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Exploring the nano-world with bright soft x-ray laser beams[1]

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The generation of bright soft x-ray (SXR) laser beams on a table-top is opening new opportunities for visualizing and altering the nano-world. Compact plasma-based SXR lasers operating at wavelengths between 10 nm and 50 nm are enabling the implementation of ultra-high resolution microscopes, chemical imaging tools, and defect-tolerant nano-patterning tools. SXR laser-based microscopes can image objects with 30 nm resolution with a single laser shot. Such "flash" illumination makes it possible to image dynamic phenomena at the nanoscale. We are also combining SXR laser-induced nano-ablation with mass spectrometry to image chemical composition in three dimensions at the nanoscale. The application of this technique to map the composition of metallic, dielectrics, and organic samples will be described. High average power beams of SXR laser light also make it possible to print arrays of nanostructures defect-free using the Talbot effect. The coherent SXR laser illumination of masks with arrays of arbitrary nano-patterns will allow, for example, the printing of plasmonic structures, arrays of nano-antennas and two-dimensional photonic crystals.

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[2]NSF Engineering Research Center for Extreme Ultraviolet Science and Technology