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Influence of velocity of pressing in RCS processed AA8090 Al-Li alloy

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Abstract:-

The effect of the velocity of pressing on grain refinement in AA8090 Al-Li alloy sheets during repetitive corrugation and straightening (RCS) at 300° C is studied. V-groove corrugation dies and flattening dies were used at three different pressing velocities of 1.5 mm/s, 2 mm/s and 2.5 mm/s. The specimen temperature was maintained at 300°C. Grain refinement was significantly influenced by the pressing velocity. The samples processed for 8 passes at a pressing velocity of 1.5 mm/s had an improved microhardness value of 104 HV and an increased tensile strength of 405 MPa which is respectively 39% and 113% more than the corresponding values in the parent material. TEM analysis showed that samples processed at a pressing velocity of 1.5mm/s had in places a grain size down to 50 nm and the EBSD results revealed that the average grain size was 2μm, with 86% of the total number of grain boundaries of the high angle type.

Keywords:- RCS; grain refinement; pressing velocity; AA8090; EBSD; TEM.

INTRODUCTION

Grain refinement is used to increase the strength of metals. Severe plastic deformation (SPD) is one among several treatments that give rise to grain refinement. Many studies have examined the different types of severe plastic deformation processes and the mechanisms of grain refinement [1,2]. SPD processes such as Equal Channel Angular Pressing (ECAP) [3], Equal Channel Angular Extrusion (ECAE) [4,5], High Pressure Torsion (HPT) [6], Accumulated Roll Bonding (ARB) [7], Cryorolling [8], Accumulative Back Extrusion (ABE) [9], Accumulative Torsion Back (ATB) [10], Shot Peening [11], Twist Extrusion (TE) [12], Cyclic Extrusion and Compression (CEC) [13], Multi-Axial Compression/Forging (MAC/F) [14] etc., have been used to produce ultrafine grained (UFG)/ nanostructured material (NSM). But each of these processes has its limitations. In particular, all these are batch production processes that have geometric restrictions. In contrast, the SPD technique, Repetitive Corrugation and Straightening (RCS), proposed by Zhu et al. [15] to develop ultrafine-/ nano- structure in sheet metals can be made a continuous process. This process, however, leads to non-uniform grain refinement. This can be overcome by selecting a suitable die profile and right processing conditions [16].