Predicting the deformation history and mechanical properties of extruded 6xxx automotive alloys using EBSD texture analysis

Mian Zhou*[1], Chrysoula Tzileroglou[2], Carla Barbatti[3], and Hamid Assadi[1]

[1]Brunel University London – United Kingdom
[2]Constellium – United Kingdom
[3]Constellium – Constellium – France

Abstract

The texture of extruded 6xxx industrial high-strength aluminium alloys was studied using EBSD and OIM, and the mechanical properties were investigated by standard tensile testing. This paper first proposes a novel texture analysis technique to construct a complete crystal orientation map while retrieving workable texture data for machine learning. The method characterises the texture distribution into five groups of texture components; the volume fraction of each component is calculated and subsequently summed for each group. A combination of $< 100 >$ and $< 111 >$ groups was found in the region within the extruded profile where the uniaxial tensile stress dominated, whereas the $< 211 >$ group was found prevailing where the shear stress dominated. Adopting the characterised texture groups as main features, a predictive tool was established using the neural network technique. The tool can draw both upstream and downstream relations, i.e., either to deduce the stress states in complex extrusion geometry or to predict the mechanical properties of extruded cross-section, providing a substantial step for achieving texture control.

Keywords: Aluminium alloy, Extrusion, EBSD texture analysis, Mechanical properties, Artificial neural network

*Speaker