ESRF	**Experiment title:** Mapping the Strain/Stress States of Individual Crystallites in Polycrystals	**Experiment number:** MA-711
Beamline: ID11	**Date of experiment:** from: 14 May 2009 to: 19 May 2009	**Date of report:** 12 April 2011
Shifts: 15	**Local contact(s):** Jonathan Wright	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
Prof. Dr. Walter Reimers (TU Berlin)
Prof. Andras Borbely* and Marcin Moscicki* (MPIE Düsseldorf)

The beamtime was shared such that the above experimentalists measured 14-15 May, and the here reported study was performed 16-19 May by the following people:
Jette Oddershede*, Søren Schmidt*, and Henning Osholm Sørensen* (Risø DTU)

Report:

Determining grain resolved stresses in polycrystalline materials using 3DXRD

Jette Oddershede, Søren Schmidt, Henning Friis Poulsen, Henning Osholm Sørensen, Jonathan Wright and Walter Reimers; *J. Appl. Cryst. 2010, 43(3):539–549.*

An algorithm is presented for characterisation of the grain resolved (type II) stress states in a polycrystalline sample based on monochromatic X-ray diffraction data. The algorithm is a robust 12-parameter-per-grain fit of the centre-of-mass grain positions, orientations and stress tensors including error estimation and outlier rejection. The algorithm is validated by simulations and by two experiments on interstitial free (IF) steel. In the first experiment, using only a far-field detector and a rotation range of $2\times110^\circ$, 96 grains in one layer were monitored during elastic loading and unloading. Very consistent results were obtained, with mean resolutions for each grain of approximately 10 μm in position, 0.05° in orientation and 80, 200 and 130×10^{-6} in the axial, normal and shear components of the strain, respectively. The corresponding mean deviations in stress are 30, 50 and 15 MPa in the axial, normal and shear components, respectively, though some grains may have larger errors. In the second experiment, where a near-field detector was added, $\sim$2000 grains were characterised with a position accuracy of 3 μm.