ESRF	**Experiment title: Dislocation transmission through grain boundaries in Fe 4%Si observed by in situ X-Ray Topography**	**Experiment number:** HS 247
Beamline: ID 19	**Date of experiment:** from: 2nd April 1997 to: 7th April 1997.	**Date of report:** 20 Aug. 1997
Shifts: 12	**Local contact(s):** Jose Baruchel, Juergen Haertwig	*Received at ESRF:* 2 9 AOUT 1997

Names and affiliations of applicants (* indicates experimentalists):

GEORGE A. * Labo. de Physique des Materiaux
JACQUES A. * Ecole des Mines
VALLINO F. * Parc de Saurupt
FEIEREISEN J.P. * 54042 Nancy cedex, France
FERRY 0. *
POLCAROVA M. * Institute of Physics, Academy of Sciences of the CR.
BRADLER J. * Na Slovance 2, Praha 8
REJMANKOVA P. * ESRF

Report:

The aim of the project was to study the transmission of dislocations, or at least transfer of deformation by slip, across coincidence grain boundaries of Fe 4% Si, and to compare the behaviour of specimens deformed in compression with that of specimens deformed in tension which had been previously studied at LURE D.C.I..

Six bicrystalline specimens, containing either a $\Sigma = 3$ (70.54” rotation a [llo] axis, (112) Grain Boundary plane) or a $\Sigma = 15$ (48.19“ rotation a [201] axis, (112) Grain Boundary plane) 3*3*8 mm3 in size were tested. They were strained in compression at room temperature using the new mechanical testing stage built at the L.P.M. (Nancy).

The in situ observations were done in white beam conditions by symmetric reflection on the $(20\bar{1})_A/(201)_B$ ($\Sigma = 3$) or $(201)_{AB}$ ($\Sigma = 15$) specimen surface. (The corresponding wavelength was appr. 0.04 nm) The images were recorded on SR films (5 s exposure time) or HR films (600 s exposure time). The films were placed parallel to the specimen surface, at 100 mm, in order to ensure a minimal distorsion of the image.

The specimen were loaded at a constant rate to the stress at which the formation of the first slip bands was expected. The loading rods were then kept immobile, to allow the recording of an image. If necessary, the load was then increased by steps, until slip bands were observed, and farther to maintain them in motion.

The results of the experiments are still under evaluation, but main features are as follows:

- It was possible to deform the two kinds of samples in the new straining stage, which was used for the first time, and to take topographs showing slip bands with satisfying contrast.
- Slip transfer was observed in the very $\Sigma = 15$ case, for which direct transmission of dislocations was very unlikely. (different Burgers vectors and non-matching at the GB for the planes of maximum resolved shear stress). This points to the activation of new dislocation sources in the opposite side of the GB by the long range stresses exerted at the heads of slip bands rather than to direct transmission, as the effective mechanism of slip transfer. This confirms our earlier observations at LURE.
-Unexpectedly, slip bands were seen to form in groups rather than isolated. This was already observed in the samples deformed in tension at LURE, but homogeneously distributed isolated slip bands were generally observed after compression at constant loading rate in an Instron machine. Therefore the grouping of slip bands, which strongly affects the conditions of slip transfer, should not be ascribed to some tension/compression asymmetry. Instead, it could be related to different loading rates or to the step by step loading applied during our in situ observations. This point must be clarified by further experiments done under better control of stress conditions.
- Another item to clarify is the time of exposure. Those we were obliged to use were surprisingly large according to our experience at LURE. Optimisation of the beam conditionning (selected wavelength, filters, ...) should reduce them by more than one order of magnitude.
- Transmission and section topographs could be obtained with thinner (0.3 mm) predeformed specimens, but have still to be improved before new information on the distribution of slips in the bulk can be gained (see preceding point).