Chemical tailoring of 2D materials for opto-electronics, energy and sensing

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The already exceptional properties of 2D materials can be further tuned, enriched and leveraged by interfacing them with ad hoc molecules, by mastering principle of supramolecular chemistry. By taking full advantage of the almost unlimited variety of molecules that can be designed and synthesized with functionalities at will, one can engineer 2D materials exhibiting dynamic physical and chemical properties, by imparting them novel functions, with the ultimate goal of generating multifunctional hybrid systems for applications in (opto)electronics, sensing and energy.
In my lecture, I will review our recent findings on the covalent and non-covalent functionalization of layered materials to engineer artificial responsive hetero-structures as well as functional foams and coatings which can operate as selective chemical sensors for ions and polar molecules. Finally, I will describe how the same approaches can be exploited to fabricate highly sensitive pressure sensors (Fig. 1) which can monitor heartbeats, thus holding great potential for their integration in medical diagnostic devices or sport apparatus.
Our approaches provide a glimpse on the chemist's toolbox to generate multifunctional 2D materials-based nanocomposites with ad-hoc properties to address key global challenges in electronics, sensing and energy applications.

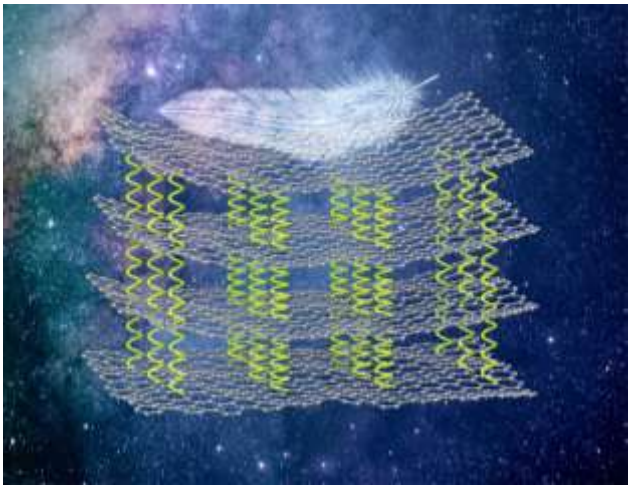

Figure 1: Architecture of the active component in the pressure sensor based on a foam of alternating conducting rGO and molecular springs with controlled compressibility.

Figures