Doxorubicin Loaded Magnetic Polymersomes:
Theranostic Nanocarriers for MR Imaging and Magneto-Chemotherapy

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Hydrophobically modified maghemite (γ-Fe2O3) nanoparticles were encapsulated within the membrane of poly(trimethylene carbonate)-*b*-poly(L-glutamic acid) (PTMC-*b*-PGA) block copolymer vesicles using a nanoprecipitation process. This formation method gives a simple access to highly magnetic nanoparticles (MNPs) (loaded up to 70 wt %) together with a good control over the vesicles size (100 to 400 nm). The simultaneous loading of maghemite nanoparticles and doxorubicin was also achieved by nanoprecipitation. The deformation of the vesicle membrane under an applied magnetic field has been evidenced by small angle neutron scattering. These superparamagnetic hybrid self-assemblies display enhanced contrast properties that open potential applications for Magnetic Resonance Imaging. They can also be guided in a magnetic field gradient. The feasibility of controlled drug release by radio-frequency magnetic hyperthermia was demonstrated in the case of encapsulated doxorubicin molecules, showing the viability of the concept of magneto-chemotherapy. These magnetic polymersomes can be used as efficient multifunctional nano-carriers for combined therapy and imaging.

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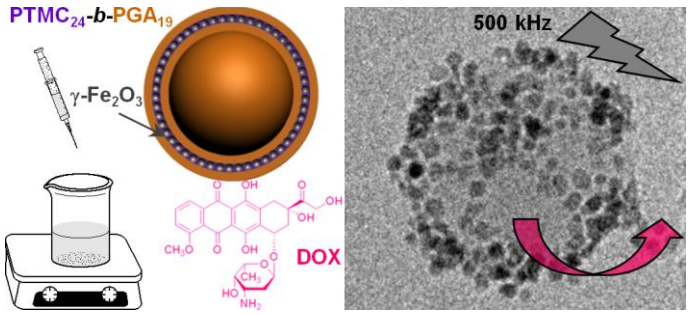
Figures



Left: Sketch of dually-loaded vesicles prepared by addition of an aqueous buffer into a mixture of PTMC-b-PGA copolymer, hydrophobically coated magnetic nanoparticles and doxorucin drug.
Right: Cryo-TEM image of vesicle showing the dense mantle of MNPs, which excitation by a radiofrequency magnetic field transmits heat locally to membrane and accelerates the DOX release.