Emulsifying properties of pristine low dimensional carbon forms

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Due to their extraordinary properties, low dimensional carbon forms hold great promise for applications ranging from optoelectronic, through environmental to biomedical technologies. However, the conflicting reports about their natures hinder potential applications. For many potential large scale processing routes to efficiently manufacture and commercialize graphene based devices, composites, coatings, membranes or inks it is essential to understand the fundamental colloidal properties of pristine graphene flakes (GF). Similarly, carbon nanotubes (CNTs) which have already demonstrated scientific and technological breakthroughs including scalable coatings, composites, tissue engineering, and biosensors, hold enormous, yet unfulfilled, potential in other macro-scale applications.

Our studies into colloidal properties of pristine GF [1] and short and thin pristine CNT [2] revealed why and how they can be used as emulsion stabilizers without using any additional surfactants. The rigorous quantum-mechanical, molecular dynamics and Monte Carlo calculations supported by wet-chemistry testing, optical and electron microscopies, Raman spectroscopy and thermogravimetric analysis explained the physico-chemical mechanism governing their amphiphatic nature. Pristine GFs with the small surface areas and short thin pristine or purified CNTs, due to high hydrophilic-to-hydrophobic surface regions (edges/open-ends/oxidized and vacancy domains – to – basal plane/caps) ratio, exhibit sufficiently good emulsifying properties to form stable water-in-oil emulsions. In consequence, GFs and CNTs can be utilized as fully recyclable 2D and 1D surfactants greatly enhancing the efficiency and functionality of applications based on these materials [3]. Moreover, we already demonstrated the direct applications of CNT based emulsions with a possible use as electroconductive paints for textronics [2]. Recently, we found out that also fragments of fullerenes can stabilize water-in-oil emulsions. I will compare the emulsifying properties of low dimensional carbon forms and explain how their amphipathic strength can be controlled.

References

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Figures