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Effect of layer architecture on the mechanical behavior of accumulative roll bonded interstitial free steel/aluminum composites

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A B S T R A C T

Multi-layered interstitial free (IF) steel/aluminum (Al) composites were fabricated by the accumulative roll bonding (ARB) method. Two types of IF steel/Al6061 dissimilar layered metal composites (LMC) with varied stacking of aluminum layers were processed to examine the effect of the layer architecture. Microhardness and uniaxial tensile experiments were applied to analyze the surface and bulk monotonic mechanical properties. Besides, the cyclic mechanical response of the processed materials was investigated via high cycle fatigue (HCF) tests with positive mean stress. Microstructure and mechanical characteristics of composites with various layer architectures were analyzed up to five ARB passes. It is revealed that the monotonic and cyclic performances of all LMCs are significantly enhanced as compared to the base alloy with an aluminum layered structure. Moreover, composites with aluminum as the outer layer exhibited the highest fatigue life, due to crack branching at the interface region during propagation from the softer to the harder layer. Fracture morphology analysis of composites demonstrated that in addition to the significant impact of surface cracks on the outer layers, propagation of cracks initiating from the interface layers led to failure under cyclic loading.