Bioactive graphene-hydrogel composites

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Hydrogels are 3D-polymeric networks able to hold large amounts of water. Hydrogels are versatile nanocarrier matrices that can be modulated to tune their porosity, surface roughness, functional groups and the overall micro/nanostructure (cross linking, copolymer…). They are currently used in many areas including hygienic (e.g., disposable diapers), biomedical (e.g., tissue engineering and regenerative medicine, drug delivery, stem cell culture and cell therapy), agricultural (e.g., water reserving in soil, soil conditioning and controlled release of agrochemicals), pharmaceutical dosage forms, biotechnological (e.g. separation technology, enzymatic supports), biosensing (e.g. soft actuators/valves, electrical), environmental (e.g. sludge/coal dewatering, water remediation), etc [1].

There is currently intensive research devoted to upgrade or modulate the properties of hydrogels by incorporation of different nanoadditives and in particular graphene derivatives, mostly the highly functionalized graphene oxide (GO). The use of GO as building block or cross linker in the polymer matrix imparts the hydrogel with enhanced mechanical, rheological, electrical, thermal and optical properties [2]. These improved and tailored properties have enabled the investigation of graphene-hydrogel composites for multiple applications such as light-driven smart actuators antibacterial coatings, controlled drug release or cell culture systems, among others [3].

In this communication we will present recent progress carried out at IK4-CIDETEC on the development, characterization and applications of graphene-based PEG hydrogel composites. In particular, we will present a versatile synthetic method to incorporate in the PEG hydrogel the three main graphene derivatives, namely GO, reduced graphene oxide (RGO) and few-layer graphene (FLG), Figure 1. The mechanical, rheological, optical, thermal and cytotoxic properties of the three types of graphene-PEG hybrid hydrogels will be presented. Finally, we will illustrate the potential of the graphene-hydrogel composites for applications of environmental and biomedical relevance such as pollutant removal and radical scavenging.

Figure 1 (from left to right): Photographs of bare hydrogel and hybrid hydrogels with GO, RGO and FLG (1 % wt.)

References

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