Full 3-D image of nanocrystals' interior created by shining X-rays through them

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A vital step towards the ultimate goal of being able to take 'photographs' of individual molecules in action has been achieved by an international team led by UCL (University College London) researchers at the London Centre for Nanotechnology.

They report in the journal *Nature* on a novel method of obtaining a full 3-D image of the interior of nanocrystals. Using a process known as coherent X-ray diffraction imaging, they were able to build a picture of the inside of nanocrystals by measuring and inverting diffraction patterns.

Ultimately, the technique will help in the development of X-ray free-electron lasers, which will allow single-molecule imaging. It will also allow researchers to more accurately assess the defects in any given material which gives them specific properties.

Professor Ian Robinson, of the UCL Department of Physics & Astronomy and the London Centre for Nanotechnology, who led the study, says: "This new imaging method shows that the interior structure of atomic displacements within single nanocrystals can be obtained by direct inversion of the diffraction pattern. We hope one day this will be applied to determine the structure of single protein molecules placed in the femtosecond beam of a free-electron laser.

"Coherent X-ray diffraction imaging emerged from the realisation that over-sampled diffraction patterns can be inverted to obtain real space images. It is an attractive alternative to electron microscopy because of the better penetration of the electromagnetic waves in materials of interest, which are often less damaging to the sample than electrons."

The inversion of a diffraction pattern back to an image has already been proven to yield a unique 'photograph' in two or higher dimensions. However, previously researchers have encountered difficulties with 3-D structures with deformations as these interfere with the symmetry of the pattern. To overcome this problem, the UCL team used a lead nanocrystal that was crystallised in an ultrahigh vacuum. It showed that asymmetries in the diffraction pattern can be mapped to deformities, providing a detailed 3-D map of the location of them in the crystal.

Source: University College London

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