CRC Seminar Series

DATE: 27 May 2021
TIME: 3:00 PM – 5:00 PM
LOC: Online Zoom Meeting

GUEST SPEAKER:
Prof. Cinzia Casiraghi
Department of Chemistry, University of Manchester, UK

TITLE:
„Water-based, defect-free and biocompatible 2D material inks: from printed devices to biomedical applications"

ABSTRACT:
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. However, the success of this technology is determined by the nature and quality of the inks used.

Our group has developed highly concentrated, defect-free, printable and water-based 2D crystal formulations, designed to provide optimal film formation for multi-stack fabrication [2]. I will give 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]. Furthermore, inkjet printing can be easily combined with materials produced by chemical vapor deposition, allowing simple and quick fabrication of complex circuits on paper, such as high-gain inverters, logic gates, and current mirrors [5].

Our formulation approach also allows to easily tune the charge of graphene, which is a key parameter in biomedical applications. Amphoteric, cationic and anionic dispersions have been obtained without any post-processing after exfoliation [6-8]. Cytotoxicity tests

confirm biocompatibility of the graphene inks, with cationic graphene dispersions having exceptional intracellular uptake profile as well as stability in the biological medium, even with protein serum, making this type of graphene very attractive to use in nanomedicine [8-9].

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, Nature comms, 11 (1), 1-9 (2020)
[6] Shin et al, Mol. Syst. Des. Eng., 2019, DOI:10.1039/C9ME00024K
[7] Shin et al, Faraday Discussion, https://doi.org/10.1039/C9FD00114J
[8] Shin et al, Nanoscale, 2020, DOI: 10.1039/D0NR02689A
[9] Tringides et al, Nature Nano, just accepted

PROFILE OF PROF CINZIA CASIRAGHI:

Prof Casiraghi holds a Chair in Nanoscience at the Department of Chemistry, University of Manchester (UK). She received her B.Sc. and M.Sc. in Nuclear Engineering from Politecnico di Milano (Italy) and her Ph.D. in Electrical Engineering from the University of Cambridge (UK). In 2005, she was awarded with an Oppenheimer Early Career Research Fellowship, followed by the Humboldt Research Fellowship and the prestigious Kovalevskaja Award (1.5M Euro). In 2010 she joined the School of chemistry at the University of Manchester. Her current research work is focused on the development of biocompatible 2D inks and their use in printed electronics and biomedical applications. She is leading expert on Raman spectroscopy, used to characterize a wide range of carbon-based nanomaterials. She is recipient of the Leverhulme Award in Engineering (2016), the RSC Marlow Award (2014), given in recognition of her work on Raman spectroscopy, the RSC 2020 Gibson-Fawcett Award, in recognition of her contribution in the development of water-based 2D inks suitable for printed electronics and biomedical applications. and an ERC Consolidator grant (2015) and ERC Proof of Concept (2020).