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Surface Structure as a Foundation of Nanotechnology[1]

IAN ROBINSON, London Centre for Nanotechnology and Diamond Light Source

The three generations of synchrotron sources achieved to date, parasitic, dedicated and undulator-based, have each time revolutionized the field of X-ray diffraction. Surface structure determination, demonstrated (but very difficult) already with Coolidge tube sources, benefited from the enormous flux gain in the first generation, such as SSRL. Dedicated 2nd-generation sources, such as NSLS, allowed in-situ surface preparation and reliable steady beams to be available when a surface was ready to measure. Third generation sources, such as APS, enormously improved the brightness, hence coherence, and thus allowed access to the surfaces of nanoparticles. This talk will illustrate how these technological advances led to two significant scientific breakthroughs. The concept of crystal truncation rods (CTR) led to new views of how the surface is a modification of, but still an extension of the bulk crystal structure. The development of lensless coherent x-ray diffraction (CXD) imaging has allowed access to the structure of nanocrystalline materials by three-dimensional phase mapping of the particle interiors. The structural principles of these new nano materials are being investigated at present using these new methods.

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