Multifunctional graphene films for aerospace composites

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Abstract

Since its discovery in 2004, graphene has marked its presence in several sectors such as biomedical, sports, electronics, energy harvesting and storage, and transportation. Transportation, in particular aerospace, is third largest sector after electronics and energy. Among its major applications, graphene is largely implemented as a composite reinforcement, thermal management in electronic components to name a few. Nevertheless, there are several other application areas where graphene has potential to replace metallic counter parts. For instance, metal meshes or foils are used to dissipate electrical and thermal energies in the event of lightning strike [1]. Similarly, inflatable or electro-thermal devices are used to remove accumulated ice (de-icing) or to prevent ice accumulation (anti-icing) in sub-zero temperatures [1]. Both of these scenarios deal with external surface of an aerospace vehicle such as an aircraft. In this case, graphene layer with its excellent electrical and thermal properties [2] can be implemented to replace metallic parts and eliminate maintenance, galvanic corrosion and weight issues. In this work, graphene films have been proposed as highly conductive skins to protect against lightning strike. Graphene films with high concentration of nanofillers have been realized by solution blending, evaporation of solvent and film deposition followed by a calendaring process. The final films of around 200 µm thickness were achieved that are equivalent to an epoxy resin impregnated carbon fiber ply (pre-preg). The as-prepared graphene films were laminated onto baseline pre-pregs and co-cured in a single cycle, at recommended temperature and pressure. The graphene film laminated CFRP composites have been studied for their morphological, mechanical and electrical properties. It has been demonstrated that graphene films with high electrical and thermal properties can be prepared and implemented onto CFRP panels. In future, these graphene films laminated CFRP composites will be tested under lab scale lightning strike events.

References

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