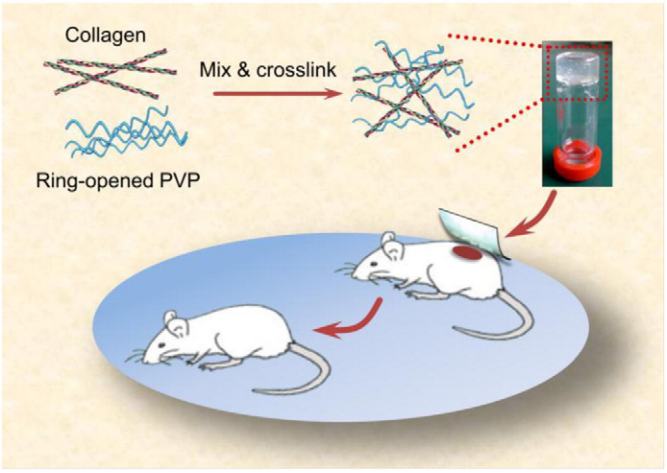
Type I collagen is a widely used biomaterial in clinical skin or tissue repairing due to its natural source, good water-solubility, excellent biocompatibility, suitability for cell adhesion and growth [1]. Since the exciting discovery that collagen and polyvinyl pyrrolidone (PVP) hybrid based solutions and hydrogels exhibit favorable anti-inflammatory properties, these systems attract many research interests [2]. However, the anti-inflammatory characteristics are unsustainable with the degradation of collagen.

To address the problem, we attempted to cross-link collagen with ring opened PVP to form interpenetrating polymer network (IPN) hydrogels (Scheme 1). The cross-linked hybrid hydrogel exhibited the desired long-term anti-inflammatory properties and non-significant stimulation in a mice model. The hydrogel could maintain a long period of moist environment over the wound bed for enhancing re-epithelialization. Furthermore, the hydrogels had a controllable mechanical strength by adjusting the ring-opening ratio of PVP and cross-linking degree of the hydrogel. The hydrogel is highly promising in clinical wound repairing and tissue regeneration.



Scheme 1. Collagen–polyvinyl pyrrolidone hybrid based hydrogel that exhibits good biocompatible and excellent wound repair behavior with anti-inflammatory properties in a mice model.

Keywords: collagen, polyvinyl pyrrolidone, hydrogel, anti-inflammatory, wound repair

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Synthesis and characterization of biodegradable poly(ester-urethane)urea for nerve tissue engineering

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Recently, the interest in using biodegradable polyurethanes for biomedical applications has been continuously increasing. Several series of degradable polyurethanes have been developed for applications including cardiac tissue engineering, orthopedic repair, controlled drug and gene delivery [1–3], etc. However, few studies have been done on developing biodegradable polyurethanes for nerve tissue engineering.

In this study we report the synthesis of a novel biodegradable poly(ester-urethane)urea (PEUU) using poly(ε-caprolactone) diol (PCL2000), l-lysine diisocyanate (LDI) and chain extender (hexanediamine). The synthetic route for the PEUU is shown in Fig. 1A. The physicochemical properties of PEUU were characterized by ^{1}H NMR, Fourier transform infrared spectroscopy (FT-IR) and differential scanning calorimetry (DSC). Furthermore, to mimic the native ECM, PEUU nanofibrous scaffolds were fabricated by electrospinning using 1,1,1,3,3,3-hexafluoro-2-propanol (HFIP) as solvent [Fig. 1B]. As a control, PCL (Mw = 80 kDa) was also electrospun into nanofibrous scaffolds. The water contact angle of PEUU was 114.07°, which was lower than that of PCL (128.97°). Measurement of the mechanical properties of PEUU nanofibrous scaffolds revealed that they had an elongation at break of 161.50% and a tensile strength of 24.09Mpa [Fig. 1C]. In contrast, PCL had a lower elongation at break (54.30%) and a poor tensile strength (3.80Mpa). MTT assays using Schwann cells demonstrated that PEUU had superior biocompatibility compared with PCL. The present study suggests that this new flexible biodegradable PEUU with good mechanical properties and biocompatibility could be a good candidate for nerve tissue engineering.

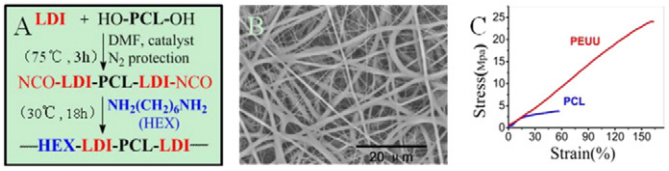

Fig. 1. (A) Synthesis route of the PEUU. (B) SEM of electrospun PEUU nanofibers. (C) Stress–strain curves of PEUU and PCL nanofibrous scaffolds.

Keywords: biodegradable polyurethane, nerve tissue engineering, electrospinning

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