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A universal formulation strategy for functional inks

Dr Tawfique Hasan and his team of researchers at the Department of Engineering, University of Cambridge have developed a universal functional ink formulation strategy applicable to a wide range of commercially available nano platelets / nano particles including graphene, transition metal dichalcogenides such as MoS_2, and *h*-BN.

Formulations are low-cost, environmentally friendly and room temperature processable and can be used as standalone functional inks, as additives to other existing ink systems or in composite systems to achieve conducting, semiconducting, insulating and thermoelectric properties.

Possible applications:

A proven formulation strategy—can be quickly adapted for a broad range of industrial applications: e.g.

- Conductive inks for paper-based electronics & smart packaging
- Electrically and thermally conductive plastics
- Conductive adhesives
- Electrodes for energy storage applications
- High-strength protective barrier coatings

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Background

Current nano platelet / nano particle (NP) functional inks are typically formulated for a specific NP type and it is often not clear whether these proposed ink formulations are suitable for other types of NPs which are commercially available.

Previous studies into solution processing of NPs reveal that suitable solvents are usually expensive, aggressive and toxic (e.g. chloroform, toluene, dichlorobenzene, etc.) and require post-treatments and special curing conditions; factors which can limit practical industrial applications.

Technology

The ink formulation strategy developed by Dr Hasan and his team uses cheap, non-toxic, environmentally friendly and low boiling point solvents. The resulting ink blends typically do not require special post treatments and can be cured at room temperature.

Commercially available NPs have been successfully blended to create standalone conducting and dielectric inks and composites (Figure 1) and to enhance the conductivity of commercially available carbon inks (Figure 2, using graphene nanoplatelets (GNP)). Other functional properties using a large range of commercially available NPs are also being tested.

The rheology of the formulations also can be tuned to enable printing/coating using methods such as flexo-, gravure-, screen-, offset printing (Figure 3), doctor blade-, web- and spray-coating.

Commercialisation

This technology is protected by a PCT patent application WO2017/013263 and we are now looking for commercial partners to further develop the inks and their manufacturing processes for industrial applications.

Dr Hasan and his team have have set up a spin-out company, Inkling Cambridge Limited, to explore such opportunities (www.inklingcambridge.com).

If you are interested in discussing how your company can work with us, please contact us using the details on the front of this sheet.

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cambridge limited

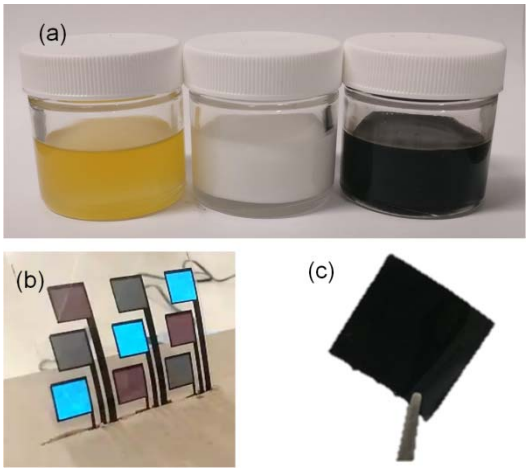

Figure 1: Example applications for the formulation. (a) Ink samples (left to right) – dielectric ink containing *h*-BN, *h*-BN dispersion, conductive graphene ink; (b) Prototype electroluminescent display; (c) Conductive polymer composite.

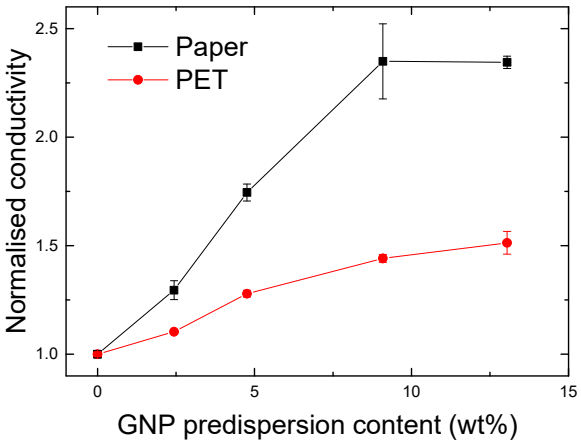

Figure 2: Using GNP conductive ink to enhance conductivity of commercial carbon ink on paper and PET.

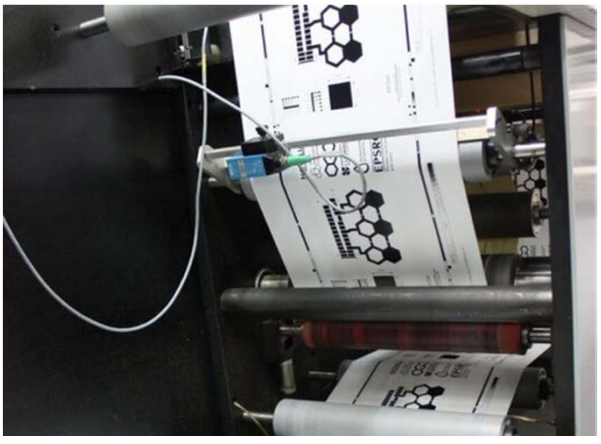

Figure 3: Successful demonstration of one of our GNP conductive ink formulations printed in a commercial press without any modification or adverse effect to the equipment.