ESRF	**Experiment title:** **Twinning behaviour of magnesium upon mechanical loading and unloading**	**Experiment number**: MA - 615
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With the excellent ratio of strength to density, magnesium and its alloy are attracting increasing attention in transportation industry. Recent work has highlighted the fact that deformation twinning in magnesium plays an important role in the relaxation that occurs during unloading. In this experiment, we tested four groups of magnesium alloy specimens with the same composition of AZ31 but different microstructure and history in heat treatment. For each group, three loading-unloading processes were employed respectively. Two-dimensional diffraction patterns were taken in-situ during the mechanical testing process. According to the experimental dataset, three aspects were analyzed.

Changes of lattice parameters with compression process

After azimuthal integration of the Debye-Scherrer rings, the change of lattice parameter for basal / pyramidal / prismatic planes were plotted in comparison with the loading process in fig.1. In this integrated representation, the prismatic plane (00.2) was affected by mechanical deformation much more than basal and pyramidal planes. Partly, this can be attributed to texture and further data evaluation needs to be done.

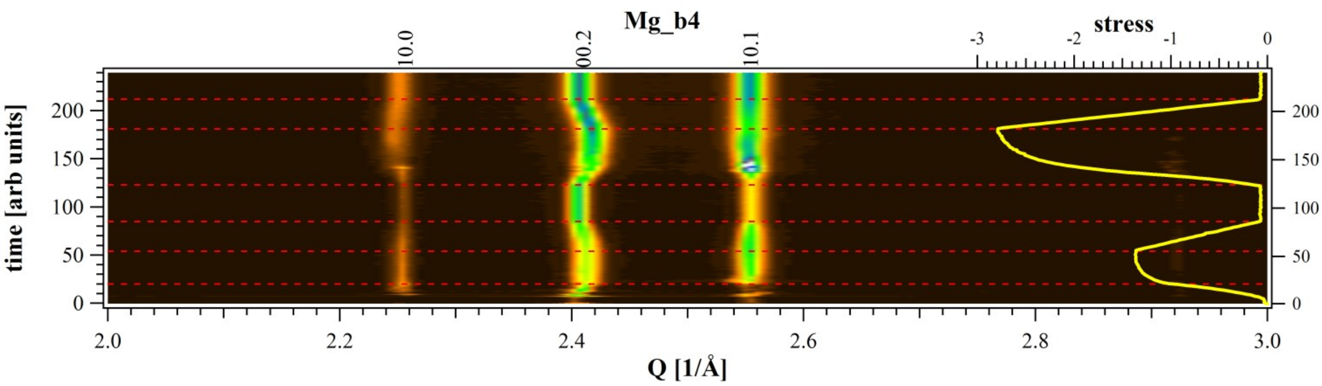

Fig. 1 Lattice parameters variation with loading-unloading process

Lattice strain variation along different directions

As the hcp lattice structure of magnesium alloy invokes anisotropic reaction to the mechanic stress, it is essential to work out the change of peak width along different directions. For example, the breath corresponding to the basal plane (00.2) changes during deformation in a peculiar manner. In Fig. 2, along the stress direction, the width of (00.2) plane increases rapidly with applied load and then drops afterwards. However, this strange drop does not re-appear on re-loading so it can be ascribed to the initial yielding behavior. It is also not present in the data for (00.2) normal inclined 30 and 40 deg. to the stress axis so there is a texture effect. From the original diffraction patterns, the initial anisotropic distribution was pretty strong, which does not allow us to compare the intensity changes along two perpendicular directions.

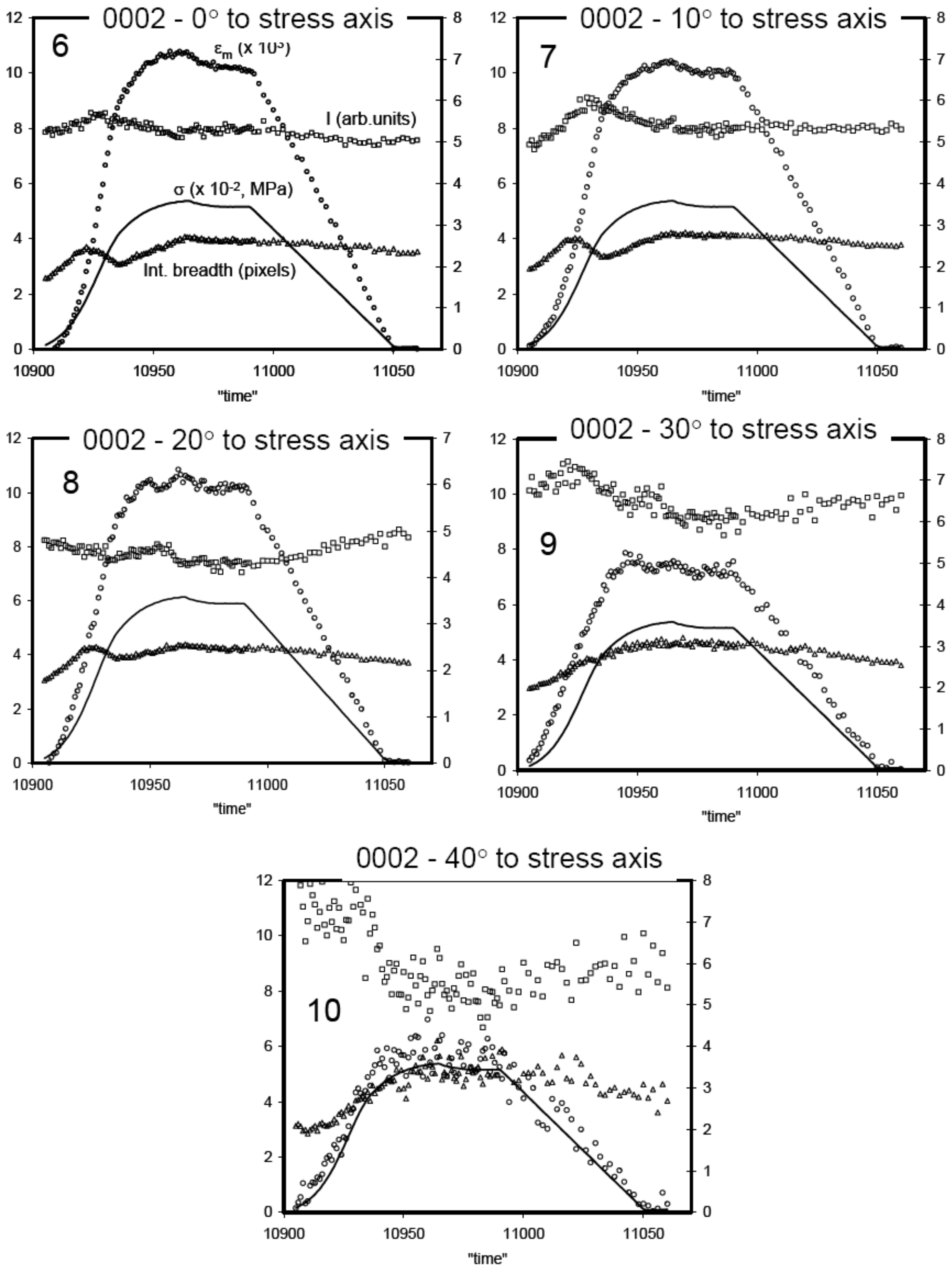

Fig. 2 Lattice parameters variation along different direction

Mosaic spread vs. load

Figure 3 shows the observed reflections in color scale as a function of azimuthal angle and time. Starting with a few sharp reflections they spread azimuthally, which can be expressed in mosaic spread by the creation of subgrain structures. Ongoing detailed studies show orientation dependence and grain rotation.

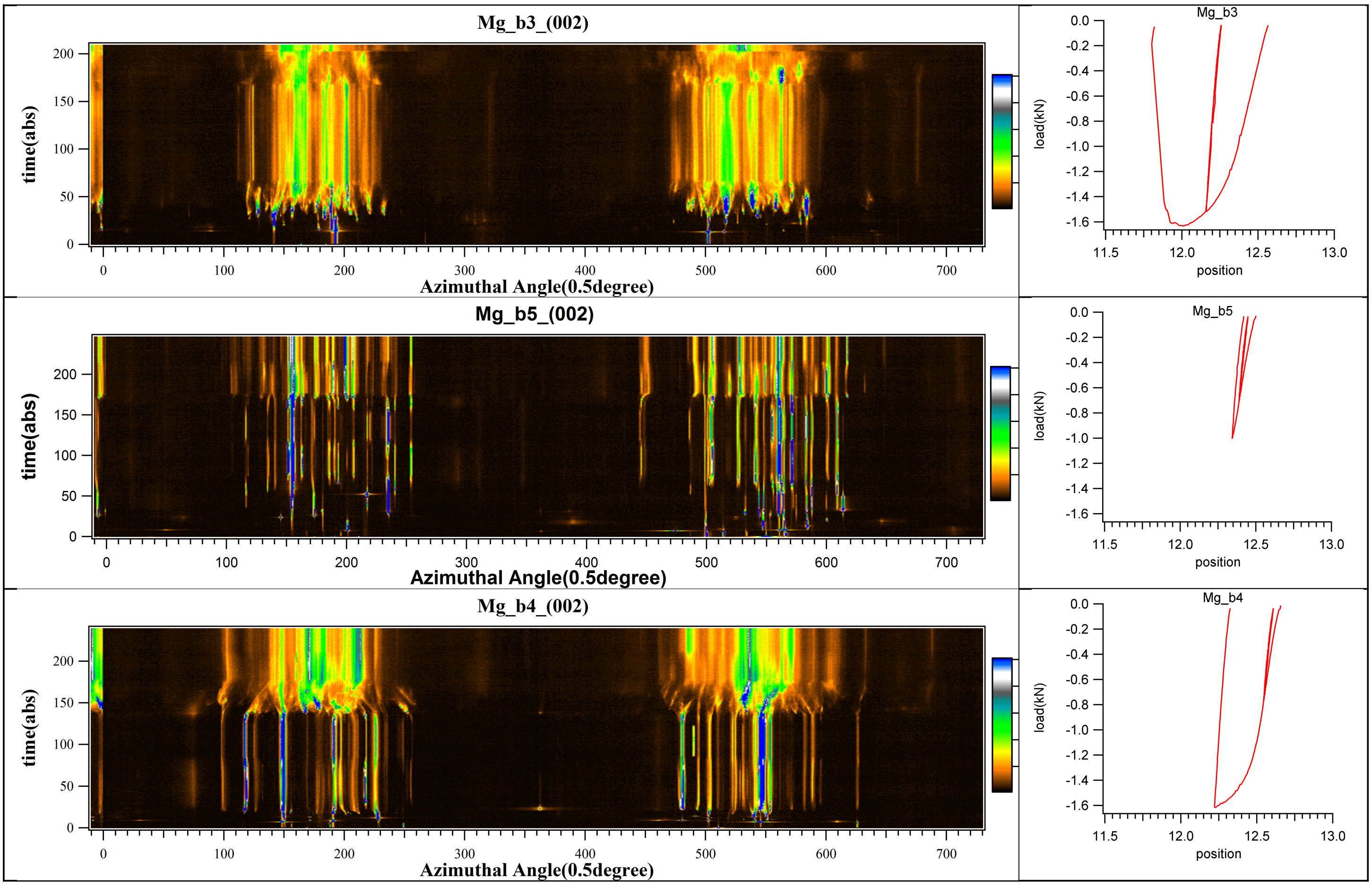

Fig. 3 Mosaic spread of subgrains

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