Characterizing Char Rate and Extent in Fiber-Reinforced Plastics Using X-ray Computed Tomography

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Orbital debris is a growing problem for the space industry and the world in general, and an important component of the problem is what happens when that debris reenters the Earth's atmosphere. With more spacecraft opting for fiber-reinforced polymer (FRP) components, we need to understand the thermal destruction process of these materials during an atmospheric reentry and how much of the material can survive to impact the ground. The NASA Orbital Debris Program Office (ODPO) has developed a new charring model for FRP components to be integrated into the latest version of the Object Reentry Survival Analysis Tool (ORSAT). To validate this new model, the ODPO performed several test series using the Inductively Coupled Plasma (ICP) Torch facility at UT Austin. To measure the extent of charred material at different conditions, some of the test samples were scanned using x-ray computed tomography (CT) by the Astromaterials Curation Lab at Johnson Space Center. 3D image analysis was then used to calculate the volume and density of the char in each test sample. This paper presents the image analysis methodology, an assessment of the accuracy of the data analysis, and a comparison with calculations using the ORSAT charring model.