Imperceptible Plastic Sensor Foils for Soft Electronics and Machines

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Electronics of tomorrow will be imperceptible and will form a seamless link between soft, living beings and the digital world. This new form of ultra-conformable electronics places severe physical requirements on the active components that constitute modern foil-like electronic systems. Weight and flexibility become key figures of merit for large area electronics such as robotic skin, as they critically influence the mechanical response and perception of the artificial sensory system. With less than 2 µm total thickness, imperceptible electronic foils are light (≈3-4 g m^{-2}) and unmatched in flexibility, they are operable with radii of curvature below 5 µm, yet highly durable and withstand severe crumpling without any performance degradation. These are prerequisites for intimate contact with soft, biological tissue or organs and complex, arbitrarily shaped 3D free forms that enable applications spanning medical, safety, security, infrastructure, and communication industries.

This talk introduces a technology platform for the development of large-area, ultrathin and lightweight electronic and photonic devices, including organic solar cells, light emitting diodes, active-matrix touch panels, implantable organic electronics, imperceptible electronic wraps and “sixth-sense” magnetoception in electronic skins. These large area sensor networks build the framework for electronic foils and artificial sensor skins that are not only highly flexible but become highly stretchable and deployable when combined with engineered soft substrates such as elastomers, shape memory polymers or tissue-like hydrogels. Applications of such sensor foils in soft robotics and in soft machines allow sensing a wide range of stimuli and will be discussed in detail.