Consiglio Nazionale delle Ricerche
Istituto dei Materiali per l'Elettronica ed il Magnetismo

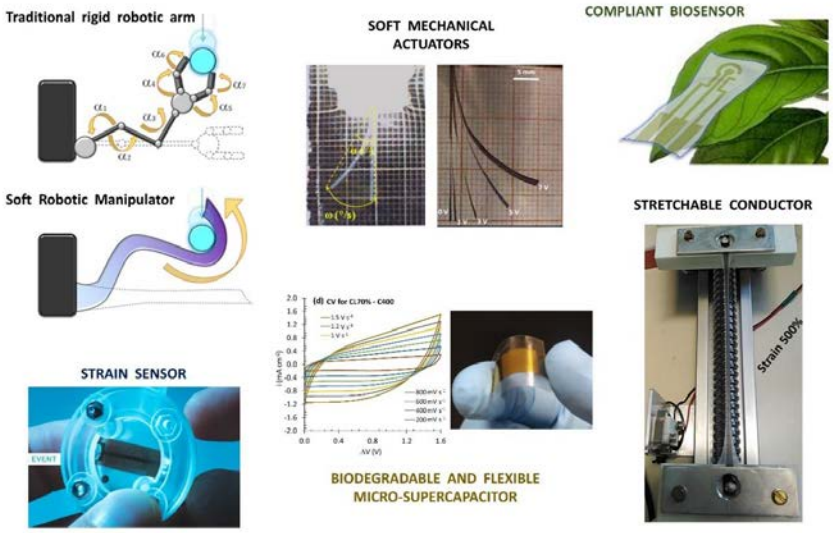
SEMINARIO

Sala A, I° Piano, CNR-IMEM, Parma | 28 novembre 2023 | ore 12:30

Functional (nano)composite materials for soft robotics and electronics

Dr. Lorenzo Migliorini

Università degli Studi di Milano



Soft robotics and electronics take inspiration from living beings, which are constituted by soft biological tissues able to change their shape and dimensions to adapt to the surrounding environment. Being based on polymeric soft materials, in place of traditional metallic and rigid ones, soft robots and devices can efficiently adhere to 3D surfaces and structures, dissipate forces, safely interact with living beings and fragile objects, adapt to unknown and rapidly changing environments. Moreover, by the efficient integration of soft polymers with both electronic and ionic conductors, robots and devices can also display "active" and functional properties such as mechanical actuation, signal delivering and computing, energy harvesting and storage, sensing, communication. Here, I want to present the development of several classes of functional (nano)composite materials, obtained in the labs of CIMaINa by following the aforementioned approach. Different polymeric materials have been employed, such as acrylic polymers, cellulose derivatives, bioplastics and silicones. Ionic conductivity has been provided by blending with aqueous electrolytes and ionic liquids. Electronic conduction, instead, has been obtained by the deposition/implantation of conductive metallic nanoparticles, thanks to the employment of supersonic cluster beam deposition (SCBD) technique. Underwater and in-air mechanical actuators, supercapacitors, piezoelectric harvesters, stretchable conductors and strain sensors are some of the functional (nano)composite materials developed and hereby reported.

[1] Santaniello, Tommaso, et al. "Supersonic cluster beam fabrication of metal–ionogel nanocomposites for soft robotics." Journal of Nanoparticle Research 20.9 (2018): 1-19.
[2] Migliorini, Lorenzo, et al. "Low-voltage electrically driven homeostatic hydrogel-based actuators for underwater soft robotics." Sensors and Actuators B: Chemical 228 (2016): 758-766.
[3] Migliorini, Lorenzo, et al. "Bioplastic electromechanical actuators based on biodegradable poly (3-hydroxybutyrate) and cluster-assembled gold electrodes." Sensors and Actuators B: Chemical 286 (2019): 230-236.
[4] Migliorini, Lorenzo, et al. "All-Printed Green Micro-Supercapacitors Based on a Natural-derived Ionic Liquid for Flexible Transient Electronics." Advanced Functional Materials 31.27 (2021): 2102180.
[5] Migliorini, Lorenzo. "Development of functional nanocomposite materials towards biodegradable soft robotics and flexible electronics." (2020).
[6] Migliorini, Lorenzo, et. al. "Super-Stretchable Resistive Strain Sensor Based on Ecoflex–Gold Nanocomposites." ACS Applied Nano Materials 6, no. 10 (2023): 8999-9007.