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DEFORMATION AND FRACTURE MICROMECHANISMS IN 7050 ALUMINUM ALLOY: "IN SITU" OBSERVATION BY TRANSMISSION ELECTRON MICROSCOPE.

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ABSTRACT

In situ tensile deformation by TEM in a 7050-T76 Al alloy has shown that the crack propagation mechanisms include crack arrest and crack blunting with dislocation emission by oppening Mode I building up of the plastic zone, which has been formed by dislocation loops around the hardened particles that arise ahead of the crack tip. The transgranular crack has propagated through the rupture of ligaments between microvoids nucleated inside the plastic zone.

INTRODUCTION

During the last ten years the "in situ" deformation experiments by Transmission Electron Microscope (TEM) have been used to study the micromechanisms of plastic deformation and fracture propagation mode occuring from the crack tip [1-10] .

These studies were performed in mono and policrystals metals purporting to investigate the dislocation emission phenomena from crack tip relating then to ductile vs. brittle behavior of materials. Once the crack has been nucleated under stress, the crack propagation depends on the competition process between crack tip emission blunting dislocation and cleavage decohesion. If the conditions for dislocation emission from crack tip are reached before those for decohesion of the interface or crystal plane ahead of crack, stress relieve will occurs around the crack tip by creating a plastic zone that shields the crack tip from the external stress [1,11-13]. The elastic stress field around the crack tip created by external stress is covered by the plastic zone blunting the crack tip. As long as the plastic zone is built, the fracture process includes a ductile mechanism either by growth and coalescence of microvoids or by strain concentration in slip bands. Otherwise, if the conditions for decohesion of the interface or crystal plane ahead of the crack are reached before those for dislocation emission from the crack tip the fracture is brittle.

The dislocation behaviour, during crack blunting and crack propagation, is affected by the presence of dislocations coming from the other sources, second phase particles and grain boundaries. The dislocations emitted from the crack tip can interact strongly with these defects consequently altering the dislocation motion. With the purpose to investigate the effects of the grain structure and the hardening second phase particles on the dislocation motion from the crack tip, associated with the deformation and crack propagation mechanisms, the "in situ" tensile deformation experiments by TEM were performed in a 7050-T76 aluminum alloy.

EXPERIMENTAL PROCEDURE

The material used in this experiment was a high strength aluminum alloy 7050 T76

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