PROSPECT: PatteRned cOatings based on 2D materials benzoxazine reSin hybrids for broad range Pressure detECTion

Main area: Sensors from GRMs and their heterostructures
Keywords: benzoxazine, resins, Graphene, pressure sensors, molecular design, photoresists, thermoresists
Duration: 36 months

Abstract

The development of pressure sensors and, in particular, of electronic skin, is fundamental to the interfacing between human bodies and the outside world, namely in prosthetics and biomedical applications. To mimic the tactile sensing properties of natural skin, one should develop large arrays of pixels, each one acting as an independent pressure detector supported on a ?exible and stretchable substrate. PROSPECT targets an innovative generation of patterned coatings based on benzoxazine thermo- and photo-resist matrices incorporating electrically conductive 2D layers for wide-range pressure sensing applications. Guided by theoretical modelling, we will design and synthesize novel benzoxazine monomers equipped with functional groups that will both serve as reticulation nodes and as centres for the (non-)covalent anchoring of electrically active (Reduced) Graphene Oxide, (R)GO, flakes. The hybrid structures will comprise (R)GO flakes well dispersed in the monomer matrix. The heat- or light-triggered reticulation of the monomers in presence of the 2D fillers will yield resins whose thermomechanical properties can be tuned by controlling the degree and rate of conversion through the curing temperature or the light exposure duration and power. Spatial confinement in the degree of reticulation achieved by laser irradiation will allow for broad-span pressure detection gratings, with each spatial domain selectively sensitive to a specific range of external pressures. As transducing signal, we will monitor the pressure-induced changes in electrical current through the (R)GO-loaded films that originate from modifications in the distances between the conducting flakes within the hybrid structure. The large versatility in the chemical structure of the monomers, but also in the nature and concentration of (R)GO fillers, offers the possibility to engineer functionalized resins close to the electrical percolation limit so as to ensure large electrical response to external pressure, thereby paving the way to highly sensitive pressure sensors. PROSPECT aims at fabricating sensors that can accurately measure pressures both in the medium-pressure regime (10–100 kPa) suitable for object manipulation and in the low-pressure regimes (<10 kPa) typical of gentle touch. The targeted devices, which will operate at low voltage for low-power consumption and will be amenable to large-scale fabrication process, provide an appealing solution for technological applications in wearable health-monitoring as Point-of-Care, multimotion detection robotics, and the Internet of (Every)Things.

Consortium

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