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# Materials Characterisation and X-ray Free Electron Laser Science at the Centre of Excellence for Advanced Molecular Imaging

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With the recent availability of X-ray Free Electron Lasers (XFELs) and the prospect of Diffraction Limited Storage Rings (DLSRs) just around the corner, the number of major new scientific breakthroughs in the area of coherent X-rays science is likely to rise sharply over the next few years. The past twelve months has already seen significant progress in the field including 3D imaging of intra-grain deformation in polycrystals, the study of hysteretic behavior in solid solution and two-phase reactions within nanoparticles and the development of fly-scanning coherent diffractive imaging combined with fluorescence mapping.

Over the last 8 years our group has contributed to experimental and theoretical developments within the field of Coherent Diffractive Imaging (CDI) which are now finding a number of key applications. In particular our work in the areas of partial coherence and diffractive imaging using curved beams have emerged as being two particularly important contributions to the field. Here we present some of our recent work in developing CDI for the mapping of deformation within nanocrystals, characterising Medium Range Order (MRO) and in exploring the limits of partial coherence in diffractive imaging. As part of the newly funded ARC Centre of Excellence for Advanced Molecular Imaging we plan to apply these methods to key problems in biology both at the synchrotron and XFEL. We will also briefly discuss the implications for CDI of the new DLSR upgrades potentially taking place at the ESRF, Spring-8 and APS within the next 5-10 years.

## Keywords or phrases (comma separated)

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## Summary

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