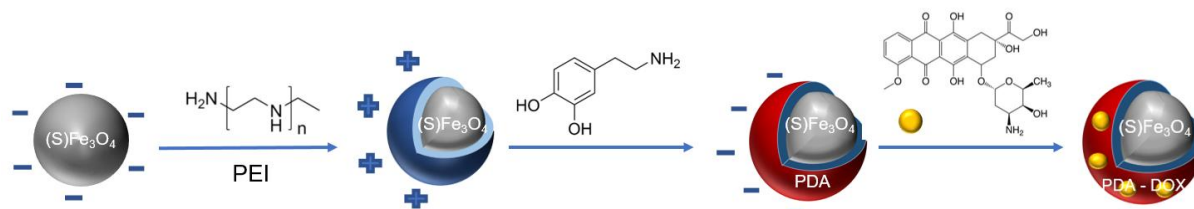


PDA coated Magnetic nanoparticles as potential theranostic platform for targeted therapy.

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Polydopamine (PDA), a mussel-inspired polymer formed by oxidative self-polymerization of dopamine under mildly alkaline conditions, has emerged as one of the most versatile surface coatings for biomedical applications. Owing to its excellent biocompatibility, strong adhesive properties, and rich surface chemistry, PDA has been extensively employed in drug delivery, bioimaging, and photothermal therapy. In parallel, magnetic iron oxide nanoparticles (Fe_3O_4), particularly those exhibiting superparamagnetic behavior, have attracted considerable attention as drug carriers and magnetic resonance imaging (MRI) contrast agents due to their magnetic responsiveness and low toxicity. In the present work, ferromagnetic and superparamagnetic Fe_3O_4 nanoparticles were synthesized by two distinct co-precipitation methods and subsequently modified with polyethyleneimine (PEI) to facilitate coating with PDA. The PDA shell, deposited by oxidative polymerization of dopamine in Tris buffer (pH 8.0), served as a multifunctional platform for immobilization of doxorubicin (DOX), polyethylene glycol (PEG), and a redox-active disulfide nitroxide radical linker (DiSS). Successful surface functionalization was confirmed by Fourier-transform infrared spectroscopy (FTIR), elemental analysis and inductively coupled plasma mass spectrometry (ICP-MS).



In vitro release studies at pH 5.2 and 7.4 demonstrated enhanced DOX release under acidic conditions, while PEGylated systems exhibited the most efficient release profiles. The hybrid nanostructures are expected to function as dual T_1/T_2 MRI contrast agents owing to the combination of superparamagnetic Fe_3O_4 cores and paramagnetic nitroxide radicals. Cytotoxicity studies in MDA-MB-231 human breast cancer cells showed that all nanoparticle formulations displayed higher anticancer efficacy than free doxorubicin hydrochloride with the same dose. The Fe_3O_4 -PDA-DOX-PEG system showed the highest therapeutic performance. These results demonstrate that PDA-coated magnetic nanoparticles are promising theranostic platforms for targeted cancer therapy and imaging.

Literature:

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