Antiphase Domains and Coherent X-Rays

Stadler L.-M.[1], Sepiol B.[1], Harder R.[2], Robinson I.K.[2], Zontone F.[3], and Vogl G.[1]

[1]Fakultät für Physik, Strudlhofgasse 4, A-1090 Wien, Austria, Email: lstadler ap.univie.ac.at, [2]Department of Physics, University of Illinois, Urbana, Illinois 61801, [3]European Synchrotron Radiation Facility, BP 220, F-38043 Grenoble Cedex, France

A decade ago Sutton et al. reported the first experiment with partially coherent X-rays where a *static* speckle pattern, related to antiphase domains contained in the coherently illuminated sample volume, was resolved in the superstructure peak of Cu_3Au [1]. Meanwhile synchrotron sources have become powerful enough that even the *dynamics* of antiphase domains can be measured applying X-ray photon correlation spectroscopy (XPCS). Recently, results for the B2-ordered $Co_{60}Ga_{40}$ intermetallic phase were reported [2]. There, XPCS data were analysed by the so-called detrended fluctuation analysis (DFA) technique, which turns out to be particularly suited for analysing very slow dynamics. A brief introduction to this method will be given.

Besides the results from the dynamics measurements one could wonder whether it is possible somehow to find out the exact arrangement of the antiphase domains in real space. It was shown that in principle it is possible to reconstruct the electron density of the scattering object from (oversampled) diffraction data by means of iterative algorithms that transform back and forth between real and Fourier space, applying appropriate constraints in each domain [3–5]. Thus it would be obvious to apply such algorithms also to antiphase domain data. Antiphase domains, however, cannot be distinguished by their electron density since there are the same kind of atoms present in each domain. Though, photons scattered by two adjacent antiphase domains get phase shifts that differ by π. This means that the antiphase domain structure is mirrored in the reconstructed *phases* [6]. Another problem results from the fact that the antiphase domain structure is not a compact object. Instead the beam spot on the sample determines the overall shape of the real space image. An attempt to reconstruct the antiphase domain structure of a B2-ordered $Fe_{65}Al_{35}$ single crystal will be presented.

References

[1] - M. Sutton et al., Nature 352, 608, (1991).
[2] - L.-M. Stadler et al., Phys. Rev. B 69, 224301, (2004).
[3] - R.W. Gerchberg and W.O. Saxton, Optik 35, 237, (1972).
[4] - J.R. Fienup, Appl. Opt. 21, 2758, (1982).
[5] - J. Miao et al., Nature (London) 400, 342, (1999).
[6] - J.A. Pitney, I.A. Vartaniants, and I.K. Robinson, SPIE **3815**, 199, (1999).