The formability AA1050/AA7050 Al multilayered sheets produced by Accumulative Roll Bonding (ARB) in traditional drawing and in single point incremental forming (IF) processes

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Abstract

The optimization of metallic materials mechanical properties by thermomechanical processing and heat treatments cannot yield simultaneous enhancement of strength and ductility. The ultrafine grain size achieved by severe plastic deformation (SPD) increases strength by 5 times but reduces elongation down to 5%. Coarse grains have the opposite effect. On the other hand, designing Hybrid Materials (HM) with hierarchy bimodal structures can maximize both properties. Because of its geometry, the accumulated roll bonding (ARB) SPD process is very suitable to fabricate HMs. A lamellar hierarchic microstructure containing 50% of each AA7050 and AA1050 aluminum alloys yields higher yield and the desirable ductiliy. This work studies the application of this material in conventional and in incremental forming processes. Sheets were processed with pre-heating at 450 ∘C and 500 ∘C for up to six ARB cycles. A bimodal grain size distribution was observed. AA7050 layers presented elongated and fine grain size with nanometric precipitates and AA1050 layers presented coarser and equiaxed grains. X-ray measurements and electron backscatter diffraction were performed to obtain the crystallographic texture and the mesotexture, respectively, and thus characterize the heterogeneous microstructure. In addition, texture analysis indicated both rolling and shear components in the sheets. The formability was tested by the Nakazima test and by incremental forming FLDs have shown that the forming properties did not follow the expected rule of mixtures when compared with monolithic alloy sheets. Single Point Incremental Forming extends the formability limit (FL) as compared to the conventional drawing.

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