Non-destructive Geometric Characterization of TRISO Particles by X-ray Tomography

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The response of the buffer and inner pyrolytic carbon (IPyC) layers of tristructural-isotropic (TRISO) particles under irradiation is a critical parameter for particle performance. Dimensional changes under irradiation are typically benign, but in some cases result in tearing of the IPyC layer leading to fission product attack on the silicon carbide (SiC) layer and eventual particle failure. Characterization of the onset and progression of dimensional changes is difficult in integral irradiation tests due to spatial variations in irradiation conditions and statistical distributions in initial particle properties such as layer thicknesses and curvatures. Uncertainties in irradiation conditions may be resolved by performing controlled irradiations and re-irradiations of individual particles; however, non-destructive characterization methods are also required to allow tracking of changes in individual particle properties. To that end, a capability has been developed which combines x-ray computed tomography (XCT) with automated image analysis and segmentation to generate high-fidelity three-dimensional segmentations of each of the constituent TRISO layers as well as common irradiation features such as a buffer/IPyC gap. The detailed geometric characterization provided by this method will enable quantitative measurements of TRISO particle dimensional changes under varying irradiation conditions and show any correlation of the behavior of the buffer and IPyC layers under irradiation to local variations in layer thicknesses and curvatures.

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