Materials that change: polymeric precursor strategies in fabrication of devices and 3D-microprinting

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Abstract

Hand-in-hand advances in both functional materials and fabrication technologies are essential for developing next-generation devices that address the needs and challenges of our society. In this regard, research on innovative materials that combine reliable functionality with the potential for designing new fabrication methods (or simplifying existing ones) provides a strong foundation for creating disruptive technologies with applications across diverse fields. In this seminar, we will explore several examples of this approach, focusing on polymeric precursors used for the preparation and processing of conjugated polymers and as sacrificial materials in 3D microfabrication via two-photon lithography.

In the first part, I will introduce our work on highly-processable polymeric precursors for synthesizing conjugated polymers with in-chain redox-active moieties.[1] Due to their flexible structure and the presence of sacrificial solubilizing chains, these precursors enable the production of high-molecular-weight materials that can be efficiently converted to their fully conjugated, non-processable counterparts through rapid and selective reactions. Remarkably, these precursors are designed to yield, from a single compound, two different conjugated polymers with distinct electronic behaviors and complementary transport properties. We have used this approach to fabricate OFETs, electrochromic surfaces, and supercapacitor plates.

In the second part, we will focus on two-photon lithography (2PL), a powerful technique for 3D additive manufacturing at the (sub-)microscale.[2] With its high resolution and small feature size (down to hundreds of nanometers), 2PL is an invaluable tool for creating complex microstructures and patterned surfaces. I will present examples of how functional materials can be combined with 2PL and other fabrication techniques to develop new strategies that expand the possibilities for creating MEMS and functional microdevices.

References

[1] M. Carlotti, T. Losi, F. De Boni, F.M. Vivaldi, E. Araya-Hermosilla, M. Prato, A. Pucci, M. Caironi, V. Mattoli, *Polymer Chemistry*, **2023**, doi: 10.1039/D3PY00868A
[2] M. Carlotti, V. Mattoli, *Small*, **2019**, doi: 10.1002/smll.201902687