Structures of Embedded Solid State Precipitated Nanoparticles in Metal Matrices

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Diffraction of X-rays is on of the most important techniques to elucidate the crystal structure of materials. Real materials of technological importance are usually crystalline, but contain imperfections and these influence the diffraction patterns in various ways. A main experimental challenge is to record weak, diffuse signatures along with strong matrix reflections. A new generation of 2-D detectors seems however to be well suited for such experiments.

Precipitation of phases from a supersaturated solid solution is an important process in materials technology. It is among other things responsible for a significant increase in strength for certain classes of alloys. Precursors for the precipitates are local structures in the solid solution and partially ordered Guinier-Preston zones. Within the ternary alloy system Al-Zn-Mg, intermediate structures are recognized according to the precipitation sequence:

$$\textit{Supersaturated solid solution} \rightarrow \textit{GP - zones} \rightarrow \eta'\textit{-precipitates} \rightarrow \eta\text{-}MgZn_2$$

The embedded η'-precipitates are disc-shaped with a diameter in the order of 100 Å and a thickness of approximately 30 Å. The particles exhibit well-defined orientation relationships to the Al-matrix. Although their unit cell is known, their structure is still not finally determined.

One experimental challenge is to measure the very strong Al-matrix reflections together with the much weaker diffracted intensities from the precipitates. This is however partly overcome by transforming the *UB*-matrix of the Al-lattice using the orientation relationships of the η'-particles. Thus individual *UB*-matrices for every of the four principal precipitate orientations are obtained. Accurate intensity profiles may then be recorded using a point detector, in combination with CCD-data.

A single crystal grain from a previously heat-treated polycrystalline sample of composition $Al_{0.88}Zn_{0.10}Mg_{0.02}$ will be investigated using the KM-6 single crystal diffractometer at the Swiss-Norwegian Beamlines (SNBL) at the ESRF. The method of *UB*-matrix transformations will be applied to collect diffraction data from the η'-precipitates with a YAP-point detector. The data will be processed in the subsequent reduction- and solution process in the search for a possible solution of the η'- structure.