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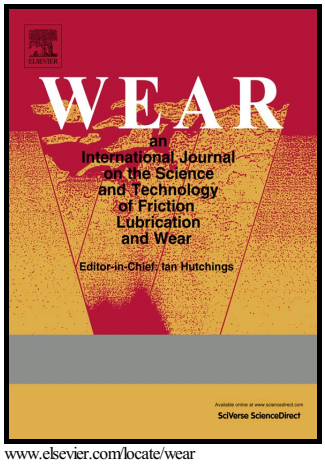

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Reinforcement Size Effects on the Abrasive Wear of Boron Carbide Reinforced Aluminum Composites

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Abstract

The use of ceramic nanoparticle reinforcements has shown significant promise for enhancing the mechanical properties of metal matrix composites due to the high specific surface area and superior intrinsic mechanical properties of nanoparticles. In this study, the effect of B_4C reinforcement particle size on the abrasive wear behavior of Al-B_4C composites was investigated. Composites with a homogenous dispersion of micrometric-B_4C, submicron-B_4C, and nano-B_4C in a nanostructured Al alloy 5083 (AA5083) matrix were fabricated using cryogenic mechanical alloying and dual mode dynamic forging. Hardness was seen to increase with decreasing B_4C reinforcement size, with the Al-nanoB_4C composite exhibiting a 56% enhancement over unreinforced AA5083. The abrasive wear resistance of the Al-nanoB_4C composite was 7% higher than the unreinforced AA5083. The other Al-B_4C composites exhibited equivalent or reduced abrasive wear resistance as compared to AA5083. Analysis of the abrasive wear scars demonstrated that larger B_4C reinforcements are prone to particle pull-out, thereby negating the benefit of higher hardness. The Al-nanoB_4C composite has superior wear resistance due its high hardness and greater interfacial area, which hindered pull-out of nano-B_4C particles.