Graphene and other 2D Material Multifunctional Composites

Ian Kinloch

University of Manchester, Manchester, UK
Ian.kinloch@manchester.ac.uk

The intriguing physical properties of graphene and related materials make them ideal fillers in composites [1]. In particular, such 2D materials could enable multifunctional composites, where one obtains simultaneous benefits in mechanical reinforcement, electrical and thermal conductivity, gas barrier performance, corrosion control, anti-static properties, EMI shielding and/or structural health sensing.

Herein, we use model experimental systems to establish the design rules for atomically thin fillers with regard to the role of their diameter, thickness, chemical structure and interface [2,3,4]. We show these broad rules can apply to graphene, GNPS and TMDs. We also show that the ideal composite microstructure is highly dependent on the property being optimized, thus forcing comprises to be made in order to achievement multifunctionality.

We then transfer these rules to produce bulk composites using a range of matrices including thermoset, thermoplastic [6], elastomer [7] and inorganic [8] matrices. Particular promise is shown in hybrid composite systems where graphene is used in combination with conventional fillers.

References

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