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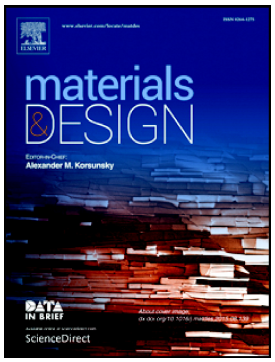

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Surface modification of aluminium by graphene impregnation

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Abstract:

In this study, graphene nanoplatelets (GNPs) were mechanically impregnated into aluminium substrates to form surface nanocomposites, which enhance the surface properties of aluminium. The impregnation was achieved by application of pressure on graphene coated aluminium plates which are locally softened by electrical resistance heating. The extent of softening of aluminium can be controlled by the process parameters current and time used for electrical resistance heating. Micro-structural characterization of the graphene impregnated aluminium surface was done through Raman spectroscopy, XRD, SEM and TEM. It was observed that GNPs were impregnated up to a depth of 200-220 μm on the aluminium surface. GNPs were mostly occupied along the grain boundaries which lead to strengthening of the composite by various mechanisms. Raman spectroscopic analysis indicates a noticeable shift and change in intensity ratios of the corresponding G, D and 2D bands of the impregnated graphene. A detailed study of surface and subsurface mechanical properties was done through nano-indentation and microhardness tests. More than 400 % improvement in surface hardness and 200 % improvement in reduced Young's modulus were observed.

Key words: Graphene, Nanocomposites, Mechanical impregnation, Solid state bonding, Surface hardening, Surface composites.

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