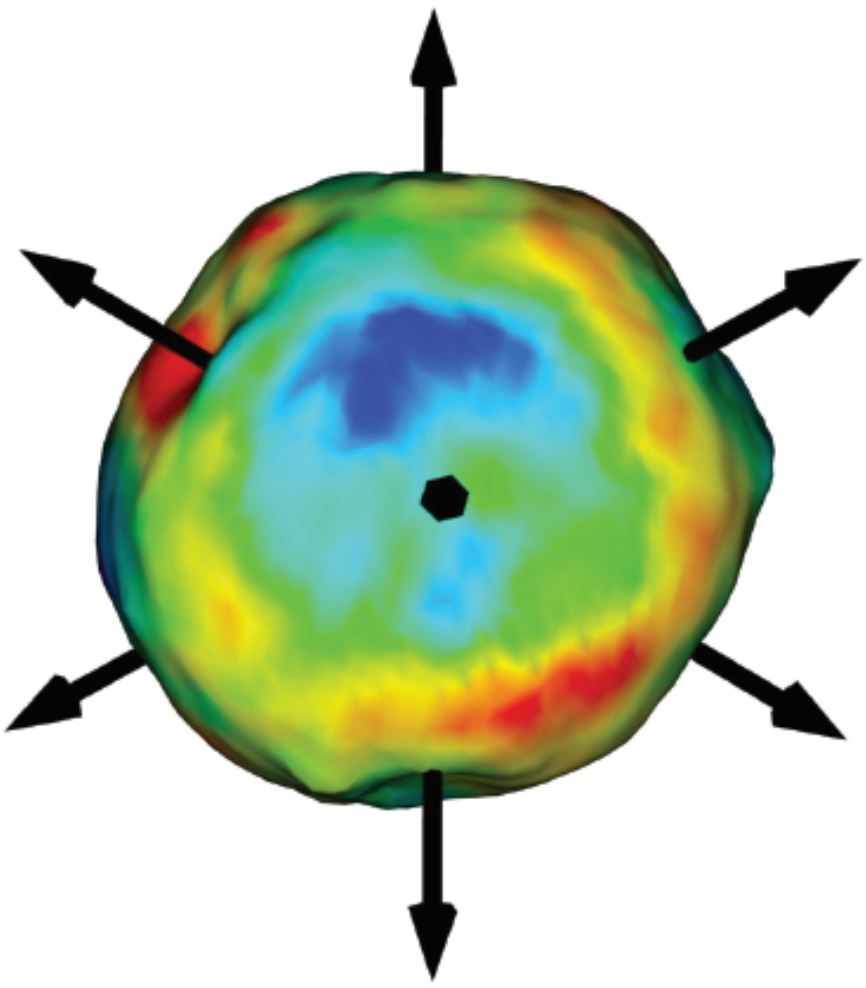
Ian Robinson

Nanocrystal Structure and Dynamics by Bragg Coherent X-ray Diffraction

X-ray free-electron lasers allow new information to be obtained about the excited states of matter, using snapshot imaging to "freeze" the vibrations. Combined with the coherent x-ray diffraction crystallographic methods, we formulate the Bragg coherent diffraction imaging (BCDI) method which can be used to study the dynamics within the three dimensional structure of nanocrystals. The BCDI method has been mostly developed at the 34-ID-C beamline of APS.



The physical reason why nanoparticles differ in structure from the bulk is fundamentally crystallographic. As with all surfaces, the missing-neighbor unit cells, which become removed to create a surface, cause a structural response. In a metal this is an inward relaxation, detectable as crystal strain. Where two surfaces meet along the edge of a crystal, the effect is enhanced. Nanocrystals are in precisely the size range which is dominated by these surface and edge properties. This results in a pattern of strain which follow the crystallographic structure of the particle. Certain simple properties of nanoparticles can be explained through these structural differences. Ultrafast imaging with free-electron laser sources allows visualization of the strain patterns in vibrating crystals.

Ian Robinson is a group leader in the Condensed Matter Physics and Materials Science Department at Brookhaven National Laboratory, and professor at the London Centre for Nanotechnology, University College. His research is currently focused on the development of coherent x-ray diffraction methods for imaging the structure of nanoparticles. His research makes extensive use of synchrotron radiation and free-electron lasers. He built a beamline at Brookhaven to develop surface x-ray diffraction and a second one at Argonne for coherent x-ray diffraction. One outcome of the work was the discovery of crystal truncation rods, for which he was awarded the Surface Structure Prize in 2011 and the Gregori Aminoff Prize in 2015.

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Bldg. 402 | APS Auditorium
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