Texture heterogeneity inside a roll bonded Fe-Al multilaminate subjected to plastic instabilities

Guillaume Hanon*[1], Loïc Malet[2], and Laurent Delannay[1]

[1]Institute of Mechanics, Materials and Civil Engineering [Louvain] – Belgium
[2]4MAT, Université Libre de Bruxelles, 1050 Bruxelles, Belgium – Belgium

Abstract

Roll bonding of dissimilar material may give rise to highly heterogeneous deformation through the plate thickness. Such strain heterogeneity depends on the roll gap geometry (determining the amount of redundant shear) as well as the occurrence of plastic instabilities (tilted shear bands) which are due to the strength contrast in adjacent layers of the stacking. The non-uniform deformation inside individual layers influences the evolution of crystallographic texture. This research presents a texture analysis inside a 9-layers multimammate produced by laboratory roll bonding at room temperature. When bonding commercial purity Aluminium alloy (AA1050) and ARMCO pure Iron, two rolling passes triggered the emergence of instabilities. The crystallographic orientations and the microstructure in each layer were probed using EBSD measurements. Texture heterogeneity was quantified by comparing different layers and also inside individual layers. Whereas iron layers had a typical rolling texture, aluminum layers exhibited a sharp rotated-cube component indicative of intense shear. The latter gave rise to continuous recrystallization. Numerical predictions of a crystal plasticity model confirm the experimental measures that texture evolution is influenced by the plastic instabilities. Texture analysis thus enables an indirect observation of the heterogeneous plastic deformation.

Keywords: Roll Bonding, Crystal Plasticity, Finite elements

*Speaker