

Photophysical interaction of liquid-phase exfoliated graphite with zinc phthalocyanines in aqueous solution and methanol

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Abstract

Graphene with its outstanding properties still attracts keen attention, even after more than a decade since the ground-breaking work by Novoselov and Geim in 2004. The material, based on a one-atom-thick planar layer of sp^2 hybridized carbon atoms, packed in a two dimensional honeycomb crystal lattice, exhibits a record stiffness and high mechanical strength, as well as high optical transparency and high stretch ability. [1] A promising top down approach for the graphene production is the liquid phase exfoliation of graphite where also monolayer of graphene flakes are produced. [2] [3]

In this work, liquid phase exfoliation of graphite is used to produce graphene flakes not only in organic solvents, but also in aqueous solution. The investigated phthalocyanines are unsymmetrically substituted zinc phthalocyanines with unprotected carboxylic acid dendritic moieties. Due to the combined water-solubility of the functional groups and the π -stacking properties of the zinc phthalocyanines an amphiphilic structure evolves, which ensures the ability to exfoliate graphite, on one hand, and stabilizes as well as interacts with the resulting graphene flakes, on the other hand. Absorption and fluorescence spectroscopy were used for ground and excited state characterization of the phthalocyanines in different solvent variations. Also electrochemical and spectroelectrochemical measurements were performed. The newly formed hybrid was obtained as a stable dispersion by addition of graphite to a phthalocyanine solution, ultrasonication and gravity sedimentation or centrifugation. Raman and TEM analyses reveal few-layer and turbostratic exfoliated graphite flakes (figure 1). An interaction of the phthalocyanine with graphene can be observed on the basis of a new absorption band and a fluorescence quenching due to the electronic coupling. The photoinduced electron coupling between the phthalocyanines and the graphene can also be observed in femtosecond transient absorption spectroscopy.

References

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Figures

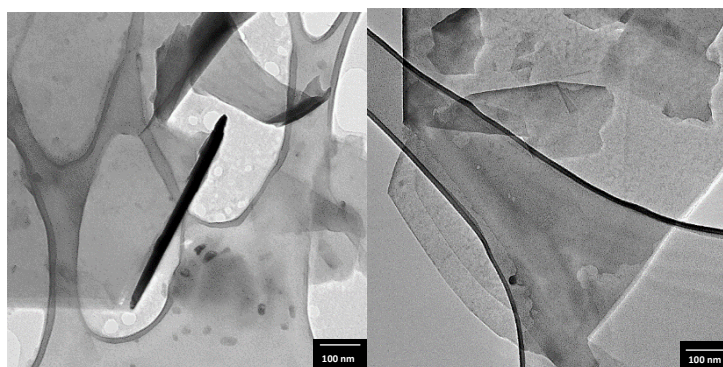


Figure 1: TEM image of graphene flakes obtained by dispersions in methanol (left) and in 1:1 v/v methanol:puffer solution (right).