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Surface Composites by Friction Stir Processing: A Review

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Abstract

Surface composites are suitable materials for engineering applications encountering surface interactions. Friction stir processing (FSP) is emerging as a promising technique for making surface composites. FSP can improve surface properties such as abrasion resistance, hardness, strength, ductility, corrosion resistance, fatigue life and formability without affecting the bulk properties of the material. Initially, FSP was used for making surface composites in aluminum and magnesium based alloys. Recently surface composites including steel and titanium based alloys have also been reported. While influence of process parameters and tool characteristics for FSP of different alloys has been considerably reviewed during the last decade, surface composites fabrication by FSP and the relation between microstructure and mechanical properties of FSPed surface composites as well as the underlying mechanisms have not been wholesomely reviewed. The present review offers a comprehensive understanding of friction stir processed surface composites. The available literature is classified to present details about effect of process parameters, reinforcement particles, active cooling and multiple passes on microstructure evolution during fabrication of surface composites. The microstructure and mechanical characteristics of friction stir processed surface micro-composites, nano-composites, in-situ composites and hybrid composites are discussed. Considering the importance of tool wear in FSP of high melting point and hard surface composites, a brief note on tool materials and the limitation in their usage is also provided. The underlying mechanisms in strengthening of friction stir processed surface composite are discussed with reported models. This review has revealed few gaps in research on surface composites via FSP route such as fabrication of defect-free composites, tailoring microstructures, development of durable and cost effective tools, and understanding on the strengthening mechanisms. Important suggestions for further research in effective fabrication of surface composited by FSP are provided.

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