Graphene Biocomposites for Flexible and Sustainable Electronics

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Emergent green conductive materials are pivotal to reduce harmful and long-lasting electronic waste [1, 2]. At the same time, the electronics industry has demand to transform rigid devices into soft, wearable and conformable structures [2-3]. A first achievement towards flexible and sustainable electronics would be blending biomaterials and conductive nanoparticles to produce electronic components. Following such an approach, we have realized conformable resistors, capacitors and inductors using a fibrous structural protein as a "polymer" matrix for graphene nanoplatelets (GnPs). Furthermore, we have obtained flexible conductors (sheet resistance ≈ 10 Ω/sq) by functionalizing cellulose with bio-based conductive inks made by mixing GnPs with biopolymers and/or natural proteins. These conductive biocomposites were exploited in foldable circuits, passive electrical components (such as filters), organic photovoltaic devices, EMI shielding films, portable antennas, electrodiagnostic sensors and supercapacitors, as shown in Figure 1 [2, 4, 5]. The success of conformable and sustainable conductors will simplify the fabrication of easily disposable devices with a low environmental footprint and, simultaneously, support the transition towards flexible electronics.

References

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Figures

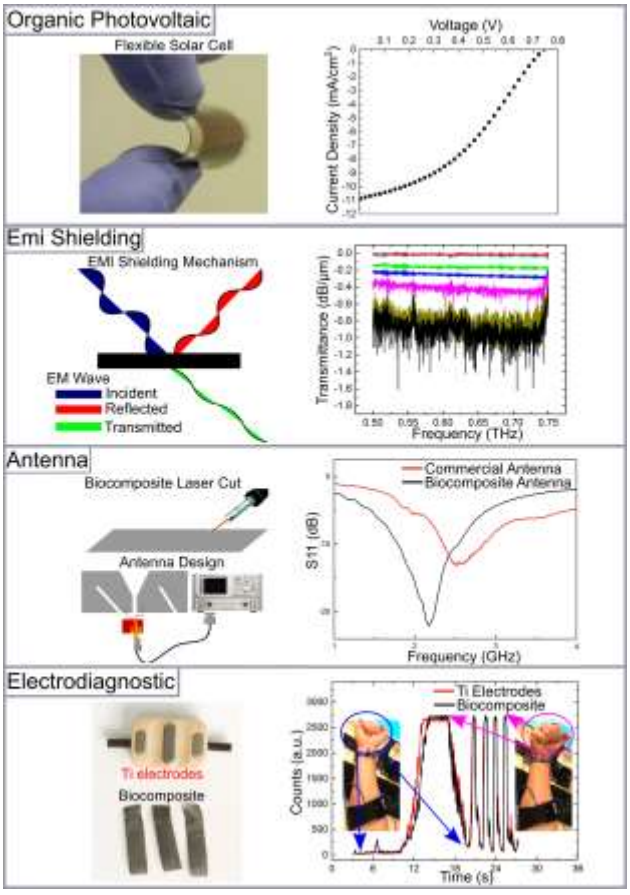

Figure 1: Examples of applications developed with ours sustainable and flexible conductors graphene-based. From the top: a flexible organic solar cell with a conductive GnPs-biocomposite as top electrode and the associated I-V features, the EMI shielding characteristics of films of GnPs-cellulose materials, the fabrication and operation of a flexible antenna protein-GnPs-based, and the performances of electromyography electrodes realized with all-cellulosic-GnPs materials.