ESRF	**Experiment title:** Dislocation transmission through grain boundaries in Fe4% and Fe6% Si observed by in situ X-ray topography	**Experiment number:** HS - 1037
Beamline: ID 19	**Date of experiment:** from: 29/10/99 at 7:00 to: 02/11/99 at 7:00	**Date of report:**
Shifts: 12	**Local contact(s):** Juergen Haertwig	*Received at ESRF:* 1 - MAR. 2000

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Report:

The aim of the experiment was to continue the study of the interaction of slip dislocations with the grain boundaries (GBs) in bicrystals of Fe – Si alloys. GBs are obstacles to slip band movement, their strength depends on crystallographic characteristics. Three kinds of bicrystals were chosen, which represent expected increasing difficulties for a direct dislocation transmission. In the Σ3 bicrystals both slip planes and Burgers vectors of the operating slip systems are parallel in the two grains. In the Σ9 bicrystals the slip planes are parallel but the Burgres vectors do not match. In the Σ15 specimens neither the slip planes nor the Burgers vectors are common. Direct dislocation transmission through the GB was observed only rarely in the Σ3 bicrystals and only in specimens deformed by compression. Even in this case, however, the GB forms an obstacle to the slip dislocation movement. The slip bands always stop at the boundary and the slip continues in the second grain only after a certain amount of dislocations is accumulated. It follows that the geometric factor is not the only reason affecting the dislocation transmission, but there are other possible effects such as

interaction with GB dislocations or image forces due to the crystal anisotropy. Therefore in the last experiments only the Σ3 bicrystals were used to investigate the effect of the GB itself. Bicrystals of an alloy of Fe – 6at%Si were prepared as it is known that the slip bands are narrower and have higher dislocation density in this alloy than in the lower Si content alloys. It can be expected that the stress due to the dislocations accumulated at the boundary will be more concentrated and the transmission will be easier.

The specimens for tension and compression deformation were prepared in the Institute of Physics, Prague. They were deformed in the stage built in Ecole des Mines, Nancy, and observed by reflection topography. Monochromatic beam (0.01 nm) and symmetric 402 reflection were used. As the bicrystals contain low-angle subgrain boundaries, rocking of the specimen by an angle up to 1.5 degree was necessary. The diffracted beam was recorded in short intervals by the FRELON CCD camera and less frequently by Ilford L4 Nuclear Plates. During the time necessary for taking the topograph the load was kept constant to avoid back movement of the dislocations.

Direct dislocation transmission was observed in the specimens deformed by compression and also in the specimens deformed by tension. The steps at the GB, which are images of the strain formed by the dislocations accumulated at the head of the stopped slip band (Fig.1a), disappear when the slip occurs in the second grain (Fig.1b). This observation confirms our hypothesis that an internal stress additional to the applied one is necessary to overcome the barrier formed by the GB. This *local* stress is higher in Fe-Si alloys with higher Si content and in specimens deformed by compression.

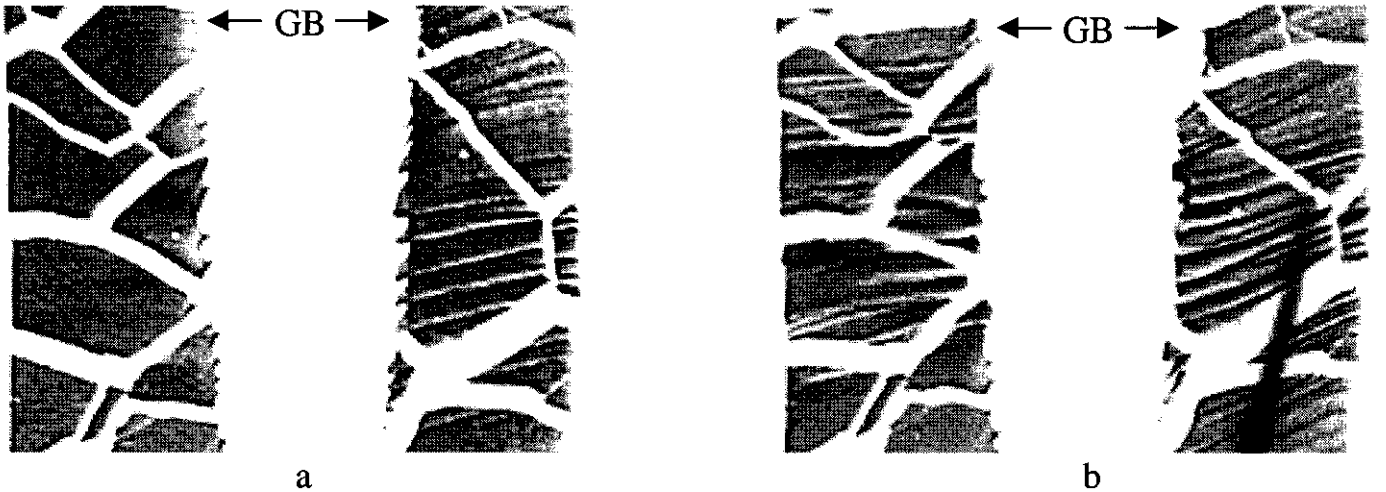

Fig 1. *In situ* topographs of a Σ3 bicrystal deformed by tension.