Characterization of Low Density Materials Using 3D X-ray Characterization Techniques

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The characterization of low density materials such as aerogels and foams using x-ray scatter will be presented using confocal micro x-ray fluorescence (confocal μXRF) microscopy as well as micro- and nano- computed tomography (CT). We have begun a rigorous campaign to better understand the use of this instrumentation for these types of materials. In the first set of studies, a series of standards were created of two different foam formulations poly(styrene) with densities between 30 and 160 mg/cm^3, and poly(methylpentene) with densities of ~10-70 mg/cm^3 These standards were synthesized and characterized using confocal μXRF. These standards are being used to gain a better understanding of how the measurement of density is affected by scale and as a way to more fully characterize the performance of confocal μXRF as a density measuring technique. The standards show a 0.99 R^2 correlation between the bulk density and the x-ray scatter intensity. A set of silicon aerogel standards with densities between 5 and 200 mg/cm^3 were formulated and 1D line scans were collected at various depth to better understand the affect of x-ray absorption upon signal as well as 2D and 3D images for the examination of the surface skin and the suitability of confocal μXRF for measuring morphology. A second set of studies were also performed in which poly(dimethylsiloxane) and poly(urethane) foams were imaged with micro- and nano-CT during in-situ compression. Finally, the application of nano-CT to the characterization of these types of samples will be presented.