CNR NANOTEC INSTITUTE OF NANOTECHNOLOGY

Seminars @ NANOTEC

12 May 2021, 11:30 – *Online seminar*

Nanostructured films of two-dimensional materials: electronic transport, printed heterojunctions and wearable electronics

Felice Torrisi

Molecular Science Research Hub, Imperial College London, UK
& Dipartimento di Fisica e Astronomia, Universita' di Catania, Italy

Wearable electronics play a primary technology to enable remote healthcare provision, which is highly important in a post-pandemic society. Graphene and related 2D materials (GRMs) hold a great potential for wearable electronics for their novel electrical and optical properties. In particular low temperature production and deposition of nanostructured GRM films from GRM-based solutions is extremely attractive for printed flexible and wearable electronics. [1, 2] GRM-based inks enable a large range of printed device and integration options, such as digital, lithographic printing and roll-to-roll coating, which are ideal to deposit nanostructured GRM films. Liquid Phase Exfoliation (LPE) of bulk precursor layered materials (such as graphite, MoS2 crystals, etc.) is a scalable approach ideally suited to produce inks. However, the low-yield of the LPE process, the absence of deposition parameters and the undetermined transport properties of the GRMs have limited the full scale applications of these materials in printed and wearable electronics. I will give a brief overview on the development of high-yield, cost-effective and large-scale production techniques for GRM-based inks, and the portfolio of reproducible deposition processes enabling GRM-based printable devices on flexible and textile substrates . [3] Then I will show how careful tuning of the flakes-substrate surface interaction and GRM deposition process enables hybrid heterojunctions from 2D materials , achieving mobility > 100 cm2 V-1 s-1 at room temperature. [4] Finally, I will demonstrate how unveiling of the electronic transport in printed networks of 2D materials paves the way to high-performance inkjet printed integrated circuits of 2D material semiconductors, such as MoS2 [5].

References

[1] F. Torrisi et al. ACS Nano, **6**, 4, 2992 (2012)
[2] F. Torrisi & J. N. Coleman Nature Nanotechnol. **9**, 10, 738, (2014)
[3] S. Qiang et al. Nanoscale 11 (20), 9912-9919. (2019)
[4] T. Carey et al. Nature Commun., DOI : 10.1038/s41467-017-01210-2, (2017) [5] T. Carey et al. arXiv:2011.12359 (2020)
[5] T. Carey et al. arXiv:2011.12359 (2020)

Short Bio: Felice Torrisi is a Senior Lecturer in 2D materials and Wearable Bioelectronics in the Dept. of Chemistry at Imperial College London and Associate Professor of Solid State Physics in the Dept. of Physics and Astronomy at the Univ. of Catania. He pioneered the development of the first printable inks with graphene and 2D materials which enabled printed electronics and optoelectronics with these novel materials. His research interests span from flexible electronics to photonics with graphene and 2D materials, with particular focus on sensing, wearable electronics and bioelectronics. This involves the synthesis and stabilisation of a wide range of 2D materials in solution for optical and electrical applications. His research group also pioneers the development of functional fibres for electronic textiles and bioelectronics by incorporation of biocompatible 2D materials and nanomaterials into sustainable fibre spinning processes and textile integration. He is the PI on various EPSRC projects focusing on the advanced large scale manufacturing of wearable electronic textiles and is member of the steering board of the UK EPSRC E-Textile Network.

For info: alessandrasabina.lanotte@cnr.it