Targeted multi-scale dispersion of 2D materials in advanced composites

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Abstract

This presentation looks at the manufacturing strategies for incorporating 2D materials at multiple length scales in fibre reinforced polymer composites. While coating natural fibres with GNP or GO improved tensile modulus and strength [1], similar improvements are not expected for aerospace grade carbon fibres. Here the objective is to improve interlaminar, intra-laminar fracture toughness, damage tolerance, fatigue performance as well as novel ways to heal/repair damage. Incorporating relatively small amounts (0.5%) of GNP/GO incorporated in bulk resin through 3-roll milling and subsequent prepregging improved fracture toughness[2], spray coating more than 0.2% [3] resulted in agglomeration and reduction in fatigue properties. However, nanoscale particles my be introduced without agglomeration up to 10% weight fraction of the resin resulting in 3-4 fold increase in fatigue life [4]. In this work, thermoplastic fibres, dissolvable and non-dissolvable have been utilised in delivering 2D materials at significantly higher concentrations in specific locations of interest. Non-dissolvable thermoplastic fibres in the form of comingled [5] or micro-wrapped [6] have shown the potential of healing/damage repair and impact damage tolerance. Nonwoven interleaves demonstrated improved mode I and Mode II fracture toughness[7,8]. Previously, dissolvable fibres [9] such as phenoxy have demonstrated some improvement in fracture toughness. Here, we use dissolvable fibres and electrospun veils to deliver highly dispersed graphene [10] in the regions of interest in a composite laminate.

References

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