Multifunctional nanostructured composite aerogels from a molecular-free gelation process

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Inorganic nanocrystals (INCs) have been already exploited as building blocks to produce nanostructured gels and aerogels. However, the poor mechanical stability of the gels, the use of advance surface functionalization for gelation and the limitations to perform multicomponent gels are still unaddressed issues. Graphene based gels partially overcome those limitations showing outstanding mechanical and chemical stability, but still gelation processes require for molecular ligands at mild conditions and gels' functionalities are rather limited. Here, we report on a molecular-free gelation process to synthesize reduced GO-INCs (rGO-INCs) nanostructured composite aerogels. Different to what has been so far reported, INCs (e.g. Fe_2O_3, CeO_2, In_2S_3, ZnS and Au) are directly exploited as the gelation agent to produce rGO-INCs aerogel composites while adding functionalities to the graphene porous structure. Through a suitable functionalization of INCs, hydrogels are formed by mixing them together with GO nanosheets in an aqueous solution at mild conditions. After drying under supercritical CO_2 conditions, aerogels with high surface area and functional properties (magnetic, photo catalytic, etc) are produced. The final high porous nanostructured composite consists of a rGO structure, that act as an scaffold providing stiffens and electric conductivity, interconnected through INCs that act as the binding agent. Our approach is rather flexible and robust providing large aerogels (in this particular work aerogels havin volumes up to 10 mL) with multiple functionalities. The latter are achieved by mixing more than one type of INCs together with GO nanosheets. As a result, binary, ternary and quaternary multifunctional aerogels showing magnetic, plasmonic, luminescent and photocatalytic properties can be produced. This approach opens a newway to produce multifunctional porous platforms with high mechanical properties and tailored functionalities for sensing, water purification or energy storage applications.

References

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Figures

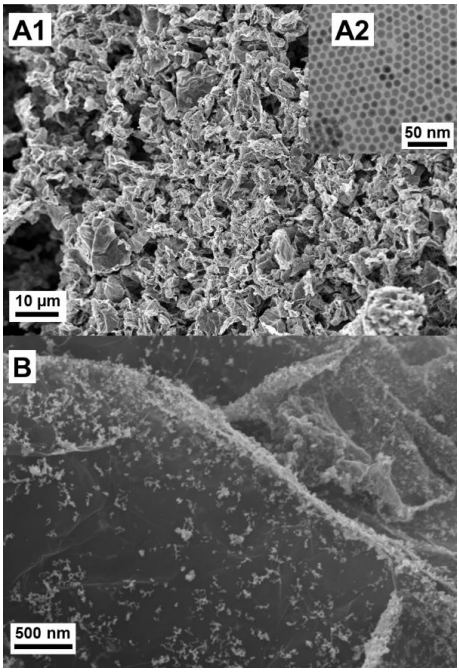

Figure 1: Structural characterization of graphene based (GO-Fe2O3) nanocomposite aerogels.