A new flow line approach for modeling the deformation field and texture in FALEP

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Abstract

The friction-assisted lateral extrusion process (FALEP) is a novel severe plastic deformation technique for producing ultrafine-grained sheets from initially bulk or powder metal. Similar to ECAP, there are two perpendicular channels in FALEP. However, the exit channel size is much smaller than the ingoing channel size, permitting to reach a very large shear strain in a single-step operation at room temperature. Another unique feature of FALEP is the shear-driving punch, which is laid horizontally on the bottom surface of the sample, and pushing the material by sticking friction into the outgoing channel. It has been experimentally observed that when the shear strain in the sample reaches a critical value (around 10), the deformation behavior of the material becomes more complex, which limits the adaptation of the flow line function previously proposed for NECAP (non-equal channel angular pressing) for FALEP. Thus, based on the experimental observations, a new flow line approach is proposed here with three distinct deformation stages: first simple shear, then two-dimensional extrusion, finally a second simple shear. The velocity gradient obtained from the new flow line model were used in the viscoplastic self-consistent (VPSC) code for the simulation of texture evolution during FALEP. A good agreement between the simulated and experimental texture was obtained, showing the pertinence of the new modeling approach.

Keywords: FALEP, Texture, Crystal plasticity

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