INV4

Flexible, stretchable and healable bioelectronics

Fabio Cicoira
Department of Chemical Engineering, Polytechnique Montreal, Montreal, Canada
Fabio.cicoira@polymtl.ca

Organic electronics, based on semiconducting and conducting polymers, have been extensively investigated in the past decades and have found commercial applications in lighting panels, smartphone and TV screens using OLEDs (organic light emitting diodes). Many other applications are foreseen to reach the commercial maturity in future in areas such as transistors, sensors and photovoltaics. Organic electronic materials, apart from consumer electronics, are playing a central role in a myriad of novel applications that are becoming ubiquitous in our society, such as artificial muscles, electronic skin, prosthetics, smart textiles, rollable/foldable displays and biomimetics. Progress in these fields comes after decades of intense research and development in materials science and engineering, which have resulted in materials combining properties that are often mutually exclusive. For instance, materials showing high flexibility/stretchability, self-healing electronic/ionic conductivity, enhanced optoelectronic performance are now a reality. Another flourishing field is that of organic bioelectronics, where devices such as conducting polymer electrodes are used for recording and stimulating neural, muscular and nerve activity. In such applications, organic polymers are very attractive candidates due to their distinct properties of ionic/electronic conduction, which leads to a lower impedance at the electrode/tissue interface, oxide-free interfaces, tunable mechanical properties, which allow films to be deposited on irregular surfaces and tunable surface chemistry, which permits to promote or hinder the adhesion of biomolecules. These features can be particularly useful for enhancing the performance and the biocompatibility of implantable electrodes and other biomedical or wearable devices. My talk will deal with processing and characterization of conducting polymer films and hydrogels and devices for flexible, stretchable and healable electronics as well as for implantable electrodes. I will particularly focus on micro-patterning of conducting polymer films for flexible and stretchable devices, on processing strategies to fabricate stretchable and self-healing conductors, on the fabrication and characterization, in vitro and in vivo, of electrodes for deep brain stimulation, electromyography and electrocardiogram .[1-9]

References

[1] Y. Li, X. Zhou, B. Sarkar, N. Gagnon-Lafrenais, and F. Cicoira, *Adv. Mater.* 2108932, 2022.

[2] Y. Li, X. Li, S. Zhang, L. Liu, N. Hamad, S. R. Bobbara, D. Pasini, F. Cicoira, *Adv. Funct. Mater.*, 30, 2002853, 2020.

[3] Y. Li, X. Li, R. N. Unnava Venkata, S. Zhang, F. Cicoira, *Flexible and Printed Electronics* 4, 044004, 2019.

[4] N. Rossetti, P. Luthra, J. Hagler, A. H. J. Lee, C. Bodart, X. Li, G. Ducharme et al., *ACS Appl. Bio Mater.* 2, 5154-5163, 2019.

[5] C. Bodart, N. Rossetti, S. Schougaard, F. Amzica, F. Cicoira et al., *ACS Appl. Mater. Interfaces*, 11, 17226-17233, 2019.

[6] S. Zhang, Y. Li, G. Tomasello, M. Anthonisen, X. Li, M. Mazzeo, A. Genco, P. Grutter, F. Cicoira, *Adv. Electron. Mater*, 1900191, 2019.

[7] S. Zhang, F. Cicoira, Adv. Mater. 29, 1703098, 2017.

[8] X. Zhou, A. Rajeev, A. Subramanian, Y. Li, N. Rossetti, G. Natale, G. A. Lodygensky, and F. Cicoira, *Acta Biomaterialia*, 139, 296-306, 2022.