Pushing the state-of-the-art in EUV and soft X-ray optics

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As material structures continue to evolve to smaller and smaller dimensions opportunities will emerge with ever greater urgency for spatially resolved materials characterization tools. EUV and soft x-ray radiation, with short wavelengths and photon energies convenient for elemental and chemical anaysis, will become ever more attractive for use in spatially resolved studies such as photoemission microscopy. Both reflective and diffractive optics will be used, depending on the required wavelength, field of view and other parameters. Furthermore, lithographic applications, where the short wavelength is used for printing electronic and other patterns, will eventually evolve to a manufacturing capability. As the need for these new imaging capabilities becomes more pressing our community will enjoy new opportunities, but also new demands to be rigorous in the pursuit of short wavelength optics which truly perform at the diffraction limit - that is with a spatial resolution set by the wavelength and the numerical aperture. For diffractive optics this will mean Fresnel zone plates with very accurate zone placement, proper illumination and several other parameters associated with the particular type of microscope or imaging system. Reflective optics with high numerical aperture will require tighter tolerences in surface figure, mid-range spatial frequencies and roughness. To achieve the requisite tolerances new diagnostic tools will be required which permit feedback to the fabrication process beyond what exists today. Among these will certainly be at-wavelength interferometry of both diffractive and reflective optics, as well as developments at more convenient wavelengths, and the careful exercise of various imaging tests. With such tools in hand we can expect to move on to microscopic resolutions well beyond the present limits of about 60 to 100 nm.