2015

Developing affordable wet-sample electron microscopy integrated with a temperature controlled sample holder

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Abstract

Scanning electron microscopy (SEM) is widely used to analyze the size, shape and composition of material systems. However, using this tool for analyzing systems such as particles suspended in solution, requires drastic sample alterations, such as precipitation and fixation. Besides altering their environment, this exposes the particles to the harsh conditions within an electron microscope, such as high vacuum and electron beam exposure. To this end, the first goal of this study was to develop methodologies for imaging wet samples using electron microscopy. This is realized by creating a sandwich structure containing the solution of interest between a partially electron transparent window and a silicon substrate. The ability of the developed imaging cells to provide good imaging conditions is demonstrated with a variety of samples including polystyrene spheres, polymeric microgels and spindle shaped nanoparticles. As some of the systems investigated are temperature sensitive, the second goal of the project was to develop a temperature controlled stage that can be integrated with the SEM. In the future this heating stage will be used alongside the wet samples to image microgels above and below their critical solution temperature.