Texture evolution in aluminum during High Pressure Compressive Reverse Shearing (HPCRS)

Satish Kailas*[1], Govind Kumar[1], Satyam Suwas[1], and Laszlo S. Toth[2,3]

[1]Indian Institute of Science – India
[2]University of Lorraine – Université de Lorraine, Centre National de la Recherche Scientifique, Arts et Métiers Sciences et Technologies – France
[3]University of Miskolc – Hungary

Abstract

High Pressure Compressive Reverse Shearing (HPCRS) is a new Severe Plastic Deformation (SPD) process that shears a material with a high degree of shear. In this process a metal plate is confined in a die such that the material can flow in two directions. In HPCRS shear is induced by multiple reverse shearing of the material. The cycle is repeated till the desired thickness of the sample is achieved. The process induces high total shear in the deformed material. The variables in HPCRS include the frequency (0.01 to 20 Hz) and amplitude of oscillation (0.01 mm to 20 mm). Frequency induces different temperatures during deformation and amplitude induces different level of shear per cycle. Controlling these two variables the texture evolution during HPCRS of CP aluminum plates of 6 mm thickness, and 15 X 15 mm is studied. At the end of the process the thickness reduces to 1 mm and the length of the sample increases to 150 mm, with the width remaining at 15 mm. In the present work results with frequency variation from 0.1 Hz to 20 Hz with an amplitude of oscillation of 2 mm is presented. Tensile strength and texture evolution during the process was studied. It is seen that the both the tensile strength and ductility of the material can be controlled by changing the frequency of processing. At lower frequencies the strength is higher and ductility lower. A very strong shear texture is evolved in the process with the intensity of shear texture increasing with frequency. This process thus enables development of a material with controlled strength, ductility and shear texture during the process itself, eliminating the need for any further heat treatment.

Keywords: Severe Plastic Deformation (SPD), High Pressure Compressive Reverse Shearing (HPCRS), Shear texture, Reverse shearing, Mechanical properties, Texture, Commercially Pure (CP) Aluminium

*Speaker