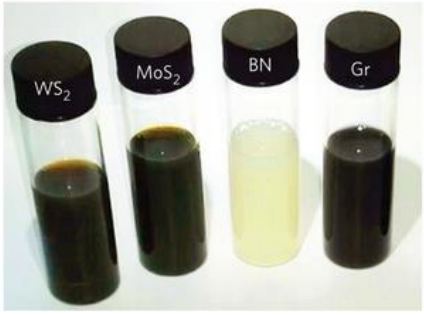
2D-Crystal Inks for Inkjet-Printed Heterostructures

BACKGROUND



Water-based 2D crystal inks

Graphene and other two-dimensional (2D) materials are outstanding candidates for use in printed electronics due to their novel optical and electronic properties. These novel properties can be can be exploited in heterostructures, where different 2D materials get stacked on top of each other. Such heterostructures can be generated to have properties that are designed for specific applications to address specific market needs. Conventional methods of heterostructure production are time consuming as they rely on the mechanical transfer of individual 2D crystal layers. Inkjet printing offers a faster and less expensive method. The process of inkjet printing is also compatible with a wide range of substrates, simple to implement, and allows the possibility of post-fabrication processing. Liquid-phase exfoliation of bulk materials is a scalable method to produce nanosheets that can be used in 2D-crystals ink formulations. However, previous methods of liquid-phase exfoliation are mostly based on the use of expensive and toxic solvents, which was a limitation of the method.

THE TECHNOLOGY

This technology focuses on the development of water based 2D-crystal inks by liquid-phase exfoliation. **The method allows the production of graphene inks with tunable viscosity and surface tension that are ideal for inkjet printing and down-stream applications.** It enables the liquid-phase exfoliation of graphene, and other inorganic 2D crystals, for the large-scale production of water based 2D-crystal ink formulations without the use of costly and hazardous solvents. The technology also describes an aqueous ink composition for use in inkjet printing.

KEY BENEFITS

- The production of 2D-crystal heterostructures through inkjet printing is scalable for mass production, in contrast to the conventional method of 2D crystal mechanical transfer
- This process, enables production of water based graphene inks without the use of costly and hazardous solvents
- The resulting ink contains fewer organic additives (such as stabilizer and surfactant) than inks generated from similar methods – enabling conductive lines to be printed with just one print pass

APPLICATIONS

2D-ink formulations that are generated through this method have potential applications in:

- Inkjet printing of films or tracks as coatings
- Flexible electronics and smart textiles
- Logic circuits
- Chemical and thermal sensors with applications in a broad range of fields, from biomedicine to environmental sciences
- Bioimaging and bioelectronics
- Photodetectors
- Micro-supercapacitors
- Thin-film transistors (TFTs)
- Electromagnetic shielding

INTELLECTUAL PROPERTY

- This technology is covered by two patent applications, one that has entered National Phase in multiple territories, and a second application that is currently at the PCT stage.

OPPORTUNITY

- We are seeking collaborating partners that have commercial applications for our inks, and would be interested in meeting with potential partners.

PUBLICATIONS

- F. Withers *et al*. Heterostructures Produced from Nanosheet-Based Inks. *Nano Lett*ers, 2014; doi: 10.1021/nl501355j
- D McManus *et al*. Water-based and biocompatible 2D crystal inks for all-inkjet-printed heterostructures. *Nature Nanotechnology*. 2017; doi:10.1038/nnano.2016.281

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UMIP Ref: 20130342,20140402