IBS Center for Multidimensional Carbon Materials

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Versatile and scalable nanocarbon chemistry, assembly, and application

May 18 Thursday, 11 am | Bldg. 101 Seminar Room on the 1st floor

Special Seminar

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 nano-ions raises interesting fundamental questions, but is also practically useful. Solvated 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. 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. Combinations with existing commercial carbon fibres can provide opportunities to enhance state of the art performance or introduce new function. 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.

References

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

[2] Rubio N, Au H, Coulter GO, Guetaz L, Gebel G, Mattevi C, Shaffer MSP,, Effect of graphene flake size on functionalisation: quantifying reaction extent and imaging locus with single Pt atom tags, Chemical Science, 12, 1-13, 2021

[3] Govada L, Rubio N, Saridakis E, Balaskandan K, Leese HS, Li Y, Wang B, Shaffer MSP, Chayen N, Graphene-based nucleants for protein crystallization, Advanced Functional Materials, 32, 2022

You are cordially invited to attend!