Development of high strength and high electrical conductivity Cu-Cr-Zr alloy through friction stir processing

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Abstract: Friction stir processing (FSP) is a solid state processing technique to alter the surface mechanical properties of metallic materials. The present study aimed to improve the surface mechanical and wear propoerties of Cu–0.62%Cr–0.11%Zr alloy (a type of high strength and high electrical conductivity alloy) through FSP without deterioting its electrical condutivity. The Cu-Cr-Zr alloy was friction stir processed by varying the tool travel speed from 50 to 200 mm/min steps of 50 mm/min and at a constant rotation speed of 600 rpm. The specimens were extracted from the stir zone to characterize its microstructure, mechanical properties and wear behavior. It was observed that grain size of the stir zone decreases from 38.2 µm to 5.4µm with the increase in tool travel speed. Whereas hardness of the processed specimens increased from initial 71VHN to 95VHN. The wear resistance of the processed samples increased with the travel speed. The peak shift seen in X-ray patterns of processed specimens suggested the presence of residual strain in the processed zone. The change in electrical conductivity, as measured using eddy current technique, noted to be insignificant in the processed specimens i.e. it decreased to 81.5 %IACS from its initial 84 % IACS. Hence, the objective of improving the mechanical and wear resistance properties of Cu-Cr-Zr alloy was achieved without impairing the electrical conductivity by friction stir processing.

Keywords: high strength and high conductivity alloy (HSHC), friction stir processing, Cu-Cr-Zr alloy, electrical conductivity.