UNIVERSITÀ
DEGLI STUDI
DI MILANO

CIMaINa
Centro Interdisciplinare Materiali
e Interfacce Nanostrutturati

Friday 18th October 2024, 14:30
Aula Polvani, Dipartimento di Fisica "Aldo Pontremoli"
Università degli Studi di Milano, Via Celoria, 16 – 20133 Milano

Materials for Green Electronics: Challenges, Opportunities, and Applications in Robotics and Green Electronics

Pietro Cataldi
Marie Curie Individual Fellow, Smart Materials, Italian Institute of Technology, Genova, Italy.

Commercially available materials for electronics offer excellent performance at affordable prices. However, these materials primarily consist of long-lasting, petroleum-derived components. Furthermore, their development has been within the framework of a linear economy (produce-use-waste), neglecting considerations of biodegradability, circularity, and end-of-life management. The sustainability of these materials is compromised by issues such as scarcity, human and environmental toxicity, and challenges in recycling. Therefore, it is crucial to prioritize developing materials for electronics that are biobased, biodegradable, and environmentally friendly. In this tutorial, we will summarize the available sustainable alternatives to traditionally employed materials for electronics. We will briefly survey the employment of biopolymers and proteins as biodegradable, flexible, and lightweight insulators and the unconventional strategies developed to produce environmentally friendly semiconductors.[1,2] The tutorial's core will be on green printed circuit board alternatives to flame retardant four (FR4) and electrical conductors, particularly electrically conductive composites. We will summarize the use of green approaches to fabricate electronic materials that can degrade partially or fully in the environment. We will discuss strategies to make compostable FR4[3] and degradable electronic conductors.[4] Finally, possible applications that will thrive by exploiting environmentally friendly materials for electronics, e.g., in the context of edible electronics or robotics, will be considered.[5]

References:
1. a) Juan J. et al., *Adv. Funct Mater. 2017*, **27**, 1604163. b) Tran, H. et al. ACS Cent. Sci. 2019, **5**, 1884.
2. a) Boutry, C.M. et al. *Nat. Biomed. Eng.* 2019, 3, 47. b) Boutry, C.M. et al. *Nat. Electron*. 2018, **1**, 314. Baumgartmer M. et al., *Nat. Mat.* 2020, **19**, 1102.
3. Honarbari H. et al., ACS Appl Electron Mater, **5,** 5050-5060.
4. a) Cataldi P. et al., *Adv. Funct Mater.* 2020, **30**, 1907301. b) Cataldi et al., ACS Sustainable Chem. Eng. 2019, 7, 12544.
5. a) Cataldi P. et al., *Adv. Funct Mater.* 2022, **32**, 2113417. b) Spallanzani et al., Adv Sustain Syst, 2023, **7**, 2300220.

Contacts:
Prof. Paolo Milani, Dr. Lorenzo Migliorini
CIMaINa website: cimaina.fisica.unimi.it emails: paolo.milani@mi.infn.it, lorenzo.migliorini@unimi.it