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Towards Imaging of Topological Defects by Coherent X-Ray Diffraction.

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With the emergence of third generation synchrotron sources, coherent x-ray diffraction (CXD) has strongly developed. Coherent x-ray beams can be used in different ways. X-ray Photon Correlation Spectroscopy (XPCS) allows studying time-dependent phenomena. Other experiments use the coherence to perform a "lensless imaging" [1] of the sample by the use of reconstruction algorithms. This technique gives good results in the low energy range and it now tends to be extended to the x-ray energy range. In CXD, the diffraction patterns consist in speckles or fringes. The intrinsic origin of these speckles is the interferences between beams scattered with different phases, and thus to the presence of phase defects in the sample. Very often, the speckle pattern is complicated, because of the presence of several defects in the probed volume.

In our studies, we try to understand the influence of a unique topological defect on the CXD pattern. We particularly focus on dislocations, which are π phase defects, and have a strong influence on the shape of the Bragg reflections. We will first present the predictions of calculations obtained when a single dislocation is probed. In that case, the Bragg reflection is split into two or four parts depending on the elastic constants. Experimental illustrations will be presented: firstly, a Silicon monocrystal containing well-known dislocations loops and secondly more complicated materials, with different order parameters, like blue bronze $K_{0.3}MoO_3$ that develops a Charge Density Wave below $T_c = 180K$, or pure chromium that stabilizes a Spin Density Wave below $T_N = 311K$. These density waves can also display their own defects [2], [3] that can be probed by CXD. These results open the way towards an understanding of more complicated structures involving many defects.

[1] J. Miao, P. Charalambous, J. Kirz, and D.Sayre, *Nature* 400, 342, **1999** [2] D. Le Bolloc'h, S. Ravy, J. Dumas, J. Marcus, F. Livet, C. Detlefs, F. Yakhou and L. Paolasini, *Phys. Rev. Lett.* 95, 116401, **2005** [3] V.L.R. Jacques, D. Le Bolloc'h, S. Ravy, *Physica B: Physics of Condensed Matter* 404, 573, **2009**.

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Imaging Diamonds with X-rays.

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The various techniques for imaging diamonds non-destructively with X-rays are discussed: X-radiography, X-ray phase-contrast imaging, X-ray diffraction topography, X-ray reciprocal-space mapping and X-ray microscopy: together with the characterization of the crystal defects which these techniques reveal. X-rays from conventional and synchrotron sources are used.

Choices of wavelength (energy) of X-rays are crucial in X-radiography. For example, the transmission through 1 mm of diamond is 82% for MoKα, 20% for CuKα, but only 0.5% for CrKα. The contrast of cracks in diamond is greatly enhanced by phase-contrast methods [1]. In recent years, the various techniques of X-ray diffraction topography have gained greatly from continuous, high-intensity, highly-collimated synchrotron radiation [2]. Images of linear and planar defects at approximately 1 micrometer resolution can be used to determine Burgers vectors of dislocations and fault vectors of stacking faults; and the linear polarization of synchrotron radiation aids the interpretation of X-ray interference effects [3]. Setting the diamond slightly off the Bragg-reflection, the Ewald sphere intersects 'spikes' in reciprocal space which are associated with platelet defects (typically 10 – 100 nm in diameter). From a 'spike' topograph one may deduce the average platelet diameter [4]. Double-crystal X-ray topography is sensitive to lattice parameter variations smaller than parts per million and has been used to map large synthetic diamonds [5]. Reciprocal-space mapping, using multi-crystal techniques, enables lattice tilting (measured in micro-radians) to be separated easily from lattice parameter variations [6]. Using fine collimators, a scanning microscope for hard synchrotron X-rays has been constructed with a resolution of less than 1 micrometer, which has been used to map and to identify inclusions in synthetic diamonds [7]. Combining a collimator with suitable refractive lenses increases the monochromatic X-ray flux by many orders of magnitude.

[1] Kowalski, G.; Moore, M.; Nailer, S.G., *J. Phys. D: Appl. Phys.* **1999**, 32, A166. [2] Moore, M., *Radiation Phys. Chem.* **1995**, 45, 427. [3] Kowalski, G.; Lang, A.R.; Makepeace, A.P.W.; Moore, M. *J. Appl. Cryst.* **1989**, 22, 410. [4] Moore, M.; Waggett, R.G.; Wierzchowski, W.K.; Makepeace, A.P.W. *Diamond Rel. Mat.* **1993**, 2, 115. [5] Lang, A.R.; Moore, M.; Wierzchowski W.K; Makepeace, A.P.W.; Welbourn, C.M. *Phil. Trans. Royal Soc. Lond.* **1991**, A337, 497. [6] Moore, M.; Golshan, M.; Kowalski, G.; Reid, J.S.; Collins, S.P.; Murphy, B.M.. *J. Phys. D: Appl. Phys.* **1999**, 32, A37. [7] Moore, M. *J. Phys. Cond. Mat.* **2009**, submitted.

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Coherent X-Ray Diffraction Imaging of Antiphase Domains and Biological Tissues with Ptychography.

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Coherent x-ray diffraction imaging (CXDI) can overcome the limitations of conventional full-field x-ray microscopy,