

Coherent Diffraction Methods for Imaging Strain

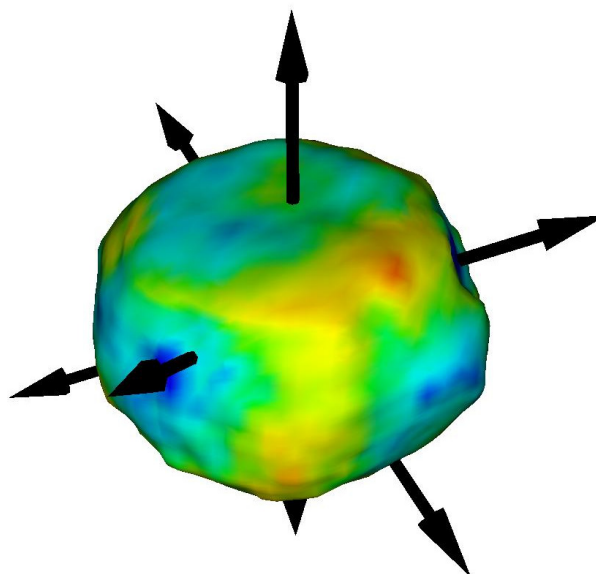
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This talk will describe the method of Coherent X-ray Diffraction (CXD), which is capable of imaging strains in nanometre-sized crystals in three dimensions [1]. The CXD method is different from powder diffraction-based methods in that it uses only data measured surrounding individual Bragg peaks, so the crystals have to be well separated and the beam confined by focussing. Because it uses the Bragg peaks, CXD is highly sensitive to strain fields present in the crystal under investigation, which are therefore mapped in three dimensions [2]. If several Bragg peaks can be measured from the same nanocrystal CXD analysis can reveal multiple components of the displacement field and hence determine the full strain tensor at every point inside the crystal [3].

The talk will show applications of CXD to the study of nanowire materials where strains are expected due to film transfer and subsequent patterning. In strained Silicon-on-Insulator material, it is found that the strain relaxation length adjacent to a reactive ion-etched cut depends on the depth of undercutting [4]. The talk will; also include patterns of strain associated with spontaneous defects in gold nanocrystals and examples of strain induced by chemical modification [5]. The illustration below shows the pattern of displacements (projections of strain as colours) found on the surface of a faceted gold nanocrystal by the CXD method.



[1] "Three-dimensional Mapping of a Deformation Field inside a Nanocrystal", Mark A. Pfeifer, Garth J. Williams, Ivan A. Vartanyants, Ross Harder and Ian K. Robinson, Nature 442 63-66 (2006).

[2] "Coherent Diffraction Imaging of Strains on the Nanoscale", Ian Robinson and Ross Harder, Nature Materials 8 291-298 (2009)

[3] "Three-Dimensional Imaging of Strain in a Single ZnO Nanorod", Marcus C. Newton, Steven J. Leake, Ross Harder and Ian K. Robinson, Nature Materials 9 120-124 (2010)

[4] "In-plane strain relaxation of strained-silicon-on-insulator structures due to micro-scale patterning", Gang Xiong, Oussama Moutanabbir, Xiaojing Huang, Seyed A. Paknejad, Xiaowen Shi, Ross Harder, Manfred Reiche and Ian K. Robinson, submitted

[5] "Differential stress induced by thiol adsorption on faceted nanocrystals", Moyu Watari, Rachel McKendry, Manuel Vögtli, Gabriel Aepli, Yeong-Ah Soh, Xiaowen Shi, Gang Xiong, Xiaojing Huang, Ross Harder and Ian Robinson, submitted