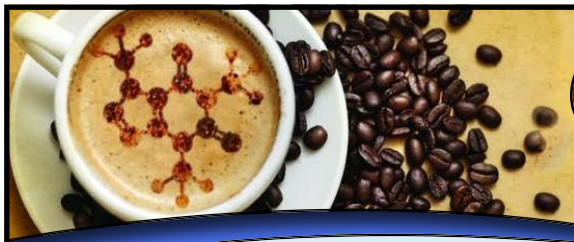

CoffeeTalk@ISOF

EXTENDED EDITION

Polymer transistors for large-area and flexible electronics: from structure-property relationships to high speed printed devices

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In this talk I will give an overview of the activities of the research line "Printed and Molecular Electronics" at the Center for Nano Science and Technology of IIT. I will first describe how it is possible to easily pattern all organic transistors, photodetectors [1] and circuits [2] through the use of only printing techniques. With the steadily improving electronic properties of polymer semiconductors, achieving charge mobility in excess of 1 cm^2/Vs, a large range of applications of printed, light-weight and mechanically robust circuits becomes possible, in diverse fields.

A key to enable these technologies is the possibility of using high-throughput, large-area printing processes to pattern polymer semiconductors with uniform and optimized morphologies. By controlling the self-assembling properties of model donor-acceptor copolymers, in combination with simple, roll-to-roll compatible coatings, it is possible to achieve well-ordered and efficient charge-transport nanostructures over large-areas [3]. In particular, such control can be extended from films tens of nanometers thick, down to mono- or sub-monolayers, still retaining high-charge mobility. In this context, the mapping of charge-induced features within the channel of working devices [4] is critical to unveil the nexus between film microstructure and electronic properties in such deposited films.

Fig. 1. All-polymer, fully printed logic circuits @IIT.

The level of control of the deposition process can boost the operational frequencies of printed polymer electronics well into the MHz regime without recurring to extreme downscaling, thus maintaining compatibility with cost-effective manufacturing of large-area circuits.

A road-map to achieve GHz operation, thus enabling wireless data communication, within the context of an European project will be presented.

[1] G. Pace et al., *Advanced Materials* **2014**, *26*, 6773

[2] S. Mandal et al., *Organic Electronics* **2015**, *20*, 132

[3] S. G. Bucella et al., *Nature Communications* **2015**, *6*, 8394

[4] N. Martino et al., *ACS Nano* **2014**, *8*, 5968

Mario Caironi *is Tenure Track researcher at the Center for Nano Science and Technology (CNST) of IIT. His main research interests currently are high-frequency printed organic and hybrid transistors and circuits, all-printed photodetectors, and polymer based energy harvesting devices. He was recipient of a Marie-Curie Career Integration Grant from 2011 to 2014 and he is a 2014 ERC Starting Grantee.*

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ISOF 12 – Meeting Room (1st floor)

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