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New capabilities in helium-ion microscopy for nanofabrication and microanalysis at the Center for Nanophase Materials Sciences[1]

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Electron microscopy is a critical technique for all types of nanoscience and basic materials research. However, it is now evident that future imaging needs at the nanoscale cannot be advanced purely by electron-beam instrumentation because enhancing one parameter of instrument performance, for example the spatial resolution, inevitably degrades some other parameter of performance, such as the depth-of-field. Minimizing these problems by techniques such as aberration correction is routine but raises the complexity and hence the cost of such electron-beam instruments to extraordinary levels. The technical advantages of using helium ions rather than electrons are clear - the ultra-short wavelength of ions compared to that of electrons of the same energy permits high resolution and high depth-of-field to be achieved simultaneously and, because the penetration depth of ions is 30 to 50x shorter than that for electrons, ion images are richer in surface detail. The Center for Nanophase Materials Sciences (CNMS) is commissioning the world's first helium-ion microscope tailored specifically for nanofabrication, to include imaging, FIB nanopatterning using helium/neon beams, and TOF-SIMS microanalysis. This instrument will be part of the user program and available to the general research community, and located within the CNMS cleanroom to accommodate fabrication and analysis of nanostructured devices within a clean environment.

[1]Work done in collaboration with David Joy.