Graphene-based cement-composite

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Abstract

Nowadays, concrete is a broadly exploited material worldwide, with consumption exceeding thirty billion tons per year and with continued demand growth.[1] The cement production processes have a significant impact on the environment due to considerable CO_2 emissions (*i.e.* 900 kg for every 1000 kg of cement). [2] To solve this environmental problem is necessary to diminish the cement degradation over time, resulting in a reduction of the demand, and thus a reduction in CO_2 emissions. The use of nano additives (*e.g.,* SiO_2 or $CaCO_3$ nanoparticles) can aid to increase the durability of cement conglomerates.[3] Moreover, nanoparticles can improve additional properties or functions of the cement composites, *e.g.*, self-sensing properties, photocatalytic or electrothermal [4], thus transforming the traditional concrete into a so-called "smart concrete". Graphene stands out among the wide variety of carbon-based nano additives that could revolutionise the cement composites sector. Nevertheless, the production at a large scale of graphene is still a bottleneck, preventing the commercialisation of the desired smart concretes. [5,6]
In this regard, we used the high-pressure homogenisers (HPH) for the production of multi-layer and few-layers graphene at semi-industrial rates, *i.e.* kg per day (**Fig 1a**).[7] The high production rate of graphene offered by HPHs enables us for testing innovative graphene-based cement composites (**Fig 1b**). The few-layer graphene-based mortars produced shown an improvement of ~25% for both the flexural and compressive strength compared to a standard cement mortar.

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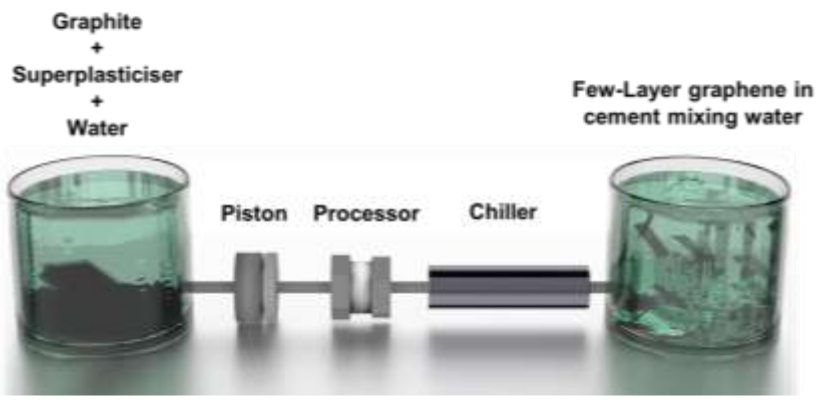
FIGURES

a) 

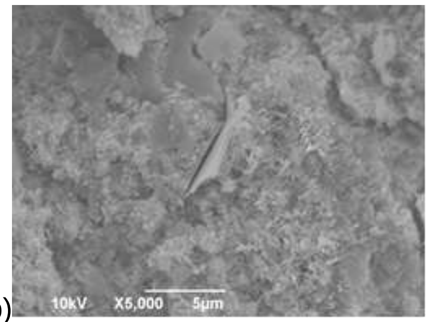
b) 

Figure 1: Schematic representation of the production process of FLG using the WJM (a); SEM Image of a graphene flake in the mortar microstructure (b).