Acknowledgements

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Co-assembly of CdTe quantum dots and magnetic nanoparticles in imprinted matrices for magnetic separation and specific recognition of endocrine disrupting chemicals

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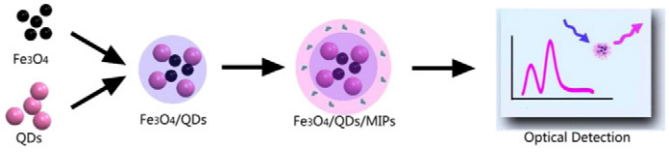
Semiconductor nanocrystals, or quantum dots (QDs), with semiconducting and size-tunable optical properties, are very attractive for use in molecular and cellular imaging, optoelectronic devices, and biosensors and bioelectronics [1]. However, one of the major drawbacks of using QDs is the nonspecific binding to cellular membranes, proteins, and complex materials. The issue of nonspecific binding causes a high level of background fluorescence that limits tagging specificity and detection sensitivity, which will be a major barrier towards the widespread use of QDs.

In this work, based on our previous work [2], we developed a general protocol for the fabrication of an imprinted matrix co-loaded with CdTe QDs and Fe_3O_4 nanoparticles for the recognition of p-nitrophenol, which is a widely used endocrine disrupting chemical (EDCs) (Scheme 1). The as-synthesized beads exhibited spherical shape (average size: 732 nm), high fluorescence intensity and superparamagnetic properties ($Ms = 1.72$ emu g^{-1}). The hybrids bind the original template p-nitrophenol with an appreciable selectivity over structurally related compounds. This advancement of magnetic fluorescent imprinting technologies may lead to exciting developments in various fields, including environmental pollutants and biochemical detection, recognition elements in biosensors and biochips.



Scheme 1. Synthesis route of magnetic fluorescent molecularly imprinted polymer beads and their application for recognition of EDCs.

Keywords: Molecularly imprinted polymer, Quantum dots, Magnetic nanoparticles, Optical detection

Acknowledgements

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Fabrication and *in vivo* test of P(LLA-CL) tubular grafts loaded with heparin

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Ideal vascular grafts should have both desirable biocompatibility and suitable mechanical properties. Despite the application of man-made polymers (Dacron, PTFE, *etc.*) in large-diameter (≥6 mm) vascular grafts, small-diameter grafts are rarely used clinically, mainly due to the acute thrombogenicity. Numerous efforts have been dedicated to tackle the problem, among them heparin loading has emerged as one of the most intensively studied antithrombotic strategies. However, the *in vivo* performance of such vascular grafts remains to be testified. In this study, we proved that the sustained release of heparin could greatly enhance the patency rate of vascular grafts in a canine model.

Heparin-loaded poly(l-Lactide-co-ε-Caprolactone) (P(LLA-CL)) tubular grafts were fabricated through coaxial electrospinning. For comparison, scaffolds from pure P(LLA-CL) solution were also electrospun as control. The *in vitro* release of heparin was measured before implantation. A bilateral implant model of dog ($n = 4$) femoral arteries was applied. After three months of implantation, digital subtraction angiography (DSA) was performed to visualize the patency of the implanted scaffolds.

As shown in Fig.1a, the heparin-loaded grafts, having an inner diameter of 4 mm and a wall thickness of 0.5 mm, were composed of core–shell structured nanofibers. The core part of the fiber was heparin, while P(LLA-CL) was selected as the shell for its superior flexibility and biocompatibility [1]. In the aqueous solution, the release of heparin was found to experience two stages: the initial burst release at day 1 and the continuous release from day 2 to day 14 (Fig.1b). The total amount of released heparin was approximately 72% after 14 days. Fig.1c showed the typical DSA image of the blood inflow into the arteries. As illustrated by the red circles, blood flow was blocked when passing through the P(LLA-CL) graft, yet was able to pass through the heparin-loaded graft smoothly. Based on the DSA results, patency rates at scheduled time points were summarized. P(LLA-CL) grafts showed a poor patency rate from the very

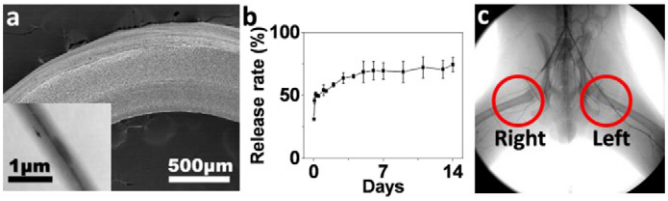

Fig. 1. a) SEM of the cross-sectional view of a heparin-loaded graft and TEM image of a single nanofiber; b) in vitro release profile of heparin from the heparin-loaded P(LLA-CL) nanofibers; c) representative DSA inspection of the implanted grafts after 3 months: the left femoral artery was replaced by heparin-loaded graft and the right one was replaced by P(LLA-CL) graft.

beginning, as only 1 of the 4 arteries remained unblocked at week one and the number dropped to 0 three months later. In comparison, heparin-loaded grafts had a 100% patency at week two and a 75% patency after three months of implantation.

By using a canine femoral artery grafting model, we demonstrated that the release of heparin loading could significantly enhance the *in vivo* patency rates of electrospun P(LLA-CL) small-diameter grafts.

Keywords: Electrospinning, Vascular grafts, Heparin, Nanofibers, Patency rate

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One-step generation of covered porous PLGA microspheres for controlled delivery and regenerative medicine

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The development of systems of controlled release plays a critical role in the area of tissue engineering. To achieve optimized delivery of cell differentiated factors or growth factors, proper delivery systems which have both an appropriate drug loading efficiency and delivery period is in great need. Poly (lactic-co-glycolic acid) (PLGA) is a synthesized copolymer and also one of the most popular materials for tissue engineering applications owing to its excellent biodegradability and biocompatibility. Moreover, PLGA has shown appealing properties for encapsulating a variety of therapeutic compounds and the release can be well manipulated [1].

Here, we report a one-step route to generate dexamethasone (Dex)-laden covered-porous PLGA microspheres for the osteogenic commitment of mesenchymal stem cells (MSCs). The covered-porous PLGA was synthesized using a single emulsion method. PLGA and starch (with the size of 10–60 μm) were stirred in methylene chloride until the PLGA was completely dissolved; the covered pores were formed during the emulsion in water by the dissolution of starch into the aqueous phase. The images of scanning electron microscopy (SEM) and light microscopy revealed that the achieved PLGA microspheres have sizes of 100–300 μm and clearly observed covered pores (Fig. 1). The osteogenic differentiated factor-Dex was loaded into the microspheres and the release profile exhibits an exponential release tendency without significant initial burst release. Afterwards, MSCs were seeded onto the microspheres, after 14 days of culture, MSCs on the microspheres exhibited strong osteogenic markers such as ALP and osteocalcin. Taken together, covered porous PLGA microspheres with excellent drug delivery properties, controlled degradability, high biocompatibility is a potential candidate for tissue regeneration applications.

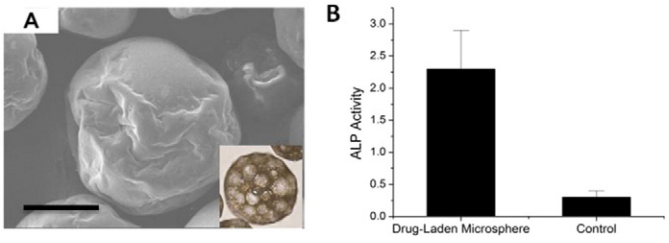

Fig. 1. The SEM and light microscopy images of covered PLGA microspheres and the expression of the osteogenic marker of MSCs on Dex-laden microspheres and non-drug-laden microspheres (control). (Scale bars: 100 μm.)

Keywords: PLGA, Microspheres, Porous, Drug delivery, Tissue regeneration

Acknowledgements
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Release behavior of a composite of silk fibroin and nano-Ag and its biocompatibility

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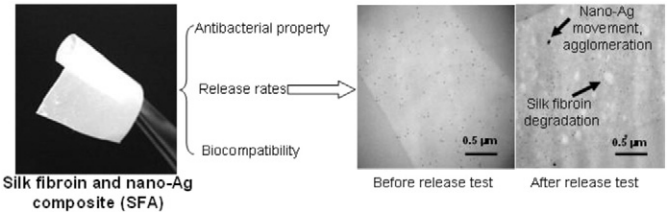
Silk fibroin has good application prospects in the field of drug delivery [1], wound dressing, and tissue engineering [2] because of its biocompatibility, biodegradability and other excellent properties. Silver nanoparticles (nano-Ag) can be used as a safe, highly effective and broad-spectrum antibacterial agent. The clinical success of the biomaterial requires the development of safe and efficient antibacterial properties. So a composite of silk fibroin and nano-Ag (SFA) was generated by incorporating nano-Ag particles into porous silk fibroin materials (Scheme 1) [3].

The generated SFA was used as a wound dressing in our research, so it was radiation sterilized with Co60-γ rays at an effective dose of 10 kGy for further use. Release tests were carried out by soaking SFA in PBS buffer for 10 days to determine the release rates of nano-Ag and silk fibroin from SFA. Bactericidal tests were carried out to determine the antibacterial properties of SFA and a rabbit model was used to evaluate the biocompatibility of SFA in wound healing.

Data indicated that nano-Ag promoted the degradation of silk fibroin, which led to an increased release rate of nano-Ag from SFA. SFA exhibited a remarkable antibacterial activity. Within 24 h, the bacteriostasis rate was 100% with regard to *Staphylococcus aureus, Pseudomonas aeruginosa* and *Escherichia coli*. In wound healing, SFA showed great biocompatibility and caused less inflammatory cells compared to the clinically used porcine acellular dermal matrix. Our results indicated that the addition of nano-Ag can help to regulate the degradation of silk fibroin and SFA might be a potential candidate for clinical wound healing.



Scheme 1. The concentrations of nano-Ag in SFA and the release rates of silk fibroin from SFA are positively correlated. SFA exhibited remarkable antibacterial activity and great biocompatibility in a wound healing assay.