Multifunctional 2D Composites for the Energy Transition

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The energy transition requires a new generation of materials to deliver high performance at low weight. This transition is made more difficult with traditional performance materials such as fluoropolymers becoming restricted due to environmental concerns and challenges in the environmental cost of producing and recycling materials. The exceptional combination of mechanical, electrical, barrier and thermal properties of 2D materials make them ideal to address these challenges, with composites being used to translate their properties to the bulk scale [1,2].

Herein, we will explore the fundamental design rules for 2D material composites using a combination of ideal experimental systems and simulation to understand the role of flake size, surface chemistry, dispersion etc. We will also show how 2D materials can work in harmony with conventional filler materials (e.g. glass fibre, carbon black etc) to enhanced properties [3] and how these properties are effect by recycling. The translation of these rules to produce advanced composite materials will be exemplified using electrical and thermal conductivity in thermosets and thermoplastics, EMI shielding [4], thermoelectric [5], hydrogen barrier properties for gas cylinders [6], new fluorine-free elastomeric and ultra-high molecular weight polymeric seals [7], and low friction metal surfaces [8,9].

References

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