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Biomimetic Synthesis of Magnetosomes for Biomedical Application

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Extended Abstract

Micro/nano- vesicles (solution encapsulated liposomes or polymersomes) are currently utilised in many applications and potential applications, such as delivery of drugs in medicine.(Abra, Bankert et al. 2002, Ren, Liu et al. 2012) In medicine, vesicles are used to encapsulate drugs, and release them at specific locations in response to a specific stimuli by engineering of the vesicle membrane.(Ganta, Devalapally et al. 2008) This means that lower doses of drugs are required significantly improving the treatment efficiency whilst reducing the magnitude and severity of any side effects. Currently, medical researchers are developing therapies which can simultaneously diagnose and treat a wide range of diseases, termed theranostic agents.(Santhosh and Ulrih 2013, Svenson 2013) Our research, is focussed on the development of magnetic vesicles for use as theranostic agents. We are combining the diagnostic capability of magnetic nanoparticles (MNPs), currently used in MRI scanning with their theraputic capability as seen in magnetic hyperthermia to treat tumours.(Pankhurst, Connolly et al. 2003, Pankhurst, Thanh et al. 2009) Biocompatibility is achieved by precipitation within vesicle, currently used as drug delivery agents.

Magnetospirillum magneticum AMB-*1* synthesise magnetosomes, which are internally formed vesicles containing a single biomineralised MNP. The magnetosome lipid membrane supports an array of magnetic bacteria specific proteins that allow the formation of uniformly sized and shaped magnetosome MNPs.(Tanaka, Mazuyama et al. 2011) To be suitable for medical use, both vesicles and MNPs must be of a consistent size and shape, to ensure consistent properties and predictable behaviour during application. The formation of our proposed theranostic agent takes inspiration from magnetic bacteria to create artifical magnetosome-like theranostic magnetic nanovesicles *in situ* under mild reaction conditions, which has been sucessfully achieved. MNPs in our system are precipitated within the vesicle membrane, and appear responsive in intial MRI and hyperthermia testing. The benefit of MNP precipitation within the vesicle membrane is that the core is free for encapsulation of hyrdrophillic drugs for delivery controlled by application of a magnetic field. Work is now focussed on the incorporation of biomineralisation and membrane iron-transport proteins from the magnetic bacteria into our vesicles to further control the MNPs size and shapes within the nanovesicles and thus tune the magnetic properties.

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