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Multifunctional graphene-based magnetic nanocarriers optimized with copolymer Pluronic F127 for biomedical applications

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The limitations of current cancer therapies prompt the urgent need for a more effective therapeutic strategy [1]. Graphene-based magnetic nanoparticles (GbMNPs) due to their unique properties, such as high chemical and thermal stability, high charge carrier mobility, large surface area for functionalization and superparamagnetic properties, have the potentiality to be used as efficient multifunctional nanocarrier systems [2]. However, one of the challenges of GbMNPs in biomedical applications is their tendency for agglomeration or precipitation in electrolyte solutions, such as those of body fluids [3]. To overcome this drawback, the developed GbMNPs were grafted with copolymer Pluronic F127 (PF127), yielding the materials denoted as GbMNPs@PF127.
PF127 is a water-soluble and biocompatible triblock copolymer (PEO_{100}-PPO_{65}-PEO_{100}) approved by the U.S. Food and Drug Administration (FDA) for use as food additive and in pharmaceutical formulations [4]. This grafting strategy allows the incorporation of a hydrophilic corona that reduces the aggregation of nanoparticles and the adsorption of blood proteins [4, 5]. Also, increases the biocompatibility of the nanosystems and its colloidal stability, prolonging blood circulation [5].
In this study, GbMNPs@PF127 were covalently conjugated with Doxorubicin (DOX), a highly effective chemotherapeutic drug against a broad spectrum of cancers. The developed therapeutic nanosystems were characterized and investigated to be used as multifunctional nanocarriers to combine thermo-chemotherapy, revealing exceptional features, such as: (i) high loading of the chemotherapeutic drug DOX; (ii) high pH stimuli-responsive controlled release; (iii) high heating efficiency profile under AMF with thermo-responsive drug release; as well as (iv) good haem- and biocompatibility even at high concentrations.
The presented strategy and findings can represent a new way to design and synthesize highly stable graphene-based materials with novel structures for synergetic thermo-chemotherapy triggered by the abnormal cell microenvironment for a more effective treatment of cancer.

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