SINGLE-WALLED CARBON NANOTUBES CHARGE MANAGEMENT BY CONTROLLED FUNCTIONALIZATION

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Managing the density of charges in carbon nanotubes opens new ways to tune their optical response, their transport properties, and their physico-chemical features. Charge transfer from molecules adsorbed onto the sidewall or filled within the hollow cavity of the nanotubes has already been demonstrated, yet a fine-tunable control of the surface coverage/filling fraction (and thus the amount of transferred charge) remains challenging to achieve. Alternatively, we developed an optically nonperturbing covalent functionalization technique based on the inclusion of a triazine derivative into the carbon network [1]. The nitrogen atom sustaining the attached group becomes an integrated part of the pi-conjugated network and contributes with its lone electron pair to uplifting the position of the Fermi level of the tube. Since the density of attached groups can be varied by adapting the synthetic conditions, this technique offers the advantage of controlling the amount of charge injected into the tubes. Additional groups attached onto the other end of the triazine moiety, moreover, are able to inject charge into the tubes as well. This, for example, allowed us to modulate the photoluminescence of the tubes, switching their emission on and off through the attachment of the switchable spiropyran/merocyanine system [2]. Here we focus on a class of charge-transfer agents that either donate or withdraw electrons depending on the arrangements of their building units [3] and how their decoration affects the properties of the tubes.

References

[1] Setaro et al. Nat. Comm. 8 (2017), 14281..
[2] Godin et al. Science Advances 5 (2019), eaax1166.
[3] Fiebor et al. J. Phys. Chem. C. 125 (2021), 19925.

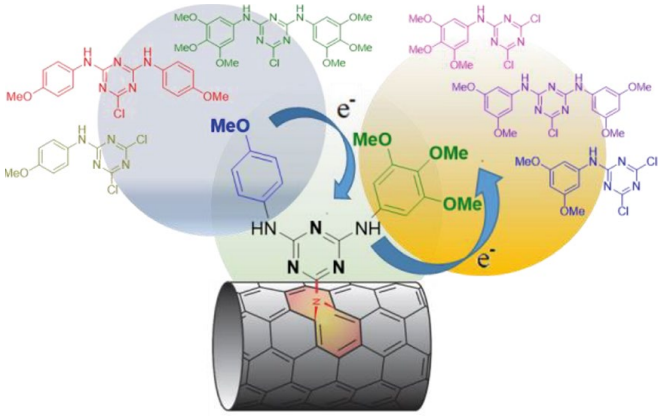

Figure 1: Different number of methoxy groups can be attached onto aniline at different positions, resulting in compounds that can either donate or withdraw electrons from the tubes they are attached onto [3].

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