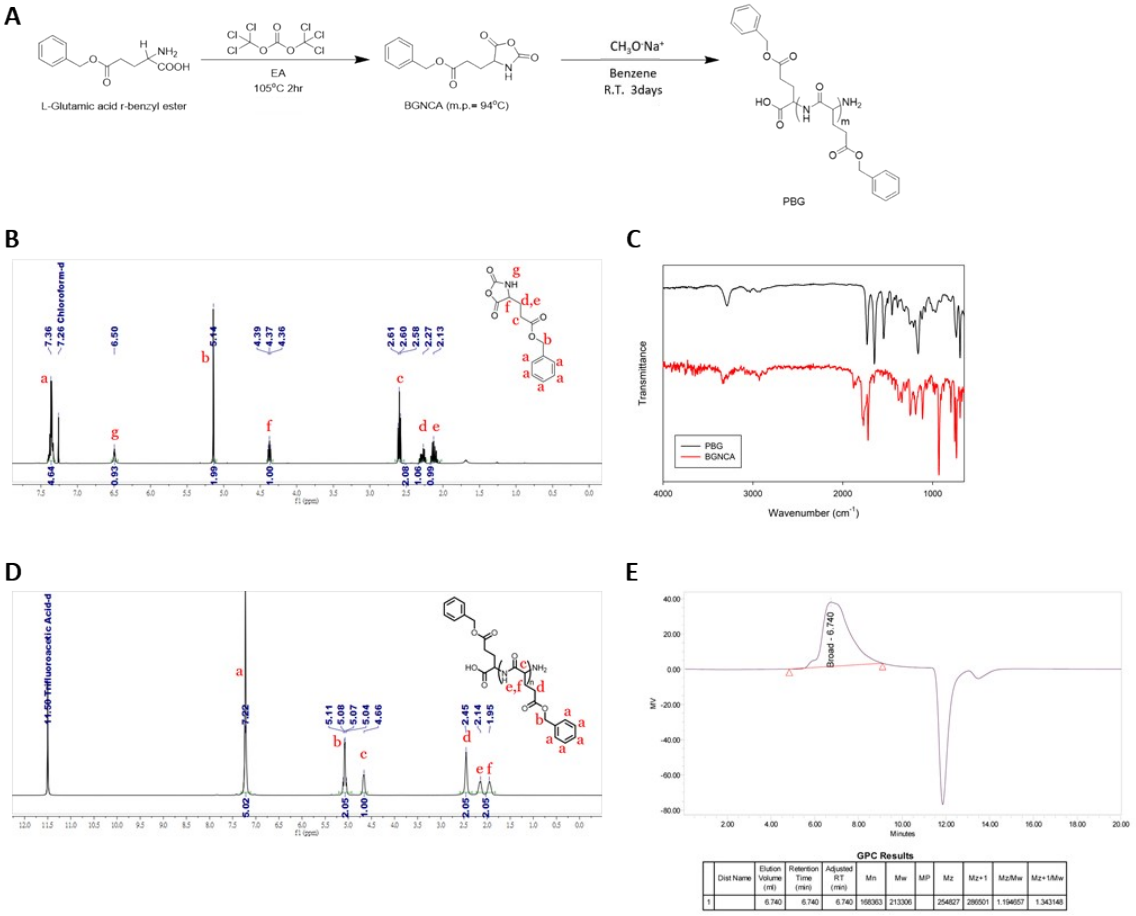
Supplementary Information

Synthesis and characterizations of poly (γ-benzyl-L-glutamate) (PBG)

The 4 g L-glutamic acid γ-benzyl ester (Sigma-Aldrich; 49510) was reacted with 2.5 g triphosgene (Sigma-Aldrich; 330752) in 120 ml anhydrous ethyl acetate (EA; Sigma-Aldrich; 270989) at 105 ℃ for 2 hours under nitrogen. After 2 hours, the product was precipitated in 2L hexane (UniRegion Bio-Tech) at -20 ℃ overnight. On the next day, the filtered product was dissolved in 250 ml EA and recrystallized in hexane at -20 ℃. The recrystallized process was repeated for five times and the γ-benzyl-L-glutamate N-carboxy anhydride (BGNCA) was vacuum-dried at 40 ℃ overnight. The synthesis reaction was shown in **Figure S1A**. The chemical structures and functional groups of BGNCA were confirmed by nuclear magnetic resonance spectroscopy (NMR; Bruker; DPX400) and Fourier transform infrared (FT-IR; Perkin Elmer; Spectrum 100). The peaks of NMR chemical shift (1H NMR, chloroform-d) of BGNCA were δ 7.36 (a; Ar-H), 6.50 (g; N-H), 5.14 (b; CH_2-benzylic), 4.37 (f; C-H), 2.60 (c; γ-CH_2), 2.27 and 2.13 (d, e; β-CH_2) (**Figure S1B**). The specific functional groups of BGNCA, the anhydride groups (1866 cm^{-1}, 1773 cm^{-1}), can be observed from the FT-IR spectrum (**Figure S1C**).

The 2 g dried BGNCA monomers were mixed with 200 ml anhydrous benzene (Sigma-Aldrich; 401765) at room temperature under nitrogen. The sodium methoxide, an initiator for the synthesis of PBG, was prepared by dissolving 50~70 mg sodium (Sigma-Aldrich; 282065) in 5 ml methanol (Macron; 15306121). The monomer solution was reacted with sodium methoxide at room temperature for 3 days under nitrogen. The ratio of initiator to monomer is 1:100. The PBG was synthesized through a ring-opening polymerization. (**Figure S1A**). After 3 days, the resulting polymer was obtained by precipitation in 1000 ml methanol and drying in a vacuum oven at 40 ℃ overnight. The peaks of NMR chemical shift (1H NMR, TFA-d) of PBG were δ 7.22 (a; Ar-H), 5.08 (b; CH_2-benzylic), 4.66 (c; C-H), 2.45 (d; γ-CH_2), 2.14 and 1.95 (e, f; β-CH_2) (**Figure S1D**). The specific functional groups of PBG, the amide groups (1653 cm^{-1}, 1547 cm^{-1}), can be observed from the FT-IR spectrum (**Figure S1C**). To determine the molecular weight of PBG, gel permeation chromatography (GPC; Breeze 2, Waters) (**Figure S1E**) was performed, and the molecular weight of PBG polymers was controlled in the range of 200~300 kDa with low molecular weight dispersity (PDI=1.1~1.3). Additionally, anionic polymerization was used to obtain predictable molecular weight and narrowed down the PDI. These standardized PBG polymers can increase chain entanglement and facilitate the electrospinning process.



	Dist Name	Elution Volume (ml)	Retention Time (min)	Adjusted RT (min)	Mn	Mw	MP	Mz	Mz+1	Mz/Mw	Mz+1/Mw
1		6.740	6.740	6.740	168363	213306		254827	286501	1.194657	1.343148

Fig. S1. (A) Schematic illustration of synthesizing BGNCA and PBG. (B) 1H NMR spectrum of BG-NCA (5-10% w/v in chloroform-d). (C) ATR-FTIR transmittance spectra of PBG and BGNCA. (D) 1H NMR spectrum of PBG (5-10% w/v in trifluoroacetic acid-d). (E) Representative gel permeation chromatography (GPC) result of PBG.

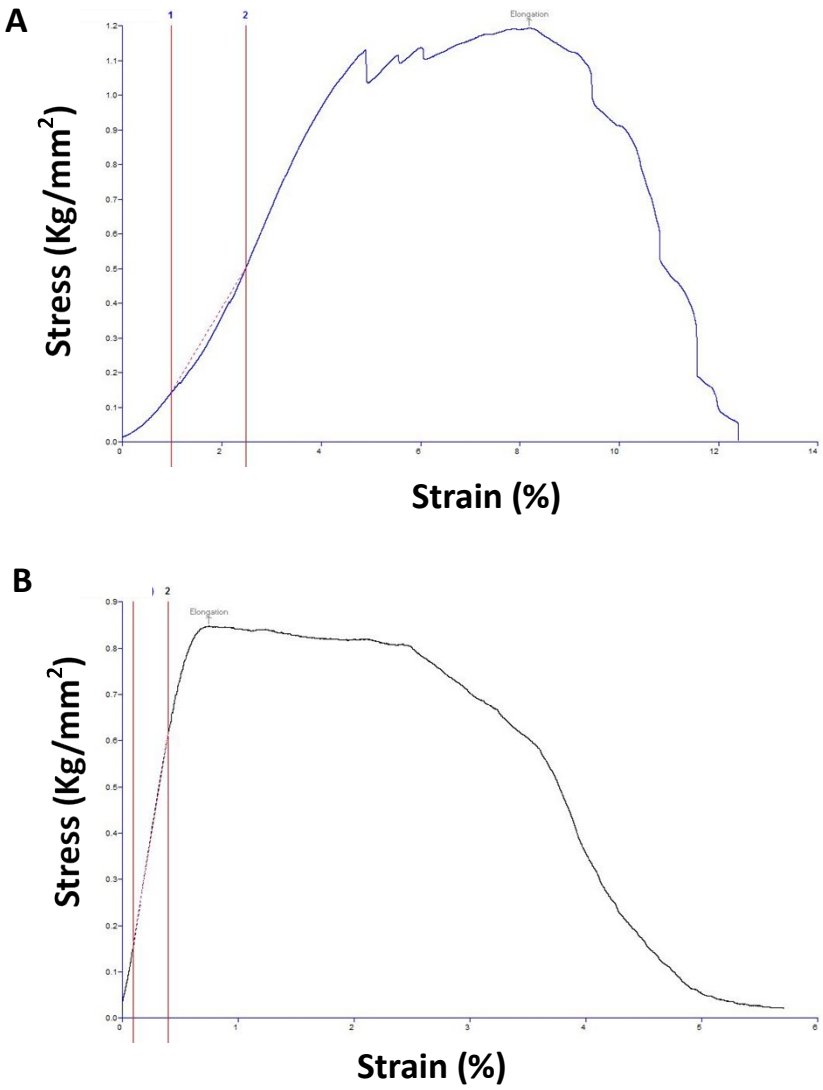


Fig. S2. The representative stress-strain curves of (A) PCL and (B) PBG fibrous scaffolds. Young's modulus of PCL: 237.4 MPa, PBG: 1486.3 MPa. Elongation of PCL: 8.2%, PBG: 0.7%.

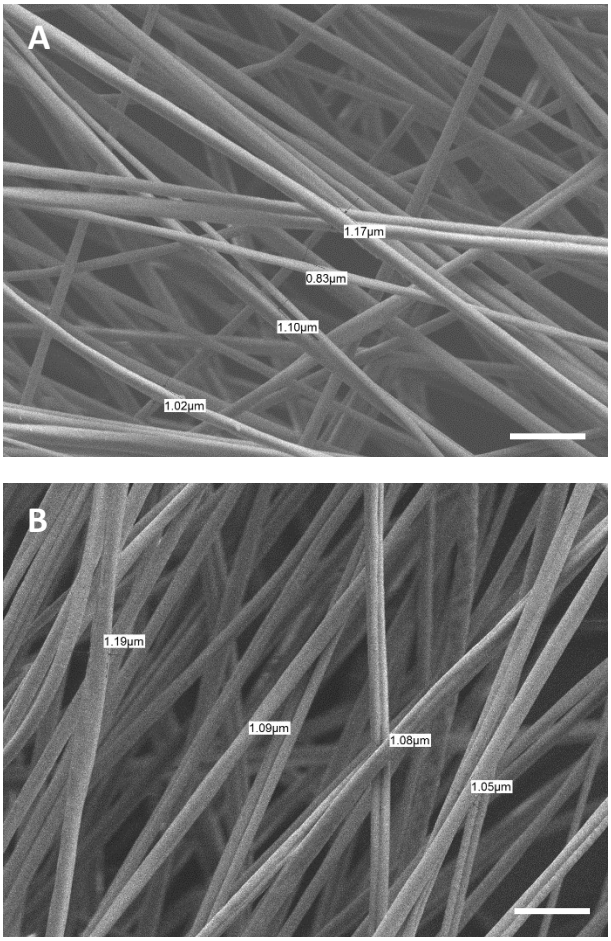


Fig. S3. The SEM images of measured fiber diameters of (A) PBG and (B) PCL fibrous scaffolds. Magnification: 3000x. Scale bar: 5 μm

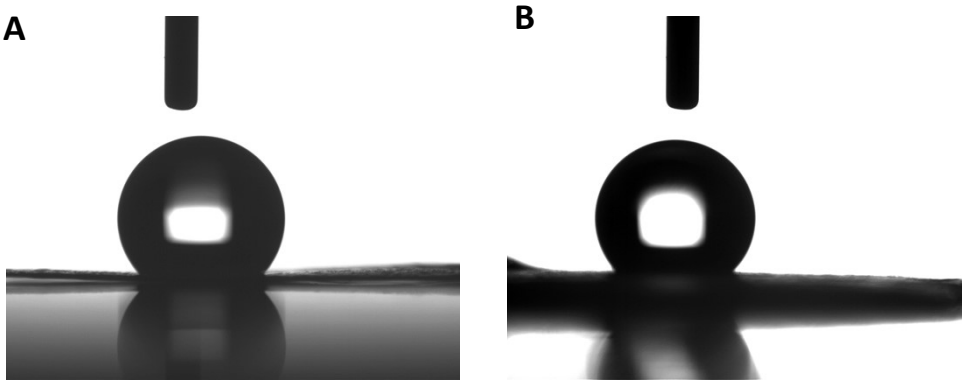


Fig. S4. The representative water contact angle images of (A) PBG and (B) PCL fibrous scaffolds.

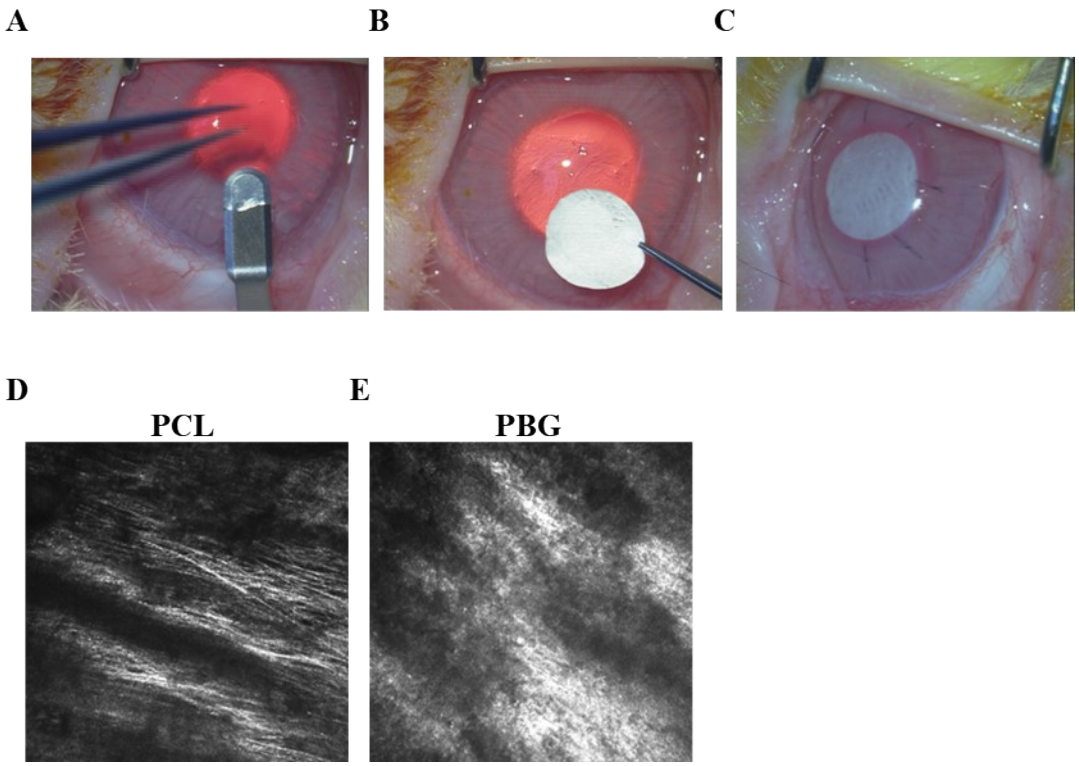


Fig. S5. The creation of an intracorneal pocket with a crescent knife and the implantation of either PCL or PBG fibrous scaffold (A-C). The in vivo confocal microscopic image of implanted PCL (D) and PBG (E) fibrous scaffolds. The electrospun fibers can be easily found.

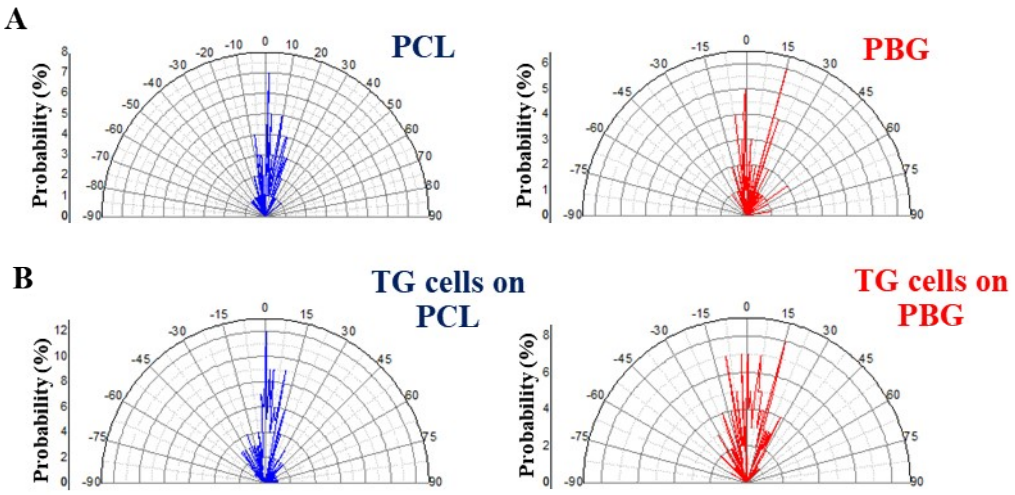


Fig. S6. (A) Diagrams of scaffold fiber orientation (left: PCL; right: PBG). The degrees of neurite alignment on PCL scaffolds: 80%; on PBG scaffolds: 80%. Fiber counts = 100~120 in each group. (B) Diagrams of TG cells orientation (left: TG cells on PCL; right: TG cells on PBG). The degree of alignment of TG cells on PCL scaffold: 73%; on PBG scaffold: 75%. Fiber counts = 100~120 in each group.

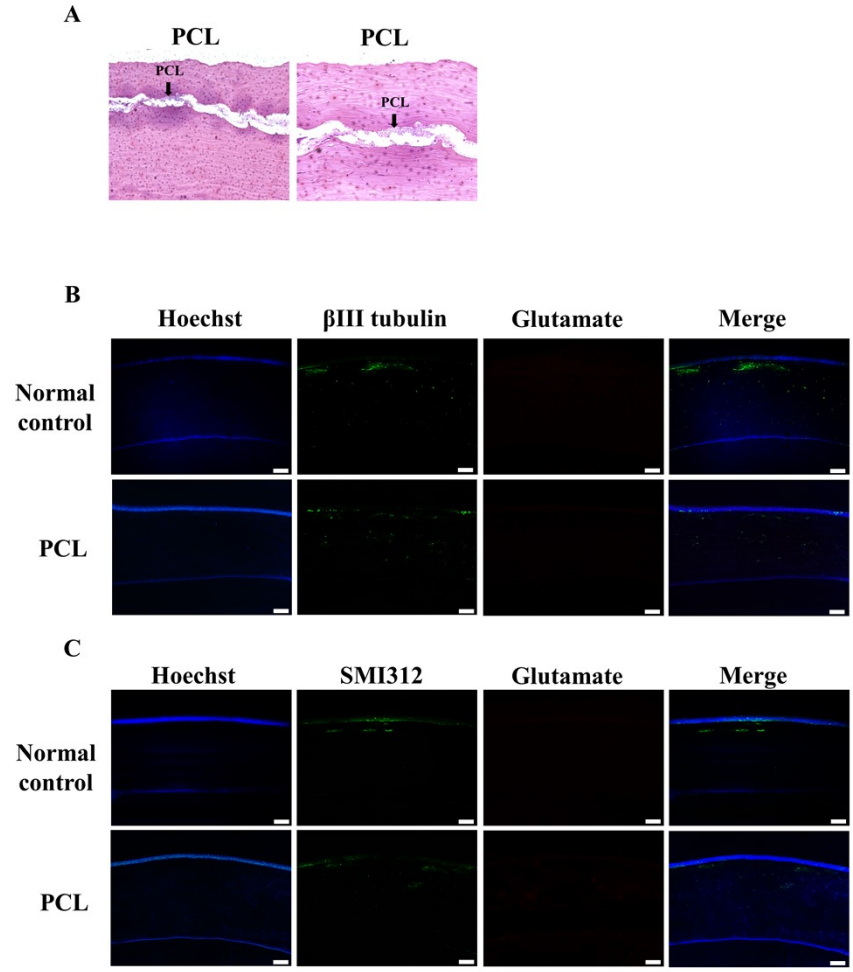


Fig. S7. (A) The histopathological examination of the left (normal) eye and the right (PCL fibrous scaffold implanted) eye after 21 days surgery. The nerve regeneration capability of the PCL fibrous scaffold was examined by neural markers (B) βIII tubulin and (C) SMI312 expression. Scale bar: 50 μm.

Table S1. Parameters of electrospinning Process

Polymer	Concentration (wt. %)	THF:DMAC (v/v)	Voltage (kV)	Flow rate (ml/hr)
PBG	20	06:04	20	5
PCL	15	01:01	15	1

Table S2. Parameters and Characteristics of Fibrous Scaffolds

Application	Polymer fiber	Electrospinning time (min)	Scaffold thickness (µm)	Scaffold density (µg/mm^3)
In Vitro	PBG	1.5	5~7	9.5±4.3
	PCL	7.5	5~7	8.3±3.2
In Vivo	PBG	30	50~70	32.8±3.4
	PCL	150	50~70	38.2±4.2

Table S3. The average/longest length and the extent of alignment of neurites of TG cells cultured on different fibrous scaffolds at 21 days.

Scaffold	Neurite length (Longest length) (µm)	Neurite alignment (%)
No	102±28 (190.16)	18
PBG	133±33 (225.26)	83
PCL	106±22 (171.05)	78