ESRF	**Experiment title:** Load partitioning and local stress distribution in metal matrix composites	**Experiment number**: MA-1223
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Report:

The multiphase hot extruded Al based alloy reinforced by non-metallic particles (Sample S250 DR: Al 5-10 micron grains, reinforced by 40 vol% Si ~1 micron grains and 25 vol% SiC ~20 micron grains) was investigated by means of 3DXRD grain centre mapping during *in-situ* loading at beamline ID11. The goal was to learn more about the reinforcing mechanisms in multiphase engineering materials, especially the load partitioning and stability of interfaces between matrix and particles. The experiment was performed with a 55 keV beam focused to a height of 5 µm. The strain maps were acquired for 19 layers covering a rotational range of 2×110° in steps of 0.1° at each load. The applied loads were: a preload of 15 MPa, and then 60 MPa, 120 MPa (elasto-plastic transition), 160 MPa, 200 MPa, and after fracture (occurred around 240 MPa). The fluorescent signal from two 10 µm Au wires glued onto the sample surface functioned as strain gauge and was used to align the sample between each load step. An independent measure of the sample-to-detector distance was achieved by measuring the diffraction signal from a CeO_2 powder likewise glued onto the sample surface.

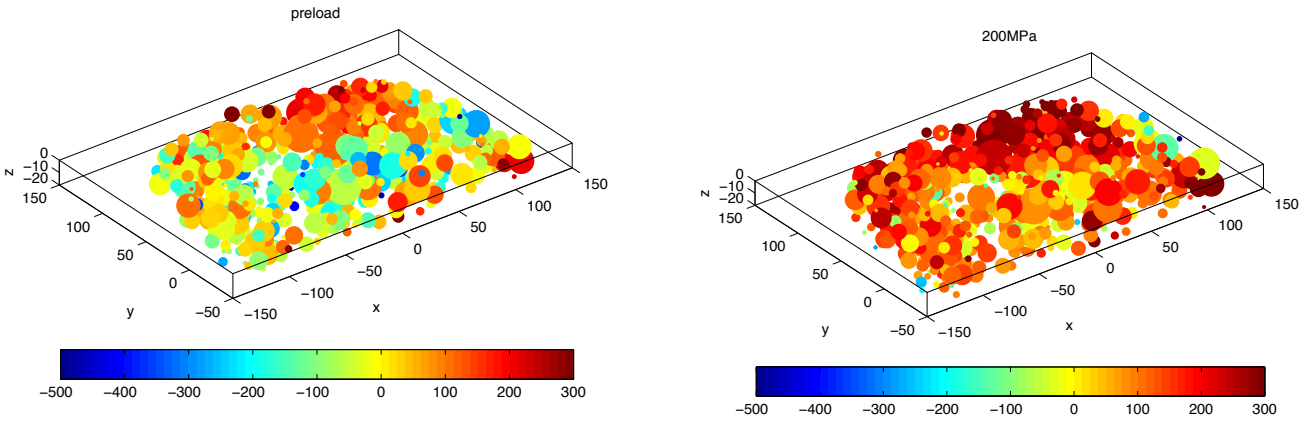

Figure 1 Axial stresses [MPa] in the SiC particles at preload and a tensile load of 200 MPa along the *z*-axis.

The data quality turned out to be such that indexing and subsequent refinement of grain resolved stresses could only be done for the large grains of the SiC phase. Results for a subset of the measured data (4 layers of the 19) are shown in Figure 1 at the preload and 200 MPa. Note the gradient across the sample. Unfortunately the strain refinement of the SiC data displayed layer-to-layer strain drifts. Since the drifts are different in sign and magnitude at the various applied loads we rule out mis-calibrations related to the z-translation between layers to be a possible cause. Energy drift has also been suggested, in which case the same drifts should be observed in the Al and Si data. Rietveld refinements of the Al and Si phase powder averages were performed to obtain the lattice strains along and transverse to the applied tensile load. The error bars from the Rietveld refinements (7×10^{-5} for Al and 11×10^{-5} for Si) are an order of magnitude larger than the layer-to-layer variations observed in these strains, and no systematic trends corresponding to those seen for the SiC phase can be found. Based on these inconsistencies we have been forced to abandon further analysis of the grain resolved stress and strain from the data set.