MAR17-2017-020765

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Ultra-high Resolution Coherent X-ray Imaging of Nano-Materials[1]

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A revolution is underway in the field of x-ray microscopy driven by the develop of experimental, theoretical and computational means of producing a complete description of coherent imaging systems from x-ray diffraction data. The methods being developed not only allow for full quantification and removal of all optical aberrations but also extension of the numerical aperture to the diffraction limit. One such method under intensive development is x-ray ptychography. This is a scanned probe method that reconstructs a scattering object and its illumination from coherent diffraction data. Within the first few years of development at the Advanced Light Source (ALS), Lawrence Berkeley National Laboratory, this method has already achieved the highest resolution x-ray images ever recorded in two, three and four dimensions. With the ability of x-rays to penetrate significantly more matter than electrons, their short wavelength and their sensitivity to chemical and magnetic states of matter, x-ray ptychography is set to revolutionize how we see the nano-scale world. In this presentation I will briefly describe the technical framework for how various methods work and will give a detailed account of a practical implementation at the ALS along with various scientific applications.

[1]The Advanced Light Source is supported by the Director, Office of Science, Office of Basic Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231