Chemical functionalization of graphene to achieve 2D-3D hybrid architectures for energy and environmental applications

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2D nanosheets like graphene or its derivatives can be processed, functionalised and then re-assembled together to create new layered composites with useful applications. One of the peculiar properties of 2-dimensional materials (2DM) is their high aspect ratio, with a thickness of few angstroms and a lateral size that can span hundreds of microns. When two nanosheets are stacked together, the space between them forms a 2D-confined environment which can capture, transport or store small molecules and ions.
Here, we will give an overview of novel layered composites with original structure that we produced recently, with useful applications in the sectors of energy storage using lithium and sodium, in sensing and in water/gas purification. Some example of possible applications are:

- **Graphene-organic composites for sodium-ion batteries.**
- **Graphene-polymer composites for selective ion and gas sieving.**
- **Graphene oxide electrodes for brain cell electrical stimulation.**
- **2D-3D nanocomposites for AI-powered chemical sensors.**

The materials we describe, besides showing in all cases good performance versus state-of-the-art, demonstrate also the high maturity and versatility reached by the processing of 2D materials into bulk applications, beyond the random mixtures typically used in composites.

References

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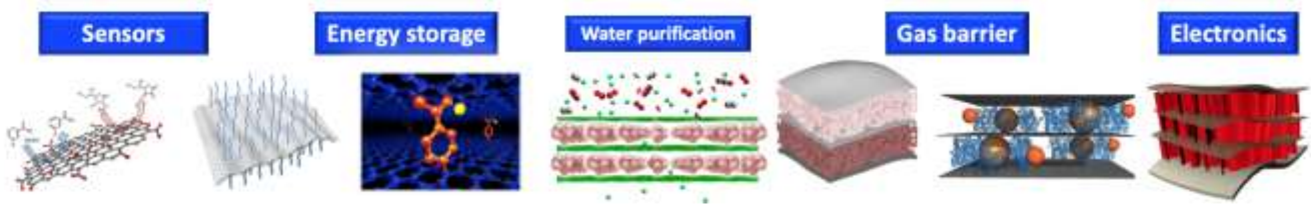

Figure 1: Examples of applications of 2D-3D hybrid architectures, taken from the cited references.