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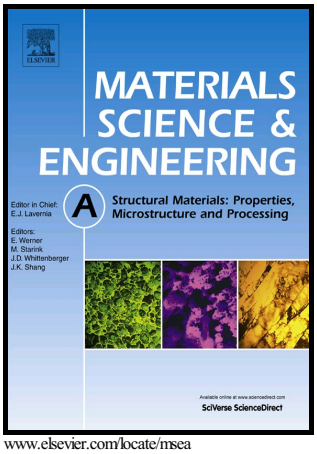

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Role of Shear in Interface Formation of Aluminium-Steel Multilayered Composite Sheets

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Abstract

Aluminium – Interstitial Free (IF) steel multilayered composite sheets with different volume fractions of aluminium were produced by accumulative roll bonding (ARB) and Asymmetric Accumulative Roll Bonding (AARB). The IF steel and Al alloy (AA1050) sheets were stacked in a sandwich like structure and roll-bonded by two passes with varying roll diameter ratios (d_r) equal to 1 and 2 for ARB and AARB processes, respectively. This work focused on a study of the effect of shear strain mode on the formation of the interface zone. The interface zone thickness, which formed by intermixing and diffusion, was characterised by different techniques including STEM-EDS line scan, HRTEM and Atom Probe. Furthermore, finite element simulations of both processes were conducted to determine the level of shear strain at the interfaces. It was demonstrated that the width of the interface zone directly correlates with the magnitude of shear strain and architecture of the hybrid material.

Keywords: Al-IF steel, accumulative roll bonding, Transmission electron microscopy, Atom Probe tomography, Mechanical properties, Interface formation.

1. Introduction

Aluminium-Steel multilayered composites (hybrid materials) are used for different applications, including marine, electro-magnetic, electrical power transformers, automotive panels and decorative building products [1-4]. These lightweight hybrid materials have excellent mechanical properties and are more economical to use than all-steel parts, which ensures an increasing range of applications.

The hybrid materials can be produced by traditional manufacturing methods for composites: solids co-deformation, liquid state methods and vapour deposition of metal on the substrate, or explosive welding [5, 6]. However, these traditional