Application Sheet

io·li·tec
Ionic Liquids Technologies

Dispersion of carbon allotropes: carbon nanotubes, graphene or fullerenes

Dispersions of nanoscaled materials in general become more and more interesting for all kind of applications. Among the various types of nanoparticles carbon allotropes like *carbon nanotubes* (CNTs), *graphene* or *fullerenes* play an increasing role e.g. in energy applications for hydrogen storage[1], or electrode materials for batteries[2], OPV[3], or printed electronics. But for all these applications long term stable and easy as well as safe to handle dispersions are of great importance in manufacturing processes, also with the background of uncertainties concerning the specific toxicity of certain nanoparticles (NPs).

Printable CNT Dispersions:

IOLITEC *nanomaterials* succeeded in dispersing MWCNTs in water by using a suitable IL and treatment with ultrasound. The stabilizing effect of the IL is extremely obvious if the dispersions are stressed by centrifugal forces. If no or an unsuitable additive was added, the dispersion will collapse even at low centrifugal force impact (Fig. 1, on the right) and sediments will be obtained.

Fig. 1. Seven MWCNT-dispersions in water (left); centrifuge (middle); dispersions without or with suitable IL after 20000 rcf, 1 min (right).

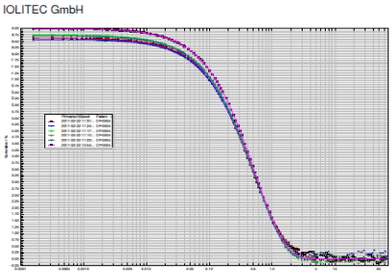

Fig. 2. several correlation functions: light decay of a stable CNT dispersion in water.

These obtained low concentrated CNT-dispersion were suitable for inkjet printing: simple filling of a ink-cartridge with the CNT-dispersions and use of standard home inkjet-printer results in conductive layers on paper (Fig. 3)

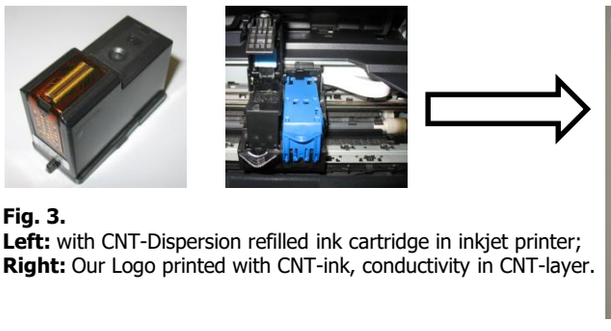

Fig. 3.
Left: with CNT-Dispersion refilled ink cartridge in inkjet printer;
Right: Our Logo printed with CNT-ink, conductivity in CNT-layer.

Graphene Dispersions:

We have investigated the dispersion of different types of graphenes in solvents like water and alcohols by using selected ILs and standard dispersing agents. In Fig. 4 a selection of three different graphene dispersions in water after application for centrifugal forces of 20'000 rcf for 1 min is shown. Two of them immediately collapsed, while the right one remains completely dispersed due to the suitable dispersing agent. This sample was investigated by PCCS: a statistical distributed correlation functions with no decrease in altitude is obtained. This sample is very stable; not until application of the highest centrifugal force for more than 20 min the dispersion starts to form sediments.

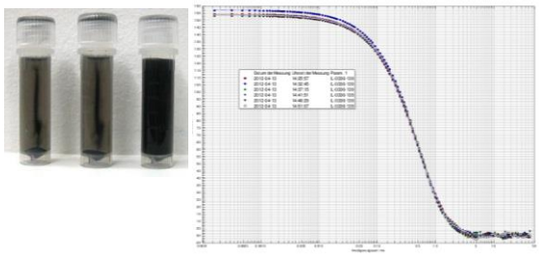

Fig. 4. *left*: two unsuitable and one suitable additives for graphene dispersion;
right: several correlation functions light decay of a stable graphene dispersion in water.

References:
[1] Ma, Y.; Xia, Y.; Zhao, M.; Wang, R.; Mei, L. *Phys. Rev. B,* **2001**, *63*, 115422.
[2] M. Liang, *J. Mater Chem.*, **2009**, *33*, 5871.
[3] Y. Lee, K. Tu, Ch. Yu, S. Li, J. Hwang, C. Lin, K. Chen, L. Chen, H. Chen, C. Chen, *ACS Nano*, **2011**, *5*, 6564.

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