Biocompatible 2D Material-based Inks: from Printed Electronics to Biomedical Applications

Cinzia Casiraghi
Department of Chemistry, University of Manchester, UK
cinzia.casiraghi@manchester.ac.uk

Solution processing of 2D materials [1] allows simple and low-cost techniques, such as ink-jet printing, to be used for fabrication of heterostructure-based devices of arbitrary complexity.
In my group we have developed a simple approach to achieve highly concentrated, defect-free, printable and water-based 2D crystal formulations, designed to provide optimal film formation for multi-stack fabrication [2]. This talk will discuss the progress in printed electronics achieved with these inks: examples of all-inkjet printed heterostructures, such as large area arrays of photosensors on plastic [2], programmable logic memory devices [2], capacitors [3] and transistors on paper [3,4] will be given. Furthermore, we will show that inkjet printing can be easily combined with high quality 2D materials, allowing simple and quick fabrication of complex circuits on paper, such as high-gain inverters, logic gates, and current mirrors [5].
Finally, I will show that our formulation approach also allows to easily tune the charge and surface properties of graphene, by allowing to produce amphoteric, cationic and anionic graphene dispersions *on-demand* in one-pot [6-8]. In particular, cationic graphene dispersions have exceptional intracellular uptake profile as well as stability in the biological medium, making this type of graphene very attractive to use in biomedical applications [7].

REFERENCES

1. Coleman et al, Science 331, 568 (2011)
2. McManus et al, Nature Nano, 12, 343 (2017)
3. Worsley et al, ACS Nano, (2018) DOI: 10.1021/acsnano.8b06464
4. Lu et al, ACS Nano, ACS Nano, 13, 11263 (2019)
5. Conti et al, accepted in Nature Comms, pre-print at: Arxiv. 1911.06233
6. Shin et al, Mol. Syst. Des. Eng., 2019, DOI:10.1039/C9ME00024K
7. Shin et al, Faraday Discussion, accepted
8. Shin et al, Nanoscale, 2020, DOI: 10.1039/D0NR02689A J