Water-based and Biocompatible 2D Crystal Inks for All-Inkjet Printed Heterostructures

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Inkjet printing is an attractive fabrication technique as it allows for production of large-area, low-cost and flexible electronics on a wide range of substrates [1-2].

The advent of 2D materials, with their ground breaking properties, show promise in this regard: graphene inks can be easily produced by liquid-phase exfoliation in organic solvents such as N-methyl-pyrrolidone (NMP) [3]. Due to the physical properties of NMP, such inks are directly suitable for inkjet printing and have been already used to fabricate all-inkjet printed in-plane devices [4,5].

Water is very attractive being a low-cost, abundant, non-toxic solvent with a relatively low boiling point. However, unlike NMP, water does not have the physical properties for either liquid-phase exfoliation or inkjet printing. Hence, water-based inks need to be carefully formulated [6,7].

Here we show a simple method to produce highly concentrated (up to 8 mg/mL), stable and inkjet printable graphene dispersions in water [8]. The method has also been successfully extended to other 2D materials. The inks can be inkjet printed on a wide range of substrates (glass, plastic, paper, silicon, etc.) and are suitable for fabrication of both planar and vertical devices [8]. In particular, we show for the first time an array of 100 heterostructure-based devices entirely made by inkjet printing [8].

Preliminary in vitro dose-escalation cytotoxicity tests also demonstrated the biocompatibility of the inks, extending their possible use to biomedical applications [8].

References

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