Abstract

In this work the planar faults in non-compact planes (non-basal faults) in the 2H and 18R martensitic phases in Cu-Zn-Al alloys are analyzed. The study was carried out using transmission electron microscopy (TEM) combining the two-beam condition technique, high resolution transmission electron microscopy (HRTEM) and computer simulated images.

The displacement vectors of the faults were determined. It was found that these vectors were different from those of the basal faults, eventhough the faults are connected. One single class of non-basal faults, named F_1, was observed in the 2H phase, whereas two different classes were found in the 18R phase, named F_o and F_x. In the latter phase non-basal faults made up of different segments of F_o and F_x faults were observed (composed faults).

The Burgers vectors of the partial dislocations at the edges of the non-basal faults were determined in both phases. Additionally, the Burgers vectors of the intermediate dislocations found between the different segments of the composed faults in the 18R phase were determined. It was verified that there exist two types of dislocations with Burgers vectors that differ in approximately $\frac{1}{3}[100]$. It was found that the presence of a particular dislocation type depends on the arrangement between the non-basal fault and the basal fault that originates the dislocation.

The internal structure of the non-basal faults in the 18R phase was studied with HRTEM. It was observed that the shift of the crystal planes due to the presence of the faults occurs in a region of a finite extension of about 1.5 nm. It was also observed that in this region the crystal planes appear rotated and lose the characteristic corrugation they have in the 18R structure. As a consequence of this, new translation vectors appear in the defect; this fact could be reflected in new plastic deformation systems.

The rotation of the crystal planes in the non-basal faulted area of the 18R phase was compared with the rotation at the interphase between the 18R phase and an intermediate structure between the 18R and β phases. It was found that the angle of rotation was the same in both cases. Assuming that in the 2H phase the width of the faulted area is equal to the one found for the 18R phase, the value of the angular rotation for the crystal planes within the fault was obtained; in this case also the value matches with the rotation angle of the planes in the macroscopic interphase between the 2H phase and a mixture of 18R and β phases.

Finally, a model that describes very well the experimental findings is proposed. The model assumes that the displacement vectors of the non-basal faults arise from three contributions: one inherited from the basal plane, a second one that adjusts the atomic volume and a last one that relaxes towards a different structure. The model predicts that the interphase between the intermediate structure in the faulted area and the martensite is coherent and mobile. This fact agrees with fault configurations observed in this work. Also, the model predicts only one returning path for the retransformation. This is in good agreement with the fact that these defects disappear when retransforming to the matrix phase.