buffer Curvature (mm^{-2}):	10.469	2.210	18.589	7.100
IPyC Curvature (mm^{-2}):	8.122	2.012	15.258	4.413
SiC Curvature (mm^{-2}):	6.628	1.672	13.086	3.574
OPyC Curvature (mm^{-2}):	5.299	1.337	10.061	3.120

6.12 SP17J

Kernel Volume (mm3):	0.0427
Buffer Volume (mm3):	0.1262
IPyC Volume (mm3):	0.0725
SiC Volume (mm3):	0.0772
OPyC Volume (mm3):	0.1142

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	216.26	2.74	209.78	224.60
Buffer Thickness (μm):	126.05	8.37	106.03	167.59
IPyC Thickness (μm):	43.50	4.96	4.56	52.44
SiC Thickness (μm):	37.39	1.22	33.06	42.18
OPyC Thickness (μm):	45.52	2.79	36.48	53.58

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.382	3.974	34.279	15.142
Buffer Curvature (mm^{-2}):	8.534	2.536	20.811	1.512
IPyC Curvature (mm^{-2}):	6.718	1.807	15.249	2.296
SiC Curvature (mm^{-2}):	5.583	1.533	12.649	1.904
OPyC Curvature (mm^{-2}):	4.552	1.309	10.394	1.815

6.13 SP18J

Kernel Volume (mm3):	0.0399
Buffer Volume (mm3):	0.1275
IPyC Volume (mm3):	0.0683
SiC Volume (mm3):	0.0759
OPyC Volume (mm3):	0.1146

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	211.43	2.80	203.55	219.65
Buffer Thickness (μm):	129.78	6.58	106.95	149.50
IPyC Thickness (μm):	41.30	2.40	31.05	48.30
SiC Thickness (μm):	37.36	1.26	33.35	42.55
OPyC Thickness (μm):	46.28	2.13	39.10	55.20

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.371	4.338	39.198	13.717
Buffer Curvature (mm^{-2}):	8.589	2.272	17.593	3.285
IPyC Curvature (mm^{-2}):	6.835	2.048	15.228	1.842
SiC Curvature (mm^{-2}):	5.673	1.724	13.450	1.460
OPyC Curvature (mm^{-2}):	4.602	1.324	9.513	1.363

6.14 SP19J

Kernel Volume (mm3):	0.0455
Buffer Volume (mm3):	0.1281
IPyC Volume (mm3):	0.0672
SiC Volume (mm3):	0.0748
OPyC Volume (mm3):	0.1147

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	220.80	4.22	211.97	239.32
Buffer Thickness (μm):	124.56	6.42	102.56	147.01
IPyC Thickness (μm):	39.86	2.44	22.79	47.86
SiC Thickness (μm):	36.41	1.60	26.21	45.58
OPyC Thickness (μm):	45.98	2.43	36.47	54.70

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	20.511	4.490	42.278	10.850
Buffer Curvature (mm^{-2}):	8.384	2.144	16.807	4.560
IPyC Curvature (mm^{-2}):	6.739	1.936	14.126	2.828
SiC Curvature (mm^{-2}):	5.625	1.658	11.588	2.142
OPyC Curvature (mm^{-2}):	4.573	1.298	9.013	2.003

6.15 SP20J

Kernel Volume (mm3):	0.0389
Buffer Volume (mm3):	0.1048
IPyC Volume (mm3):	0.0643
SiC Volume (mm3):	0.0676
OPyC Volume (mm3):	0.1058

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.49	3.57	200.50	218.73
Buffer Thickness (μm):	114.79	4.50	99.11	131.01
IPyC Thickness (μm):	42.60	2.07	35.32	50.12
SiC Thickness (μm):	36.16	1.15	28.48	41.01
OPyC Thickness (μm):	46.20	2.42	37.59	53.54

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.787	4.787	40.071	15.927
Buffer Curvature (mm^{-2}):	9.510	2.089	16.666	3.595
IPyC Curvature (mm^{-2}):	7.429	1.756	14.363	1.951
SiC Curvature (mm^{-2}):	6.156	1.482	11.821	1.485
OPyC Curvature (mm^{-2}):	4.955	1.163	9.596	1.619

6.16 SP21J

Kernel Volume (mm3):	0.0418
Buffer Volume (mm3):	0.1248
IPyC Volume (mm3):	0.0700
SiC Volume (mm3):	0.0779
OPyC Volume (mm3):	0.1111

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.59	3.49	205.42	223.78
Buffer Thickness (μm):	126.11	5.11	111.32	142.30
IPyC Thickness (μm):	42.32	2.01	34.43	49.35
SiC Thickness (μm):	38.20	1.14	34.43	42.46
OPyC Thickness (μm):	44.73	2.65	35.58	53.94

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.717	4.387	36.790	14.130
Buffer Curvature (mm^{-2}):	8.615	1.784	15.759	5.299
IPyC Curvature (mm^{-2}):	6.816	1.602	14.058	4.299
SiC Curvature (mm^{-2}):	5.636	1.346	11.885	3.326
OPyC Curvature (mm^{-2}):	4.606	1.166	9.273	2.533

6.17 SP22J

Kernel Volume (mm3):	0.0423
Buffer Volume (mm3):	0.0739
IPyC Volume (mm3):	0.0575
SiC Volume (mm3):	0.0633
OPyC Volume (mm3):	0.0938

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.57	2.89	208.28	227.74
Buffer Thickness (μm):	86.55	4.24	72.10	108.72
IPyC Thickness (μm):	43.36	2.17	29.75	50.35
SiC Thickness (μm):	37.77	1.04	35.48	41.20
OPyC Thickness (μm):	45.14	2.08	37.77	53.79

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.518	4.119	37.164	13.748
Buffer Curvature (mm^{-2}):	10.956	2.210	21.566	7.179
IPyC Curvature (mm^{-2}):	8.378	1.767	15.256	4.708
SiC Curvature (mm^{-2}):	6.808	1.485	13.028	3.848
OPyC Curvature (mm^{-2}):	5.449	1.153	9.768	3.096

6.18 SP24J

Kernel Volume (mm3):	0.0391
Buffer Volume (mm3):	0.0954
IPyC Volume (mm3):	0.0615
SiC Volume (mm3):	0.0659
OPyC Volume (mm3):	0.1066

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.95	3.41	202.72	219.90
Buffer Thickness (μm):	107.22	4.94	85.90	122.55
IPyC Thickness (μm):	42.47	2.15	35.50	49.25
SiC Thickness (μm):	36.54	1.16	33.21	40.09
OPyC Thickness (μm):	47.86	1.82	41.23	54.97

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.687	4.498	36.500	16.701
Buffer Curvature (mm^{-2}):	9.941	2.304	22.749	4.510
IPyC Curvature (mm^{-2}):	7.732	1.911	18.711	2.783
SiC Curvature (mm^{-2}):	6.371	1.608	15.706	2.111
OPyC Curvature (mm^{-2}):	5.072	1.202	12.100	2.148

6.19 SP25J

Kernel Volume (mm3):	0.0442
Buffer Volume (mm3):	0.0962
IPyC Volume (mm3):	0.0632
SiC Volume (mm3):	0.0686
OPyC Volume (mm3):	0.1082

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	218.79	2.95	211.64	230.04
Buffer Thickness (μm):	103.01	4.72	81.66	116.17
IPyC Thickness (μm):	42.52	2.20	35.66	54.06
SiC Thickness (μm):	37.07	1.35	27.60	41.41
OPyC Thickness (μm):	47.44	1.94	41.41	55.21

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	20.890	3.883	35.002	14.535
Buffer Curvature (mm^{-2}):	9.657	1.945	16.513	5.951
IPyC Curvature (mm^{-2}):	7.534	1.691	12.886	3.569
SiC Curvature (mm^{-2}):	6.207	1.441	10.816	2.931
OPyC Curvature (mm^{-2}):	4.964	1.086	8.377	2.716

6.20 SP27J

Kernel Volume (mm3):	0.0387
Buffer Volume (mm3):	0.0707
IPyC Volume (mm3):	0.0556
SiC Volume (mm3):	0.0618
OPyC Volume (mm3):	0.0984

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.33	2.50	202.90	217.72
Buffer Thickness (μm):	86.81	5.75	74.09	133.37
IPyC Thickness (μm):	43.56	3.89	2.28	51.30
SiC Thickness (μm):	38.03	1.25	34.20	45.60
OPyC Thickness (μm):	48.26	2.06	41.04	55.86

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.822	3.899	35.769	18.924
Buffer Curvature (mm^{-2}):	11.403	2.799	32.424	5.285
IPyC Curvature (mm^{-2}):	8.666	2.252	17.541	4.216
SiC Curvature (mm^{-2}):	7.009	1.857	14.070	3.113
OPyC Curvature (mm^{-2}):	5.511	1.377	10.578	2.421

6.21 SP29J

Kernel Volume (mm3):	0.0393
Buffer Volume (mm3):	0.1352
IPyC Volume (mm3):	0.0690
SiC Volume (mm3):	0.0744
OPyC Volume (mm3):	0.1086

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.27	2.68	204.15	217.84
Buffer Thickness (μm):	135.84	6.20	116.33	159.67
IPyC Thickness (μm):	40.69	2.09	34.22	47.90
SiC Thickness (μm):	36.00	1.23	31.93	44.48
OPyC Thickness (μm):	43.56	2.77	34.22	52.46

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.618	4.125	34.406	17.596
Buffer Curvature (mm^{-2}):	8.348	1.844	17.239	4.984
IPyC Curvature (mm^{-2}):	6.684	1.675	14.617	3.420
SiC Curvature (mm^{-2}):	5.594	1.432	12.113	2.856
OPyC Curvature (mm^{-2}):	4.598	1.211	10.487	2.700

6.22 SP30J

Kernel Volume (mm3):	0.0384
Buffer Volume (mm3):	0.0699
IPyC Volume (mm3):	0.0495
SiC Volume (mm3):	0.0615
OPyC Volume (mm3):	0.0899

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	208.66	4.43	198.33	221.12
Buffer Thickness (μm):	86.38	4.52	71.81	98.02
IPyC Thickness (μm):	39.51	2.08	33.05	49.01
SiC Thickness (μm):	38.83	1.39	28.50	45.59
OPyC Thickness (μm):	45.37	2.52	36.47	54.71

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.968	5.268	42.026	12.812
Buffer Curvature (mm^{-2}):	11.488	2.462	22.997	6.917
IPyC Curvature (mm^{-2}):	8.935	2.041	18.921	4.742
SiC Curvature (mm^{-2}):	7.173	1.676	15.421	3.558
OPyC Curvature (mm^{-2}):	5.703	1.383	12.112	3.167

6.23 SP31J

Kernel Volume (mm3):	0.0425
Buffer Volume (mm3):	0.0843
IPyC Volume (mm3):	0.0522
SiC Volume (mm3):	0.0680
OPyC Volume (mm3):	0.0993

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.79	3.76	207.43	226.80
Buffer Thickness (μm):	95.16	4.19	80.92	108.27
IPyC Thickness (μm):	38.00	1.97	31.91	44.45
SiC Thickness (μm):	39.61	1.56	29.63	44.45
OPyC Thickness (μm):	46.39	2.75	33.05	54.71

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.475	4.540	35.768	13.705
Buffer Curvature (mm^{-2}):	10.342	2.241	22.452	6.612
IPyC Curvature (mm^{-2}):	8.212	1.973	19.051	4.684
SiC Curvature (mm^{-2}):	6.623	1.688	15.444	2.714
OPyC Curvature (mm^{-2}):	5.286	1.388	11.655	2.017

6.24 SP32J

Kernel Volume (mm3):	0.0394
Buffer Volume (mm3):	0.0942
IPyC Volume (mm3):	0.0598
SiC Volume (mm3):	0.0686
OPyC Volume (mm3):	0.1107

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.51	3.04	203.34	218.11
Buffer Thickness (μm):	105.94	5.34	92.02	119.28
IPyC Thickness (μm):	41.59	2.40	32.94	48.85
SiC Thickness (μm):	38.18	1.26	34.08	42.03
OPyC Thickness (μm):	49.49	1.98	43.17	56.80

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.565	4.295	36.832	14.932
Buffer Curvature (mm^{-2}):	9.986	2.522	17.346	5.617
IPyC Curvature (mm^{-2}):	7.801	2.232	14.423	3.476
SiC Curvature (mm^{-2}):	6.370	1.864	11.972	2.771
OPyC Curvature (mm^{-2}):	5.034	1.385	9.671	2.223

6.25 SP33J

Kernel Volume (mm3):	0.0401
Buffer Volume (mm3):	0.0800
IPyC Volume (mm3):	0.0594
SiC Volume (mm3):	0.0640
OPyC Volume (mm3):	0.0997

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	211.75	3.39	204.20	223.70
Buffer Thickness (μm):	93.72	5.62	78.01	134.22
IPyC Thickness (μm):	43.91	4.69	6.88	50.48
SiC Thickness (μm):	37.43	1.09	34.42	41.30
OPyC Thickness (μm):	46.94	2.14	40.15	53.92

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.302	4.397	38.544	16.853
Buffer Curvature (mm^{-2}):	10.716	2.648	22.381	3.477
IPyC Curvature (mm^{-2}):	8.192	1.802	15.153	4.724
SiC Curvature (mm^{-2}):	6.684	1.515	12.891	4.011
OPyC Curvature (mm^{-2}):	5.315	1.179	10.016	3.359

6.26 SP34J

Kernel Volume (mm3):	0.0521
Buffer Volume (mm3):	0.0901
IPyC Volume (mm3):	0.0656
SiC Volume (mm3):	0.0717
OPyC Volume (mm3):	0.1062

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	231.02	4.70	212.86	241.47
Buffer Thickness (μm):	92.03	4.92	74.39	117.87
IPyC Thickness (μm):	43.58	3.47	22.89	51.50
SiC Thickness (μm):	38.16	1.45	34.33	43.49
OPyC Thickness (μm):	45.99	2.00	40.05	53.79

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	18.737	4.841	34.330	4.887
Buffer Curvature (mm^{-2}):	9.582	2.724	22.146	2.431
IPyC Curvature (mm^{-2}):	7.439	2.401	18.740	1.046
SiC Curvature (mm^{-2}):	6.103	2.022	16.012	0.723
OPyC Curvature (mm^{-2}):	4.921	1.581	12.202	0.913

6.27 SP36J

Kernel Volume (mm3):	0.0430
Buffer Volume (mm3):	0.0832
IPyC Volume (mm3):	0.0565
SiC Volume (mm3):	0.0675
OPyC Volume (mm3):	0.1028

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	216.65	3.07	208.80	224.78
Buffer Thickness (μm):	93.85	4.24	77.59	106.11
IPyC Thickness (μm):	40.81	2.02	34.23	46.78
SiC Thickness (μm):	38.93	1.25	28.53	42.22
OPyC Thickness (μm):	47.52	2.15	38.79	55.91

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.306	3.891	33.398	15.612
Buffer Curvature (mm^{-2}):	10.373	2.188	19.233	6.624
IPyC Curvature (mm^{-2}):	8.103	1.860	14.506	4.429
SiC Curvature (mm^{-2}):	6.567	1.551	11.727	3.585
OPyC Curvature (mm^{-2}):	5.218	1.168	9.266	2.927

6.28 SP37J

Kernel Volume (mm3):	0.0415
Buffer Volume (mm3):	0.0894
IPyC Volume (mm3):	0.0625
SiC Volume (mm3):	0.0660
OPyC Volume (mm3):	0.1013

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.20	3.16	206.42	225.81
Buffer Thickness (μm):	100.10	5.34	86.67	135.71
IPyC Thickness (μm):	43.76	3.62	18.25	60.44
SiC Thickness (μm):	36.91	1.50	20.53	45.62
OPyC Thickness (μm):	45.96	2.89	37.63	69.57

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.795	4.118	41.589	13.758
Buffer Curvature (mm^{-2}):	10.123	2.541	22.383	5.079
IPyC Curvature (mm^{-2}):	7.800	1.721	14.367	4.016
SiC Curvature (mm^{-2}):	6.410	1.439	12.188	3.263
OPyC Curvature (mm^{-2}):	5.143	1.166	9.377	2.906

6.29 SP38J

Kernel Volume (mm3):	0.0386
Buffer Volume (mm3):	0.0909
IPyC Volume (mm3):	0.0618
SiC Volume (mm3):	0.0679
OPyC Volume (mm3):	0.1054

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.13	2.14	202.83	216.51
Buffer Thickness (μm):	104.18	4.18	87.74	118.51
IPyC Thickness (μm):	43.61	2.48	25.07	50.14
SiC Thickness (μm):	38.06	1.13	34.19	43.30
OPyC Thickness (μm):	47.60	2.21	39.88	54.70

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.865	4.001	35.894	18.755
Buffer Curvature (mm^{-2}):	10.188	2.015	17.963	6.515
IPyC Curvature (mm^{-2}):	7.850	1.739	14.613	4.764
SiC Curvature (mm^{-2}):	6.410	1.481	12.128	3.262
OPyC Curvature (mm^{-2}):	5.105	1.176	9.369	2.831

6.30 SP39J

Kernel Volume (mm3):	0.0371
Buffer Volume (mm3):	0.0910
IPyC Volume (mm3):	0.0523
SiC Volume (mm3):	0.0674
OPyC Volume (mm3):	0.1040

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	206.26	2.99	199.63	214.55
Buffer Thickness (μm):	105.80	4.97	91.78	123.91
IPyC Thickness (μm):	37.81	1.91	32.12	45.89
SiC Thickness (μm):	39.13	1.24	33.27	45.89
OPyC Thickness (μm):	48.28	2.14	40.16	55.07

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	23.504	4.487	37.697	15.068
Buffer Curvature (mm^{-2}):	10.268	2.376	21.003	6.110
IPyC Curvature (mm^{-2}):	8.169	1.972	17.833	4.360
SiC Curvature (mm^{-2}):	6.608	1.625	14.766	3.561
OPyC Curvature (mm^{-2}):	5.230	1.305	11.115	2.417

6.31 SP40J

Kernel Volume (mm3):	0.0419
Buffer Volume (mm3):	0.0812
IPyC Volume (mm3):	0.0592
SiC Volume (mm3):	0.0659
OPyC Volume (mm3):	0.0991

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.78	2.32	208.77	222.46
Buffer Thickness (μm):	93.13	4.26	81.00	108.38
IPyC Thickness (μm):	43.09	2.36	37.65	51.34
SiC Thickness (μm):	38.09	1.20	34.22	42.21
OPyC Thickness (μm):	46.18	2.38	36.51	53.62

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.678	3.751	33.146	17.998
Buffer Curvature (mm^{-2}):	10.548	2.361	20.920	5.852
IPyC Curvature (mm^{-2}):	8.117	2.085	17.960	4.102
SiC Curvature (mm^{-2}):	6.605	1.754	14.650	3.248
OPyC Curvature (mm^{-2}):	5.278	1.382	11.807	2.365

6.32 SP41J

Kernel Volume (mm3):	0.0429
Buffer Volume (mm3):	0.1018
IPyC Volume (mm3):	0.0590
SiC Volume (mm3):	0.0671
OPyC Volume (mm3):	0.0992

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	216.53	3.50	208.69	228.08
Buffer Thickness (μm):	108.54	4.66	90.09	123.16
IPyC Thickness (μm):	39.30	2.17	31.93	46.76
SiC Thickness (μm):	36.32	1.38	26.23	42.19
OPyC Thickness (μm):	43.99	2.62	35.35	54.74

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.329	4.191	35.521	12.366
Buffer Curvature (mm^{-2}):	9.464	1.911	20.084	6.777
IPyC Curvature (mm^{-2}):	7.532	1.773	16.704	4.445
SiC Curvature (mm^{-2}):	6.229	1.541	14.051	3.299
OPyC Curvature (mm^{-2}):	5.057	1.209	11.222	2.921

6.33 SP42J

Kernel Volume (mm3):	0.0408
Buffer Volume (mm3):	0.0846
IPyC Volume (mm3):	0.0579
SiC Volume (mm3):	0.0649
OPyC Volume (mm3):	0.0986

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	212.87	2.85	206.38	221.20
Buffer Thickness (μm):	97.00	8.01	71.83	120.86
IPyC Thickness (μm):	41.79	3.06	31.93	51.31
SiC Thickness (μm):	37.44	1.48	33.07	42.19
OPyC Thickness (μm):	46.01	2.31	38.77	54.73

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.068	4.128	35.543	17.460
Buffer Curvature (mm^{-2}):	10.414	3.410	24.829	3.409
IPyC Curvature (mm^{-2}):	8.086	3.164	21.131	1.668
SiC Curvature (mm^{-2}):	6.605	2.645	17.371	1.155
OPyC Curvature (mm^{-2}):	5.282	2.025	13.206	1.286

6.34 SP43J

Kernel Volume (mm3):	0.0380
Buffer Volume (mm3):	0.0772
IPyC Volume (mm3):	0.0518
SiC Volume (mm3):	0.0616
OPyC Volume (mm3):	0.0904

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	208.03	2.31	200.74	216.80
Buffer Thickness (μm):	93.29	4.44	79.15	104.39
IPyC Thickness (μm):	39.74	2.29	30.97	45.88
SiC Thickness (μm):	37.69	1.14	34.41	42.44
OPyC Thickness (μm):	44.57	2.44	36.71	55.06

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	23.107	4.177	37.076	16.671
Buffer Curvature (mm^{-2}):	11.014	2.297	20.179	7.046
IPyC Curvature (mm^{-2}):	8.597	2.062	16.759	3.772
SiC Curvature (mm^{-2}):	6.971	1.702	15.079	3.051
OPyC Curvature (mm^{-2}):	5.580	1.425	12.670	2.271

6.35 SP44J

Kernel Volume (mm3):	0.0393
Buffer Volume (mm3):	0.0675
IPyC Volume (mm3):	0.0502
SiC Volume (mm3):	0.0626
OPyC Volume (mm3):	0.0895

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.20	2.99	203.05	217.80
Buffer Thickness (μm):	83.48	4.99	70.33	99.83
IPyC Thickness (μm):	40.31	2.38	32.90	48.78
SiC Thickness (μm):	39.58	1.29	36.30	43.11
OPyC Thickness (μm):	45.16	2.37	36.30	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.632	4.208	36.136	17.060
Buffer Curvature (mm^{-2}):	11.594	2.821	22.907	6.600
IPyC Curvature (mm^{-2}):	8.964	2.492	19.341	3.361
SiC Curvature (mm^{-2}):	7.166	2.092	15.902	2.727
OPyC Curvature (mm^{-2}):	5.703	1.605	12.410	2.272

6.36 SP45J

Kernel Volume (mm3):	0.0412
Buffer Volume (mm3):	0.0657
IPyC Volume (mm3):	0.0561
SiC Volume (mm3):	0.0593
OPyC Volume (mm3):	0.0965

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	213.63	3.23	204.21	223.71
Buffer Thickness (μm):	80.14	3.62	67.69	98.66
IPyC Thickness (μm):	44.39	2.21	30.98	50.48
SiC Thickness (μm):	36.94	1.07	33.27	40.15
OPyC Thickness (μm):	47.98	2.12	40.15	55.07

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.912	4.344	35.397	13.726
Buffer Curvature (mm^{-2}):	11.587	2.237	23.483	7.180
IPyC Curvature (mm^{-2}):	8.745	1.855	16.683	4.931
SiC Curvature (mm^{-2}):	7.107	1.516	12.912	3.999
OPyC Curvature (mm^{-2}):	5.587	1.208	10.166	2.965

6.37 SP46J

Kernel Volume (mm3):	0.0438
Buffer Volume (mm3):	0.0632
IPyC Volume (mm3):	0.0532
SiC Volume (mm3):	0.0610
OPyC Volume (mm3):	0.0895

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	217.94	4.35	207.59	238.22
Buffer Thickness (μm):	75.86	5.35	54.45	97.56
IPyC Thickness (μm):	42.41	2.43	21.55	49.91
SiC Thickness (μm):	38.27	1.99	28.36	62.39
OPyC Thickness (μm):	44.98	2.49	36.30	54.45

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.054	4.741	48.704	11.819
Buffer Curvature (mm^{-2}):	11.585	2.788	27.515	6.738
IPyC Curvature (mm^{-2}):	8.847	2.186	20.067	5.337
SiC Curvature (mm^{-2}):	7.131	1.887	15.997	4.198
OPyC Curvature (mm^{-2}):	5.683	1.412	12.383	3.523

6.38 SP47J

Kernel Volume (mm3):	0.0412
Buffer Volume (mm3):	0.0835
IPyC Volume (mm3):	0.0568
SiC Volume (mm3):	0.0654
OPyC Volume (mm3):	0.0952

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	213.58	5.75	197.38	229.14
Buffer Thickness (μm):	95.67	5.58	76.00	122.51
IPyC Thickness (μm):	41.32	2.70	12.48	48.78
SiC Thickness (μm):	37.95	1.49	27.23	47.64
OPyC Thickness (μm):	44.69	2.38	37.43	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.923	6.317	43.764	5.695
Buffer Curvature (mm^{-2}):	10.456	2.792	26.173	5.349
IPyC Curvature (mm^{-2}):	8.137	2.044	16.799	3.919
SiC Curvature (mm^{-2}):	6.625	1.670	13.975	3.046
OPyC Curvature (mm^{-2}):	5.329	1.304	11.700	2.739

6.39 SP48J

Kernel Volume (mm3):	0.0403
Buffer Volume (mm3):	0.0941
IPyC Volume (mm3):	0.0560
SiC Volume (mm3):	0.0684
OPyC Volume (mm3):	0.1018

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	212.04	3.19	205.32	222.34
Buffer Thickness (μm):	105.09	5.23	87.35	120.24
IPyC Thickness (μm):	39.06	2.23	30.63	48.78
SiC Thickness (μm):	38.44	1.29	32.90	44.24
OPyC Thickness (μm):	46.21	2.49	36.30	54.45

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.242	4.128	37.271	15.191
Buffer Curvature (mm^{-2}):	9.943	2.360	18.249	5.134
IPyC Curvature (mm^{-2}):	7.882	2.153	16.127	4.024
SiC Curvature (mm^{-2}):	6.421	1.785	13.651	2.555
OPyC Curvature (mm^{-2}):	5.146	1.436	9.914	2.632

6.40 SP49J

Kernel Volume (mm3):	0.0418
Buffer Volume (mm3):	0.0930
IPyC Volume (mm3):	0.0596
SiC Volume (mm3):	0.0666
OPyC Volume (mm3):	0.1045

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.64	4.01	204.19	224.61
Buffer Thickness (μm):	102.70	5.07	83.94	122.51
IPyC Thickness (μm):	41.26	2.02	30.63	46.51
SiC Thickness (μm):	37.09	1.88	23.82	47.64
OPyC Thickness (μm):	47.13	1.99	38.57	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.707	5.067	34.646	11.944
Buffer Curvature (mm^{-2}):	9.930	2.456	19.218	5.567
IPyC Curvature (mm^{-2}):	7.777	2.050	15.605	3.806
SiC Curvature (mm^{-2}):	6.387	1.776	13.132	2.839
OPyC Curvature (mm^{-2}):	5.100	1.336	10.040	2.398

6.41 SP50J

Kernel Volume (mm3):	0.0439
Buffer Volume (mm3):	0.1145
IPyC Volume (mm3):	0.0635
SiC Volume (mm3):	0.0724
OPyC Volume (mm3):	0.1070

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	218.18	3.55	208.73	229.14
Buffer Thickness (μm):	116.82	3.95	103.23	128.18
IPyC Thickness (μm):	39.92	1.80	34.03	46.51
SiC Thickness (μm):	37.03	1.01	34.03	40.84
OPyC Thickness (μm):	44.95	2.22	36.30	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.007	4.452	36.913	14.182
Buffer Curvature (mm^{-2}):	8.910	1.883	15.154	6.243
IPyC Curvature (mm^{-2}):	7.114	1.653	12.967	4.572
SiC Curvature (mm^{-2}):	5.893	1.354	10.511	3.600
OPyC Curvature (mm^{-2}):	4.790	1.107	9.360	2.510

6.42 SP51J

Kernel Volume (mm3):	0.0434
Buffer Volume (mm3):	0.1019
IPyC Volume (mm3):	0.0636
SiC Volume (mm3):	0.0726
OPyC Volume (mm3):	0.1045

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	217.48	2.65	210.99	225.74
Buffer Thickness (μm):	108.09	4.46	93.02	131.59
IPyC Thickness (μm):	41.95	2.56	20.42	47.64
SiC Thickness (μm):	38.48	1.18	32.90	41.97
OPyC Thickness (μm):	45.06	2.96	35.17	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.143	3.731	32.870	16.166
Buffer Curvature (mm^{-2}):	9.435	2.067	19.252	6.430
IPyC Curvature (mm^{-2}):	7.404	1.755	16.154	4.073
SiC Curvature (mm^{-2}):	6.067	1.465	12.591	3.160
OPyC Curvature (mm^{-2}):	4.915	1.343	10.729	2.089

6.43 SP52J

Kernel Volume (mm3):	0.0380
Buffer Volume (mm3):	0.0644
IPyC Volume (mm3):	0.0530
SiC Volume (mm3):	0.0614
OPyC Volume (mm3):	0.0931

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	207.92	2.69	201.29	215.02
Buffer Thickness (μm):	81.68	3.99	68.62	91.50
IPyC Thickness (μm):	43.28	2.45	34.31	51.47
SiC Thickness (μm):	39.12	1.24	35.45	43.46
OPyC Thickness (μm):	47.11	2.62	37.74	54.90

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	23.132	4.187	37.280	16.275
Buffer Curvature (mm^{-2}):	11.924	2.513	21.009	7.898
IPyC Curvature (mm^{-2}):	9.025	2.240	17.467	4.873
SiC Curvature (mm^{-2}):	7.226	1.832	13.976	3.727
OPyC Curvature (mm^{-2}):	5.693	1.512	11.404	3.021

6.44 SP53J

Kernel Volume (mm3):	0.0398
Buffer Volume (mm3):	0.0800
IPyC Volume (mm3):	0.0536
SiC Volume (mm3):	0.0600
OPyC Volume (mm3):	0.0954

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	211.10	3.63	203.49	225.21
Buffer Thickness (μm):	94.01	4.53	77.74	107.46
IPyC Thickness (μm):	40.07	2.73	32.01	46.87
SiC Thickness (μm):	36.04	1.14	32.01	40.01
OPyC Thickness (μm):	46.21	2.21	37.73	53.73

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.439	4.617	45.726	14.776
Buffer Curvature (mm^{-2}):	10.742	2.417	21.133	5.733
IPyC Curvature (mm^{-2}):	8.392	2.325	18.054	3.778
SiC Curvature (mm^{-2}):	6.881	1.942	14.901	2.613
OPyC Curvature (mm^{-2}):	5.474	1.485	11.261	2.514

6.45 SP54J

Kernel Volume (mm3):	0.0388
Buffer Volume (mm3):	0.0652
IPyC Volume (mm3):	0.0509
SiC Volume (mm3):	0.0582
OPyC Volume (mm3):	0.0872

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.30	3.27	202.31	218.31
Buffer Thickness (μm):	81.83	3.76	66.29	92.58
IPyC Thickness (μm):	41.43	1.97	35.43	46.86
SiC Thickness (μm):	37.41	1.06	34.29	41.15
OPyC Thickness (μm):	44.88	2.89	35.43	53.72

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.828	4.464	38.288	15.776
Buffer Curvature (mm^{-2}):	11.799	2.478	20.209	7.010
IPyC Curvature (mm^{-2}):	9.042	2.052	17.378	5.104
SiC Curvature (mm^{-2}):	7.306	1.656	13.544	3.975
OPyC Curvature (mm^{-2}):	5.811	1.439	11.760	3.054

6.46 SP55J

Kernel Volume (mm3):	0.0411
Buffer Volume (mm3):	0.0594
IPyC Volume (mm3):	0.0523
SiC Volume (mm3):	0.0561
OPyC Volume (mm3):	0.0880

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	213.52	3.66	205.33	224.61
Buffer Thickness (μm):	74.29	5.17	60.12	97.56
IPyC Thickness (μm):	43.25	2.37	27.23	49.91
SiC Thickness (μm):	36.40	1.21	28.36	40.84
OPyC Thickness (μm):	45.73	2.68	36.30	54.45

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.933	4.724	39.102	15.426
Buffer Curvature (mm^{-2}):	12.072	2.849	24.957	5.998
IPyC Curvature (mm^{-2}):	9.124	2.207	18.663	4.045
SiC Curvature (mm^{-2}):	7.406	1.819	15.323	3.529
OPyC Curvature (mm^{-2}):	5.857	1.500	11.903	2.472

6.47 SP56J

Kernel Volume (mm3):	0.0393
Buffer Volume (mm3):	0.0682
IPyC Volume (mm3):	0.0481
SiC Volume (mm3):	0.0623
OPyC Volume (mm3):	0.0896

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.33	2.86	203.06	217.80
Buffer Thickness (μm):	84.10	4.07	73.74	97.56
IPyC Thickness (μm):	38.64	1.97	31.76	45.38
SiC Thickness (μm):	39.62	1.21	36.30	44.24
OPyC Thickness (μm):	45.36	2.71	32.90	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.604	4.351	38.796	16.380
Buffer Curvature (mm^{-2}):	11.536	2.395	21.300	6.625
IPyC Curvature (mm^{-2}):	9.014	2.056	17.321	4.344
SiC Curvature (mm^{-2}):	7.200	1.734	14.795	3.356
OPyC Curvature (mm^{-2}):	5.722	1.412	11.088	2.782

6.48 SP57J

Kernel Volume (mm3):	0.0425
Buffer Volume (mm3):	0.1014
IPyC Volume (mm3):	0.0559
SiC Volume (mm3):	0.0677
OPyC Volume (mm3):	0.0988

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.96	2.40	208.28	222.01
Buffer Thickness (μm):	108.57	5.12	92.70	125.88
IPyC Thickness (μm):	37.54	2.22	28.61	44.63
SiC Thickness (μm):	37.03	1.32	28.61	45.78
OPyC Thickness (μm):	44.13	2.24	35.48	54.93

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.442	3.909	34.376	15.303
Buffer Curvature (mm^{-2}):	9.495	2.016	16.636	3.929
IPyC Curvature (mm^{-2}):	7.628	1.873	14.510	2.228
SiC Curvature (mm^{-2}):	6.278	1.595	12.802	1.766
OPyC Curvature (mm^{-2}):	5.090	1.253	10.834	1.609

6.49 SP58J

Kernel Volume (mm3):	0.0460
Buffer Volume (mm3):	0.0982
IPyC Volume (mm3):	0.0612
SiC Volume (mm3):	0.0720
OPyC Volume (mm3):	0.1088

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	221.61	4.61	209.02	241.97
Buffer Thickness (μm):	103.03	5.89	79.52	117.01
IPyC Thickness (μm):	40.64	2.80	27.26	47.71
SiC Thickness (μm):	38.53	1.41	31.81	43.17
OPyC Thickness (μm):	47.19	2.03	40.90	55.66

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	20.362	4.473	48.819	4.749
Buffer Curvature (mm^{-2}):	9.488	2.461	20.473	2.151
IPyC Curvature (mm^{-2}):	7.494	2.190	15.836	0.488
SiC Curvature (mm^{-2}):	6.133	1.827	14.341	0.388
OPyC Curvature (mm^{-2}):	4.917	1.369	9.929	0.484

6.50 SP59J

Kernel Volume (mm3):	0.0421
Buffer Volume (mm3):	0.0902
IPyC Volume (mm3):	0.0570
SiC Volume (mm3):	0.0659
OPyC Volume (mm3):	0.1001

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	215.25	2.37	209.02	222.66
Buffer Thickness (μm):	100.11	8.08	80.66	151.09
IPyC Thickness (μm):	40.13	2.91	4.54	47.71
SiC Thickness (μm):	37.29	1.49	30.67	44.30
OPyC Thickness (μm):	45.89	2.40	37.49	54.53

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.583	3.770	32.458	17.446
Buffer Curvature (mm^{-2}):	10.055	2.850	30.699	0.012
IPyC Curvature (mm^{-2}):	7.913	2.154	24.703	1.146
SiC Curvature (mm^{-2}):	6.482	1.863	20.018	0.527
OPyC Curvature (mm^{-2}):	5.197	1.450	14.282	0.613

6.51 SP60J

Kernel Volume (mm3):	0.0427
Buffer Volume (mm3):	0.0746
IPyC Volume (mm3):	0.0567
SiC Volume (mm3):	0.0604
OPyC Volume (mm3):	0.0957

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	216.10	5.47	202.58	233.65
Buffer Thickness (μm):	86.79	5.12	73.66	101.29
IPyC Thickness (μm):	42.55	3.27	31.08	52.95
SiC Thickness (μm):	36.13	1.41	32.23	41.44
OPyC Thickness (μm):	46.22	2.19	37.98	55.25

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.413	5.550	44.039	5.863
Buffer Curvature (mm^{-2}):	10.900	3.356	27.712	4.083
IPyC Curvature (mm^{-2}):	8.380	2.995	22.377	1.055
SiC Curvature (mm^{-2}):	6.868	2.501	18.594	0.818
OPyC Curvature (mm^{-2}):	5.464	1.871	13.509	1.131

6.52 SP61J

Kernel Volume (mm3):	0.0502
Buffer Volume (mm3):	0.0824
IPyC Volume (mm3):	0.0604
SiC Volume (mm3):	0.0673
OPyC Volume (mm3):	0.1005

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	228.10	5.13	209.57	242.78
Buffer Thickness (μm):	87.44	5.26	67.57	106.50
IPyC Thickness (μm):	41.99	3.88	28.63	54.97
SiC Thickness (μm):	37.59	1.56	32.07	42.37
OPyC Thickness (μm):	45.56	2.72	35.50	54.97

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	19.220	5.087	40.411	4.719
Buffer Curvature (mm^{-2}):	10.044	3.275	20.424	1.978
IPyC Curvature (mm^{-2}):	7.823	3.111	17.573	0.247
SiC Curvature (mm^{-2}):	6.405	2.569	14.571	0.279
OPyC Curvature (mm^{-2}):	5.149	2.028	12.213	0.636

6.53 SP62J

Kernel Volume (mm3):	0.0434
Buffer Volume (mm3):	0.0907
IPyC Volume (mm3):	0.0560
SiC Volume (mm3):	0.0665
OPyC Volume (mm3):	0.1004

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	217.42	3.12	210.63	225.60
Buffer Thickness (μm):	99.51	4.62	85.17	116.25
IPyC Thickness (μm):	39.11	2.33	29.93	46.04
SiC Thickness (μm):	37.51	1.32	29.93	41.44
OPyC Thickness (μm):	45.81	2.85	36.83	56.40

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.154	4.003	34.057	15.489
Buffer Curvature (mm^{-2}):	9.956	2.368	18.849	3.948
IPyC Curvature (mm^{-2}):	7.889	2.149	16.265	1.940
SiC Curvature (mm^{-2}):	6.457	1.812	13.667	1.281
OPyC Curvature (mm^{-2}):	5.180	1.495	11.006	1.120

6.54 SP63J

Kernel Volume (mm3):	0.0516
Buffer Volume (mm3):	0.0964
IPyC Volume (mm3):	0.0617
SiC Volume (mm3):	0.0693
OPyC Volume (mm3):	0.1027

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	230.27	5.93	214.00	243.76
Buffer Thickness (μm):	97.14	5.21	84.69	114.44
IPyC Thickness (μm):	40.35	2.68	28.61	46.92
SiC Thickness (μm):	36.78	1.28	32.04	41.20
OPyC Thickness (μm):	44.59	3.44	29.75	54.93

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	18.860	5.368	39.057	5.230
Buffer Curvature (mm^{-2}):	9.329	2.595	19.979	2.768
IPyC Curvature (mm^{-2}):	7.394	2.301	17.942	1.020
SiC Curvature (mm^{-2}):	6.110	1.899	14.979	0.720
OPyC Curvature (mm^{-2}):	4.957	1.643	11.318	0.895

6.55 SP64J

Kernel Volume (mm3):	0.0428
Buffer Volume (mm3):	0.0801
IPyC Volume (mm3):	0.0478
SiC Volume (mm3):	0.0602
OPyC Volume (mm3):	0.0922

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	216.40	3.79	207.26	227.99
Buffer Thickness (μm):	91.36	4.53	78.30	103.63
IPyC Thickness (μm):	35.67	1.81	29.94	41.45
SiC Thickness (μm):	36.46	1.22	26.48	43.76
OPyC Thickness (μm):	45.11	1.48	39.15	51.82

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.353	4.592	41.141	14.005
Buffer Curvature (mm^{-2}):	10.558	2.484	22.077	6.947
IPyC Curvature (mm^{-2}):	8.478	2.111	17.372	5.164
SiC Curvature (mm^{-2}):	6.929	1.792	15.060	4.137
OPyC Curvature (mm^{-2}):	5.536	1.293	11.176	3.640

6.56 SP65J

Kernel Volume (mm3):	0.0443
Buffer Volume (mm3):	0.0982
IPyC Volume (mm3):	0.0607
SiC Volume (mm3):	0.0695
OPyC Volume (mm3):	0.1020

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	218.97	3.01	211.86	229.03
Buffer Thickness (μm):	104.36	9.62	81.31	148.87
IPyC Thickness (μm):	41.01	7.79	3.44	52.68
SiC Thickness (μm):	37.58	1.15	34.36	48.10
OPyC Thickness (μm):	44.96	1.65	40.08	51.53

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	20.856	3.775	32.938	15.786
Buffer Curvature (mm^{-2}):	9.566	3.453	26.959	1.760
IPyC Curvature (mm^{-2}):	7.533	1.641	12.330	3.215
SiC Curvature (mm^{-2}):	6.191	1.379	10.347	2.726
OPyC Curvature (mm^{-2}):	5.007	1.030	8.409	2.639

6.57 SP70J

Kernel Volume (mm3):	0.0400
Buffer Volume (mm3):	0.0914
IPyC Volume (mm3):	0.0591
SiC Volume (mm3):	0.0665
OPyC Volume (mm3):	0.1001

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	211.48	4.44	201.98	229.36
Buffer Thickness (μm):	103.24	5.36	81.02	122.10
IPyC Thickness (μm):	41.56	2.17	34.23	49.07
SiC Thickness (μm):	37.46	1.21	31.95	42.22
OPyC Thickness (μm):	45.70	2.14	38.80	54.77

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.358	5.136	47.424	12.643
Buffer Curvature (mm^{-2}):	10.095	2.190	22.056	5.546
IPyC Curvature (mm^{-2}):	7.878	1.911	17.905	3.705
SiC Curvature (mm^{-2}):	6.450	1.647	15.287	2.958
OPyC Curvature (mm^{-2}):	5.178	1.292	10.964	2.416

6.58 SP71J

Kernel Volume (mm3):	0.0390
Buffer Volume (mm3):	0.0722
IPyC Volume (mm3):	0.0567
SiC Volume (mm3):	0.0619
OPyC Volume (mm3):	0.0960

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	209.83	3.42	202.99	223.52
Buffer Thickness (μm):	87.90	5.58	69.56	115.18
IPyC Thickness (μm):	43.92	3.48	18.25	51.32
SiC Thickness (μm):	37.74	1.12	33.07	42.19
OPyC Thickness (μm):	46.91	2.02	38.77	53.60

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.714	4.704	39.300	13.182
Buffer Curvature (mm^{-2}):	11.282	2.771	27.357	5.004
IPyC Curvature (mm^{-2}):	8.567	2.034	16.983	3.184
SiC Curvature (mm^{-2}):	6.948	1.655	13.834	2.563
OPyC Curvature (mm^{-2}):	5.503	1.198	10.453	2.292

6.59 SP72J

Kernel Volume (mm3):	0.0445
Buffer Volume (mm3):	0.0878
IPyC Volume (mm3):	0.0599
SiC Volume (mm3):	0.0658
OPyC Volume (mm3):	0.1061

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	219.24	3.24	212.17	228.23
Buffer Thickness (μm):	96.19	4.15	83.72	123.86
IPyC Thickness (μm):	41.90	2.27	22.94	48.17
SiC Thickness (μm):	36.87	1.13	33.26	40.14
OPyC Thickness (μm):	48.04	2.02	41.29	55.05

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	20.804	4.005	35.019	15.134
Buffer Curvature (mm^{-2}):	10.051	2.339	20.796	5.534
IPyC Curvature (mm^{-2}):	7.832	2.031	16.146	4.358
SiC Curvature (mm^{-2}):	6.435	1.711	13.363	3.472
OPyC Curvature (mm^{-2}):	5.113	1.244	9.790	2.752

6.60 SP73J

Kernel Volume (mm3):	0.0393
Buffer Volume (mm3):	0.0853
IPyC Volume (mm3):	0.0543
SiC Volume (mm3):	0.0640
OPyC Volume (mm3):	0.0986

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.23	2.96	203.13	222.53
Buffer Thickness (μm):	98.91	5.46	84.45	114.12
IPyC Thickness (μm):	39.65	2.12	33.09	46.79
SiC Thickness (μm):	37.52	1.34	33.09	42.22
OPyC Thickness (μm):	46.56	2.55	34.23	54.78

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.625	4.276	38.097	16.845
Buffer Curvature (mm^{-2}):	10.464	2.859	20.396	4.414
IPyC Curvature (mm^{-2}):	8.220	2.459	16.698	2.972
SiC Curvature (mm^{-2}):	6.701	2.088	14.801	2.184
OPyC Curvature (mm^{-2}):	5.337	1.632	11.049	1.931

6.61 SP74J

Kernel Volume (mm3):	0.0415
Buffer Volume (mm3):	0.0828
IPyC Volume (mm3):	0.0588
SiC Volume (mm3):	0.0653
OPyC Volume (mm3):	0.0952

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.25	2.67	207.54	222.36
Buffer Thickness (μm):	94.75	4.15	83.24	110.61
IPyC Thickness (μm):	42.62	2.16	35.35	52.45
SiC Thickness (μm):	37.68	1.14	34.21	42.19
OPyC Thickness (μm):	44.56	2.45	35.35	52.45

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.785	4.132	35.921	14.266
Buffer Curvature (mm^{-2}):	10.473	2.194	19.756	6.594
IPyC Curvature (mm^{-2}):	8.088	1.909	17.493	3.967
SiC Curvature (mm^{-2}):	6.598	1.580	15.153	3.190
OPyC Curvature (mm^{-2}):	5.313	1.258	11.491	2.489

6.62 SP75J

Kernel Volume (mm3):	0.0415
Buffer Volume (mm3):	0.0863
IPyC Volume (mm3):	0.0538
SiC Volume (mm3):	0.0670
OPyC Volume (mm3):	0.0975

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.12	3.34	206.24	225.61
Buffer Thickness (μm):	97.72	4.55	85.46	109.38
IPyC Thickness (μm):	38.79	1.93	33.04	46.72
SiC Thickness (μm):	38.76	1.27	31.90	43.30
OPyC Thickness (μm):	45.46	2.41	36.46	53.55

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.811	4.505	37.974	12.520
Buffer Curvature (mm^{-2}):	10.283	2.327	19.164	6.807
IPyC Curvature (mm^{-2}):	8.133	1.991	16.704	4.729
SiC Curvature (mm^{-2}):	6.595	1.651	13.631	3.842
OPyC Curvature (mm^{-2}):	5.288	1.404	11.309	2.935

6.63 SP76J

Kernel Volume (mm3):	0.0383
Buffer Volume (mm3):	0.0832
IPyC Volume (mm3):	0.0601
SiC Volume (mm3):	0.0645
OPyC Volume (mm3):	0.0982

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	208.42	3.01	200.46	224.38
Buffer Thickness (μm):	98.15	5.36	75.17	112.76
IPyC Thickness (μm):	44.01	2.27	36.45	51.25
SiC Thickness (μm):	37.44	1.25	29.61	42.14
OPyC Thickness (μm):	46.04	2.08	37.59	53.53

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	23.021	4.333	43.763	12.200
Buffer Curvature (mm^{-2}):	10.640	2.642	23.124	4.149
IPyC Curvature (mm^{-2}):	8.136	2.288	19.154	3.620
SiC Curvature (mm^{-2}):	6.642	1.880	16.159	2.162
OPyC Curvature (mm^{-2}):	5.307	1.419	11.541	2.536

6.64 SP77J

Kernel Volume (mm3):	0.0418
Buffer Volume (mm3):	0.0822
IPyC Volume (mm3):	0.0602
SiC Volume (mm3):	0.0643
OPyC Volume (mm3):	0.0978

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	214.71	2.84	207.24	228.88
Buffer Thickness (μm):	93.94	7.80	68.32	144.62
IPyC Thickness (μm):	43.73	5.87	0.00	54.66
SiC Thickness (μm):	37.07	1.23	29.61	43.27
OPyC Thickness (μm):	45.60	2.30	36.44	53.52

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	21.692	4.077	42.146	13.412
Buffer Curvature (mm^{-2}):	10.497	3.066	32.098	3.686
IPyC Curvature (mm^{-2}):	8.054	1.923	15.317	4.395
SiC Curvature (mm^{-2}):	6.593	1.618	12.497	3.408
OPyC Curvature (mm^{-2}):	5.284	1.280	9.738	2.845

6.65 SP78J

Kernel Volume (mm3):	0.0409
Buffer Volume (mm3):	0.0989
IPyC Volume (mm3):	0.0584
SiC Volume (mm3):	0.0679
OPyC Volume (mm3):	0.1008

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	213.10	2.66	206.38	221.20
Buffer Thickness (μm):	108.23	3.91	95.78	120.86
IPyC Thickness (μm):	39.70	1.96	33.07	45.61
SiC Thickness (μm):	37.28	1.12	33.07	43.33
OPyC Thickness (μm):	45.10	2.51	36.49	53.59

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.021	3.990	34.639	15.908
Buffer Curvature (mm^{-2}):	9.685	1.940	17.887	6.992
IPyC Curvature (mm^{-2}):	7.672	1.755	15.115	4.724
SiC Curvature (mm^{-2}):	6.303	1.511	12.560	3.880
OPyC Curvature (mm^{-2}):	5.086	1.223	10.500	3.144

6.66 SP85J

Kernel Volume (mm3):	0.0392
Buffer Volume (mm3):	0.0648
IPyC Volume (mm3):	0.0436
SiC Volume (mm3):	0.0552
OPyC Volume (mm3):	0.0862

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.12	3.33	201.92	221.21
Buffer Thickness (μm):	80.96	4.99	66.93	97.56
IPyC Thickness (μm):	36.04	2.27	28.36	43.11
SiC Thickness (μm):	36.59	1.37	29.49	43.11
OPyC Thickness (μm):	45.67	2.34	38.57	53.32

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.650	4.460	39.858	15.004
Buffer Curvature (mm^{-2}):	11.803	3.170	25.467	4.811
IPyC Curvature (mm^{-2}):	9.345	2.808	21.784	2.529
SiC Curvature (mm^{-2}):	7.559	2.354	19.086	1.756
OPyC Curvature (mm^{-2}):	5.967	1.770	13.823	2.124

6.67 SP86J

Kernel Volume (mm3):	0.0392
Buffer Volume (mm3):	0.0547
IPyC Volume (mm3):	0.0465
SiC Volume (mm3):	0.0572
OPyC Volume (mm3):	0.0872

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	210.09	4.18	199.39	221.16
Buffer Thickness (μm):	71.20	4.55	51.57	83.65
IPyC Thickness (μm):	40.40	2.08	34.38	46.98
SiC Thickness (μm):	38.90	1.65	25.21	44.69
OPyC Thickness (μm):	46.83	2.43	35.52	55.00

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	22.655	5.112	36.492	11.768
Buffer Curvature (mm^{-2}):	12.638	3.188	25.555	6.121
IPyC Curvature (mm^{-2}):	9.663	2.602	22.278	4.242
SiC Curvature (mm^{-2}):	7.690	2.137	18.152	3.220
OPyC Curvature (mm^{-2}):	6.024	1.677	13.676	2.840

6.68 SP87J

Kernel Volume (mm3):	0.0375
Buffer Volume (mm3):	0.0500
IPyC Volume (mm3):	0.0465
SiC Volume (mm3):	0.0553
OPyC Volume (mm3):	0.0828

	Mean	Standard Deviation	Min	Max
Kernel Radius (μm):	207.05	3.40	198.45	215.55
Buffer Thickness (μm):	67.72	3.34	55.88	77.55
IPyC Thickness (μm):	42.08	2.27	34.21	49.04
SiC Thickness (μm):	38.74	1.22	34.21	42.20
OPyC Thickness (μm):	45.74	2.12	37.64	53.60

	Expected Curvature	Mean Absolute Deviation	Max Curvature	Min Curvature
Kernel Curvature (mm^{-2}):	23.326	4.666	38.106	17.093
Buffer Curvature (mm^{-2}):	13.246	2.704	24.952	7.144
IPyC Curvature (mm^{-2}):	9.961	2.296	19.428	4.479
SiC Curvature (mm^{-2}):	7.909	1.922	16.024	3.354
OPyC Curvature (mm^{-2}):	6.209	1.514	11.566	2.751