In-situ electromechanical testing of stretchable metal/polymer interconnects.

Pasquale Vena

Politecnico di Milano Department of Chemistry, Materials and Chemical Engineering, Giulio Natta, Italy

The development of wearable sensing medical devices requires to move traditional electronic or electrochemical systems from rigid substrates to flexible, wearable, polymeric materials and tissue.
This is a possible thanks to the development of deformable electronics, which can realize wearable electronic devices by means new fabrication techniques and design strategies. Flexible and stretchable electronics refers to electronic devices that can be bent and stretched to large deformation without losing the functionality, opening a new perspective in many engineering fields. These techniques generally rely on polymeric substrates which are typically Polyethylene terephthalate (PET), Polyimide (PI) and Polydimethylsiloxane (PDMS). The deformability of these materials opened new application perspectives, starting from paper-like displays and then extending to the general paradigm of electronic devices, which can establish conformal contact with curvilinear surfaces. The two important parameters that must be regarded are high deformability and low and constant electrical resistance upon deformation.
In this work different designs of metal interconnects on a PI substrate are investigated in terms of mechanical performance and electrical conductivity. To this purpose mechanical tests with in-situ laser confocal scanning and electro-mechanical measures are performed on the samples. Different meander geometries of a 1micron thick aluminum coating on the PI substrates are taken into consideration. The in-situ testing with confocal laser scanning has the purpose to identify the role of the meander geometry on the adhesion of the metal layer on the substrate; while the electromechanical tests aimed at identifying the role of the geometrical feature of the meanders with the evolution of electrical resistance during the uniaxial deformation process.
The in-situ tests have clearly indicated that one specific design parameter plays a relevant role in promoting delamination of the meanders from the substrates; the electromechanical tests allowed to identify the geometry featuring the most stable resistance-strain experimental relationship.