NEUTRON DIFFRACTION MEASUREMENT OF RESIDUAL STRESSES IN FRICTION STIR PROCESSED NANOCOMPOSITE SURFACE LAYER*

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Friction stir processing (FSP) was successfully used to stir and mix nano-sized Al_2O_3 particles into a pure aluminum surface to form a nanocomposite layer up to 3 mm thick, which has demonstrated significantly improved surface hardness, yield strength, and wear-resistance without sacrificing the substrate ductility and conductivity. The Al_2O_3 particles were uniformly distributed in the aluminum matrix up to 15% volume fraction. Neutron diffraction analysis was conducted at HFIR to determine the residual stress distribution in the nanocomposite surface layer. For comparison, the residual stress of a pure aluminum surface that was processed identically but has no particle involved was also measured. Results showed that the residual strains of the Al matrix in the nanocomposite layer are tensile up to 1000 $\mu\varepsilon$. The residual strains of the Al matrix in the aluminum without particles are small which are below 400 $\mu\varepsilon$. The details of the results will be further discussed in the paper

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