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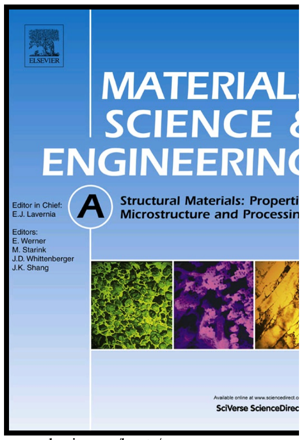

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Mechanism of macroscopic shear band formation in plane strain compressed fine-grained Aluminium

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ABSTRACT

The microstructure and microtexture evolutions during shear banding of very fine grained commercially pure aluminium (AA1050) have been characterized to elucidate the mechanisms of band formation and propagation across layered microstructures and the resulting texture evolution. Samples were pre-deformed in ECAP to 6 passes *via* route C, then machined and further compressed in a channel-die to form two sets of copper-type macroscopic shear bands (MSBs). The local changes in microstructure and crystallographic orientations were characterized by SEM equipped with a high-resolution EBSD facility. The ECAP-processing led to the formation of a fine-grained structure composed of complementarily oriented layers parallel to the transverse direction and inclined ~ 20^o to the extension direction (ED). During the secondary straining in the channel-die, the layers exhibited two rotation tendencies: i) a global rotation of the layers towards the compression plane, and ii) a deflection of layers within narrow areas. The latter increased the layers' inclination with respect to ED and led to kink-type bands, which are the precursors of MSBs. The mechanism of MSB formation is strictly crystallographic since in all the grains of the sheared zone, the crystal lattice rotated such that one of the {111} slip planes became nearly parallel to the shear plane and the <011> direction became parallel to the direction of maximum shear. This strain-induced crystal lattice rotation led to the formation of specific MSB components that facilitated slip propagation across the grain boundaries.

Keywords: Strain path change, Shear bands, Orientation mapping, Texture, AA1050 alloy

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