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CV/ biography

Prof. Milo Shaffer is Professor of Materials Chemistry at Imperial College and was co-Director of the London Centre for Nanotechnology (2010-2020). He is a leader in nanomaterials synthesis, modification, and hierarchical assembly, for applications including composites and electrochemical devices. He has pioneered the development of redox methods for nanocarbon processing, and at a larger scale, he developed new hierarchical combinations of nanocarbons as structural electrochemical energy storage electrodes (see www.sorcerer.eu). He was an investigator on a major UK Programme Grant developing high performance ductile composites (www.hiperduct.ac.uk), and now leads the UK NextCOMP program on next generation composites in compression (www.nextcomp.ac.uk). He was awarded the RSC Meldola Medal (2005) and the RSC Corday-Morgan Prize (2014). He has published around 240 peer reviewed journal papers and 30 patents, with 26700 citations, and an h-index (GS) of 72.

Versatile and scalable approaches to chemical processing of nanocarbons

Individual perfect nanocarbon structures have exceptional properties; the challenge is often how to exploit their potential in real macroscopic systems. Chemical functionalisation is critical to a wide range of nanocarbon technologies, but needs to be versatile and applicable at scale. Existing approaches tend to rely on liquid phase reactions, often requiring damaging sonication or lengthy work up through filtration or centrifugation. The formation of individualized functionalised single wall nanotubes (SWNTs) and graphenes is a particular challenge.

One particularly promising approach, relies on reductive charging to form pure charged nanocarbon anions which can be redissolved, purified, or optionally functionalised, whist avoiding the damage typically associated with sonication and oxidation based processing. This simple system is effective for a host of nanocarbon materials including MWCNTs, ultralong SWCNTs, carbon blacks, graphenes, and related materials. The resulting nanocarbon ions can be readily chemically grafted for a variety of applications. The chemistry of these discrete nanions raises interesting fundamental questions, but is also practically useful. Dispersed nanocarbon related materials can be assembled, by electrophoresis, cryogel formation, or direct cross-linking to form Joule heatable networks, protein nucleants, supercapacitor electrodes, and catalyst supports, particularly suited to combination with other 2d materials, such as layered double hydroxides[Erreur ! Source du renvoi introuvable.]. Comparative studies allow the response of nanocarbons with different dimensionalities to be assessed to identify fundamental trends and the most appropriate form for specific situations. The use of nanostructured materials often provides opportunities to simultaneously address otherwise conflicting materials property requirements, such as high ionic conductivity with high stiffness, or self-healing with high absolute strength.

Clancy, Shaffer, et al, Charged Carbon Nanomaterials: Redox Chemistries of Fullerenes,Carbon Nanotubes, and Graphenes, Chem.Rev., 118, 7363−7408, 2018

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