Towards the development of dual-responsive composites for simultaneous hyperthermia and chemotherapy

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Abstract

There is an urgent need to develop more effective therapies to fight cancer. Nanotechnology-based approaches are a possible route to perturb tumour's biology and deliver therapies. Hyperthermia is an emergent therapeutical strategy as tumour cells are more susceptible than "normal" cells to rises in temperature. One of the biggest challenges in hyperthermia is the induction of local heating in deep tumours, being magnetic nanoparticles a potential route to achieve this goal. Previously, we incorporated iron oxide nanoparticles (Fe_3O_4-NP) with thermo-responsive polymers for simultaneous hyperthermia and *in situ* delivery of chemotherapeutic drugs (Doxorubicin) [1]. We are now applying this approach to a novel cationic thermo-responsive copolymer, AEtMA-Cl/DEAEA (1:3 ratio), possesses excellent properties suitable for long-term cell culture [2,3]. Here, we aim to produce nanocomposites of AEtMA-Cl/DEAEA containing Fe_3O_4-NP for combinatory chemotherapy and hyperthermia. To produce fibrous composite, we have successful obtained poly-AEtMA-Cl (PAEtMA-Cl) by RAFT and making fibres using electrospinning. PAEtMA-Cl was successfully electrospun together with poly(ethene glycol) (PEO) as observed by atomic force and optical microscopy. By electrospinning, we obtained PAEtMA-Cl fibres that ranged (1-9 μm) diameter. As predicted, PAEtMA-Cl/PEO nanofibers are soluble in water. In order to use PAEtMA-Cl/PEO for cell culture, we are investigating different crosslinking strategies – covalent and ionic. Preliminary data shows that multivalent anions such as sodium tripolyphosphate (TPP) leads to the formation of porous networks of PAEtMA-Cl in aqueous solutions (Fig. 1), so we will use it to crosslink nanofibres. In addition, we observed that TPP can be used to form soft microgels, which may in future provide a novel material for drug delivery applications. In summary, we have demonstrated that PAEtMA-Cl can be electrospun and processed as microgels. This will allow us to produce a novel dual-responsive magnetic nanocomposite for cancer applications.

REFERENCES

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FIGURES

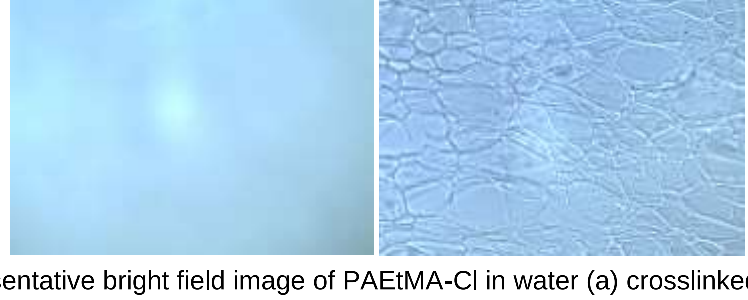

Figure 1: Representative bright field image of PAEtMA-Cl in water (a) crosslinked with TPP (b). Total Magnification = 400x.