Supporting Information

Dynamic Remodeling Bio-mimic Extracellular Matrix to Reduce Thrombotic and Inflammatory Complications of Vascular Implants

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1.Synthesis routs for PBA

PBA was synthesized through the reaction of (2-hydroxy-5-methyl-1,3-phenylene) dimethanol , 4-bromomethylphenyl boronic acid pinacol ester, TBDMCl and adipic acid chloride. The synthesis pathway of PBA was shown in Figure S1. ^{1}H-NMR spectra of compound 1, compound 2, compound 3 and PBA(4) were exhibited in Figure S2. The average molecular weight (Mn) was determined to be 7.8x10^{3} Da with the polydispersity of 1.1 by GPC.

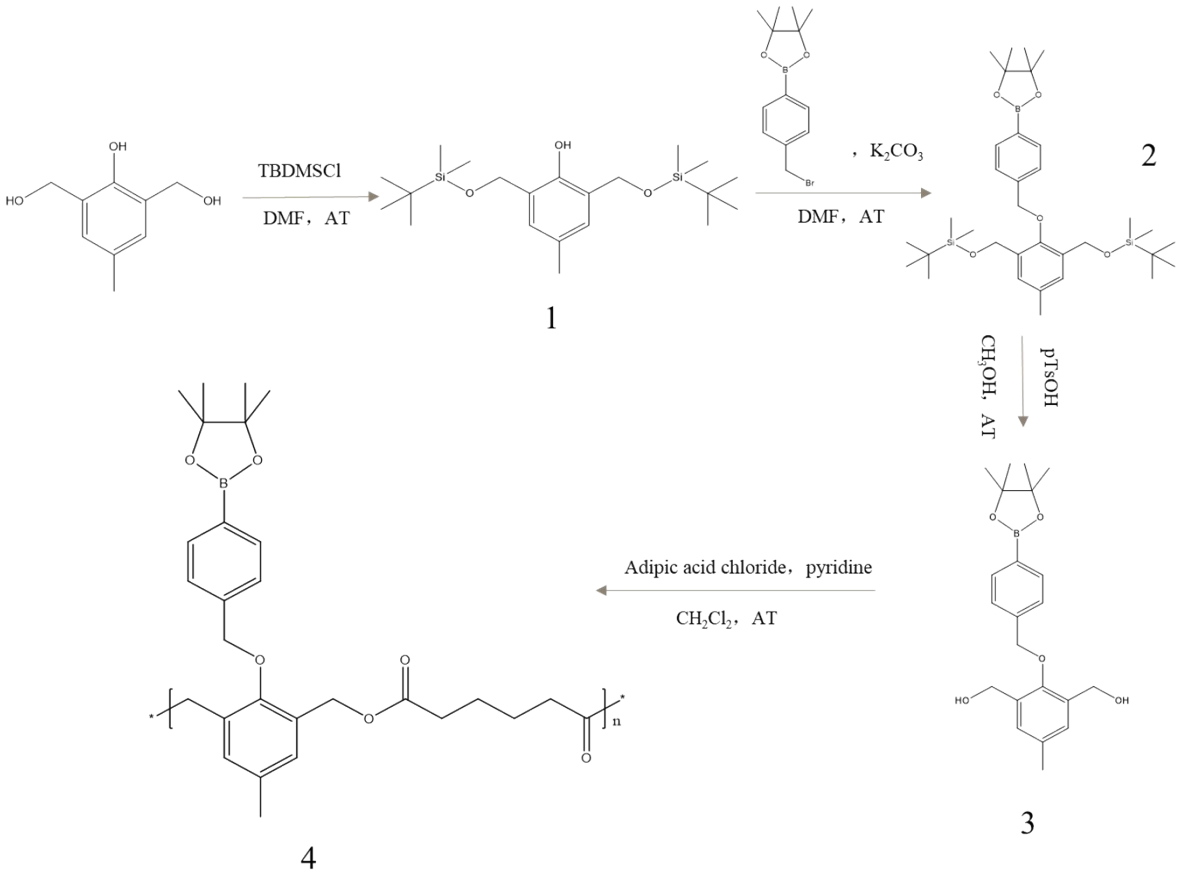

Figure S1. Synthesis pathway for PBA.

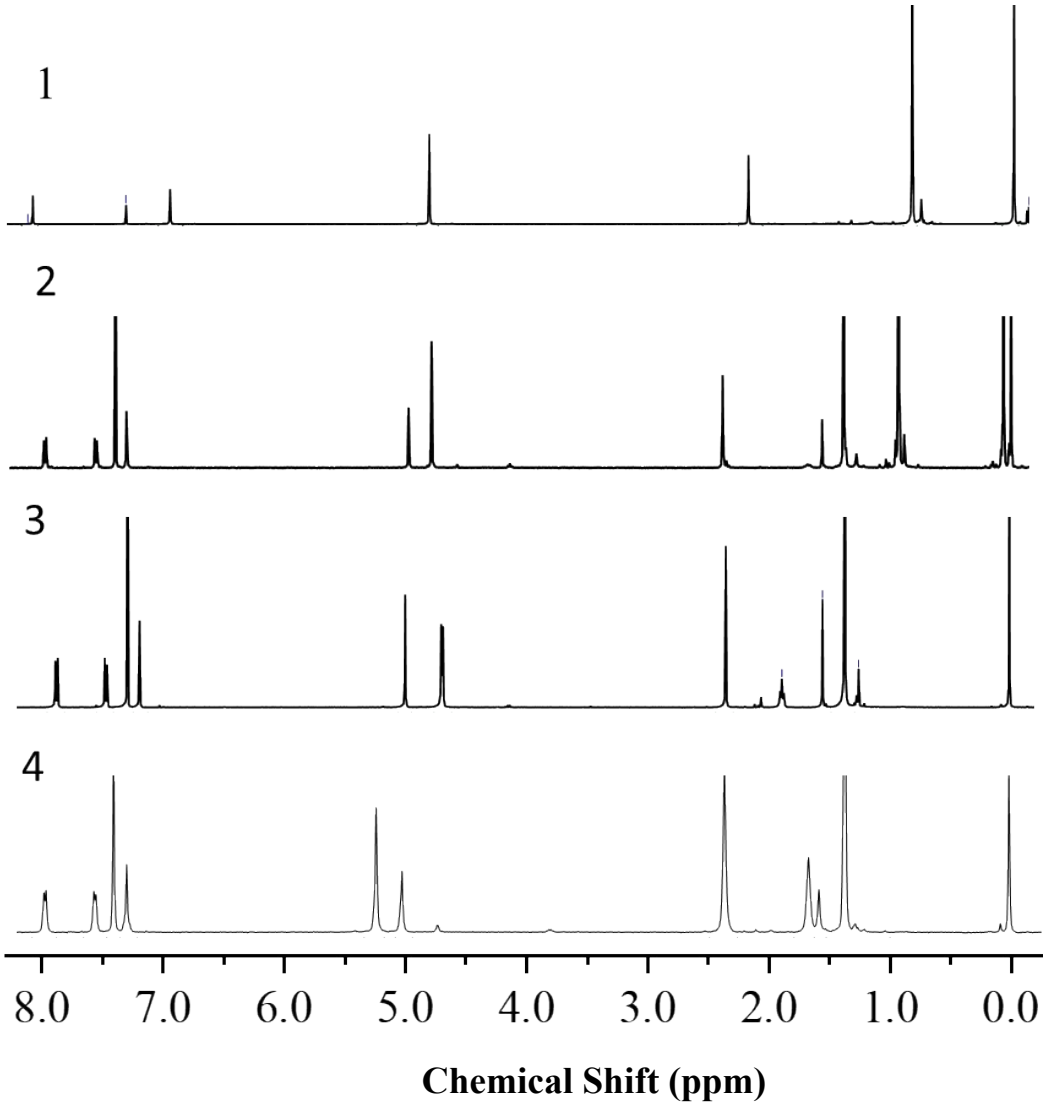

Figure S2. ^{1}H-NMR spectra of compound 1, compound 2, compound 3 and PBA (4)

2. GPC data of PCL-PEG-PCL

PCL-PEG-PCL was dissolved in THF and the molecular weight was determined by a gel permeation chromatography (WYATT technology) at room temperature using polystyrene as standards. GPC data of PCL-PEG-PCL in THF were listed in Table 1. The average molecular weight (Mw) was determined to be 1.28×10^5 Da with the polydispersity of 1.62.

Table S1. GPC data of PCL-PEG-PCL in THF

M_n(Daltons)	M_w (Daltons)	M_P(Daltons)	Polydispersity
74104	128169	98669	1.621269
M_z(Daltons)	**M_{z+1}(Daltons)**	**M_z/M_w**	**M_{z+1}/M_w**
207796	304912	1.729585	2.378990

3. Au-heparin nanoparticles characterization

Au-heparin nanoparticles were characterized by Infrared spectrum and XPS. The date was shown at Figure S3. The appearance of the typical peaks of CO-NH in FTIR spectra at about 1550cm^{-1} confirm the successful synthesis of thiol heparin(Figure S3A). And the typical peaks of Au4f in XPS of the full elements Au-heparin nanoparticles indicated the successful synthesis of Au-heparin nanoparticles(Figure S3B).

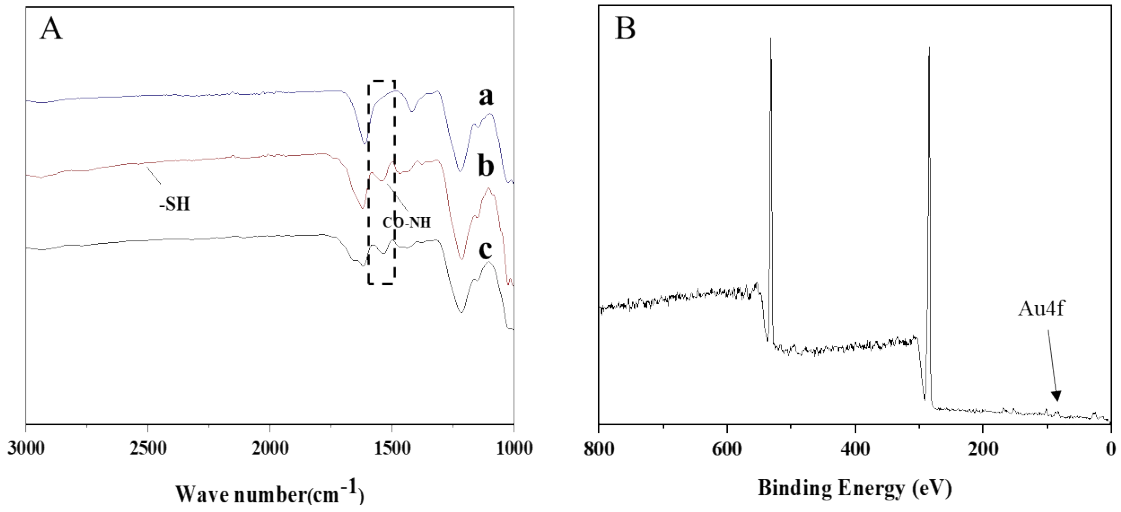

Figure S3. Characterization of Au-heparin nanoparticles. A, FTIR spectra of heparin (a), thiol heparin (b) and Au-heparin nanoparticles (c), respectively. B. the XPS of the full elements nanoparticles.

4. Anti-oxidation of biomimicking ECM for red blood cells

We tested the stability of dual-layer surface under the shear of the plasma by the shaker at 37 ^{o}C with shaking at 30 rpm for 7 days (the shear rate was comparable to that of blood in the vein). Then, the surface structure was observed with SEM. The double-layer structure remained stable although the fibers were collapsed (Figure S4a). Microfibers was soaked in fresh rabbit blood (1 ml), H_2O_2 (400μmol/L) was added and incubated for 24h. The RBCs were removed by centrifugation (3000 rpm, 5 min), and the supernatant was transferred to 96-well plates and its absorbance at 541 nm was measured by microplate reader. The hemolysis ratio (HR) was calculated to reveal the stability of ECM to protect RBCs from H_2O_2.Compared with Inner layer and Out layer, ECM perform the best effect to protect RBCs from H_2O_2 because of PBA and sustaining release of anti-inflammatory drugs (Figure S4b).

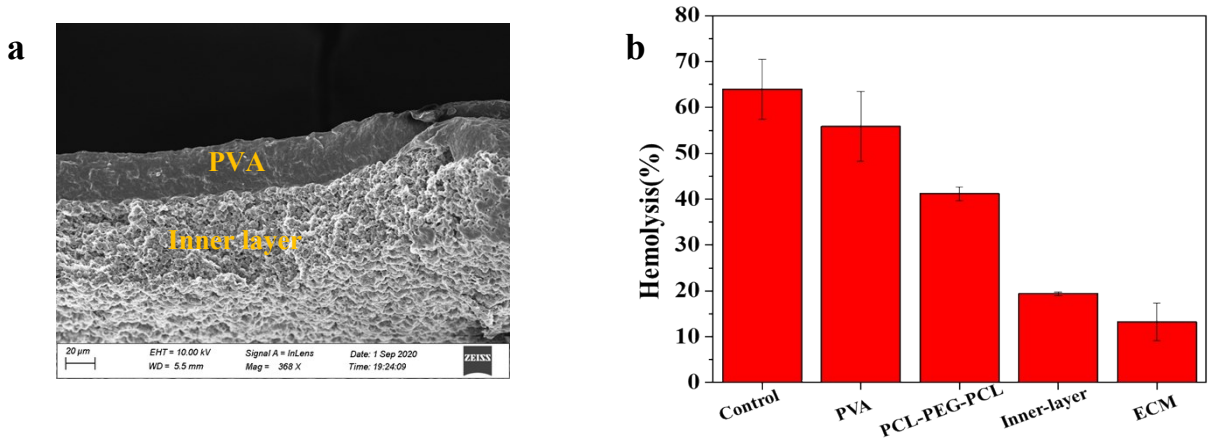

Figure S4. a, SEM image of cross-sectional of ECM after shearing with blood plasma for 7 days. b, Hemolysis of RBCs in the presence of H_2O_2 and electrospun fibers.

5. Characterization of hydrogen bonds between PCL-PEG-PCL and PVA.

1 wt% PVA and PCL-PEG-PCL (1:1 and 1:2) were mixed in DMSO, respectively. Then, the PVA/PCL-PEG-PCL film was prepared by casting solution on the glass slide. For comparison, PVA and PCL-PEG-PCL film were prepared, respectively. FTIR spectra of those films were shown in Figure S5. The shift of wavenumber from 3315 to 3346 cm-1 indicated the hydrogen bonds between PVA and PCL-PEG-PCL.

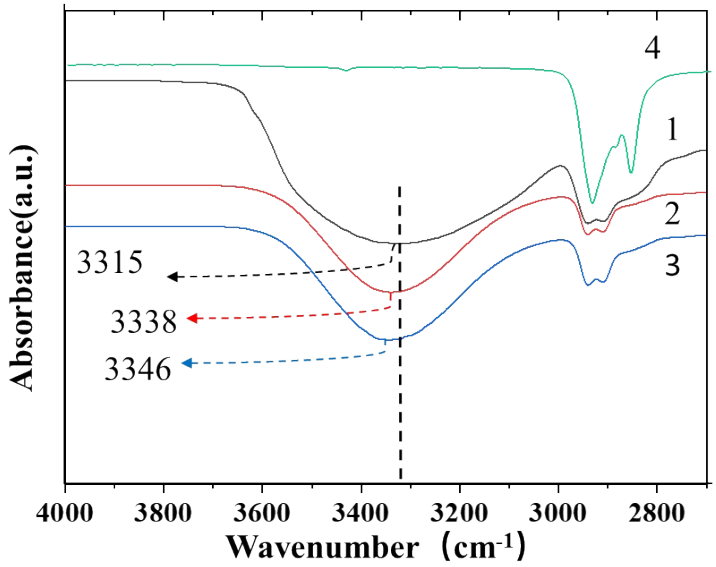

Figure S5. Characterization of hydrogen bonds between PCL-PEG-PCL and PVA. FTIR spectra of PVA (1), PCL-PEG-PCL(4), and casting films blending with PVA and PCL (1:1(2),1:2(3)).

6. Oxidation of endotheliocyte with chronic inflammation

The endothelial cells were stimulated with LPS (100ng/mL) for 6 h. Then, the LPS-stimulated cells were incubated by 5% CO_2 for 24 h at 37 °C in the presence of different samples. The ROS in endothelial cells (one of the inflammatory state) was characterized by the ROS kit and laser scanning confocal microscope was used to observe the fluorescence of the sample. The fluorescence intensity is most weak for the cells incubated with bio-inspired ECM, demonstrating the best anti-oxidation capability.

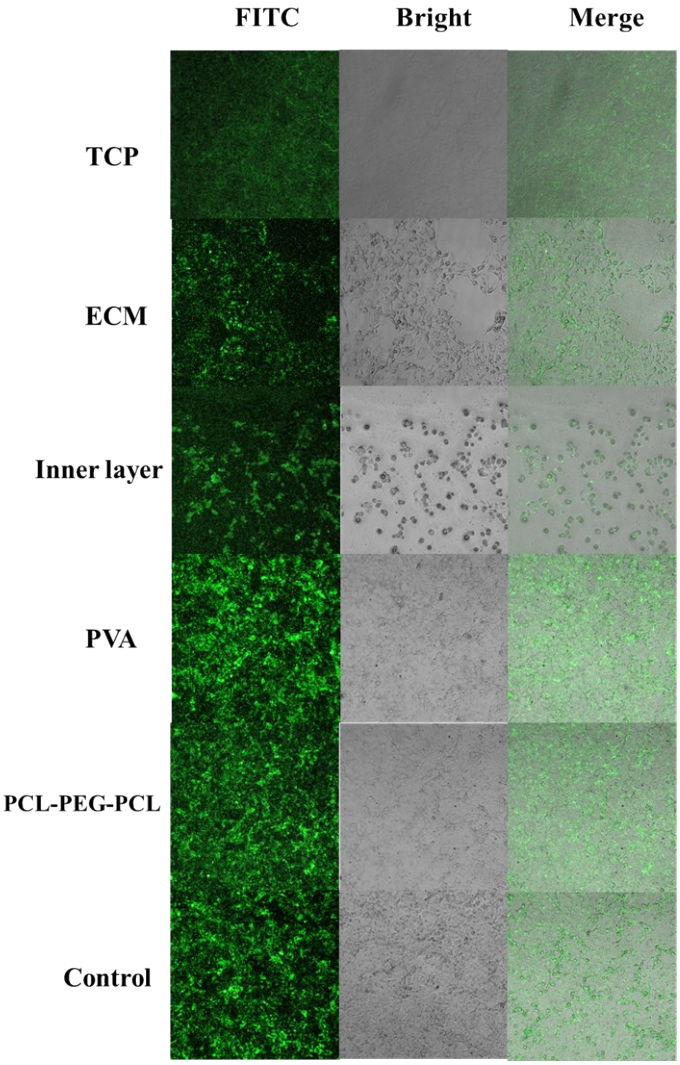

Figure S6. Fluorescence image of endotheliocytes with oxidation.

7. Determination of friction coefficient

The setup for friction coefficient measurement was shown in the Figure S7A. The weight was 0.6 kg. The relationship of friction with pressure was shown in Figure S7B. The friction coefficients of PVA, PCL-PEG-PCL and PEO on glass slide were 6.22, 6.7, 4.89, respectively. The friction coefficients of PVA and PEO were smaller than that of PCL-PEG-PCL. After friction, the surface of PVA layer remained stable, but the surface of PEO layer became tangled and pilling (Figure S8).

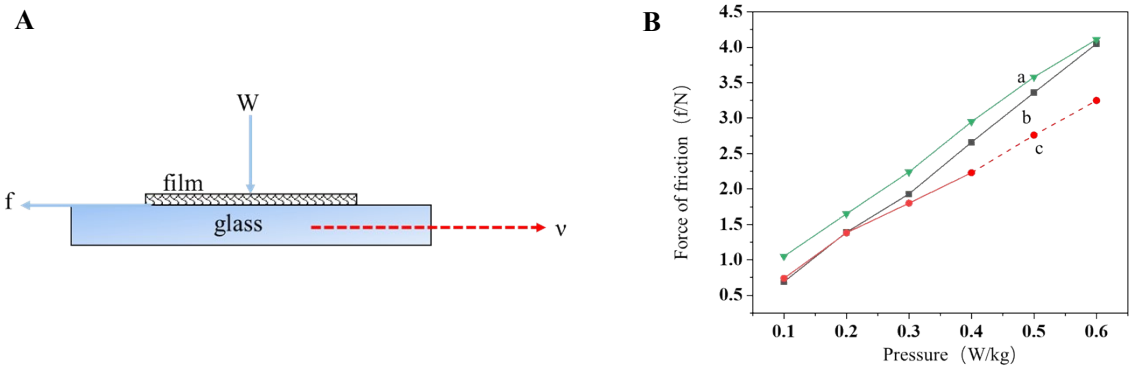

Figure S7. A. The schematic illustration of setup for friction test. B. the relationship between friction and pressure. (a) PVA, (b) PCL-PEG-PCL, (c) PEO.

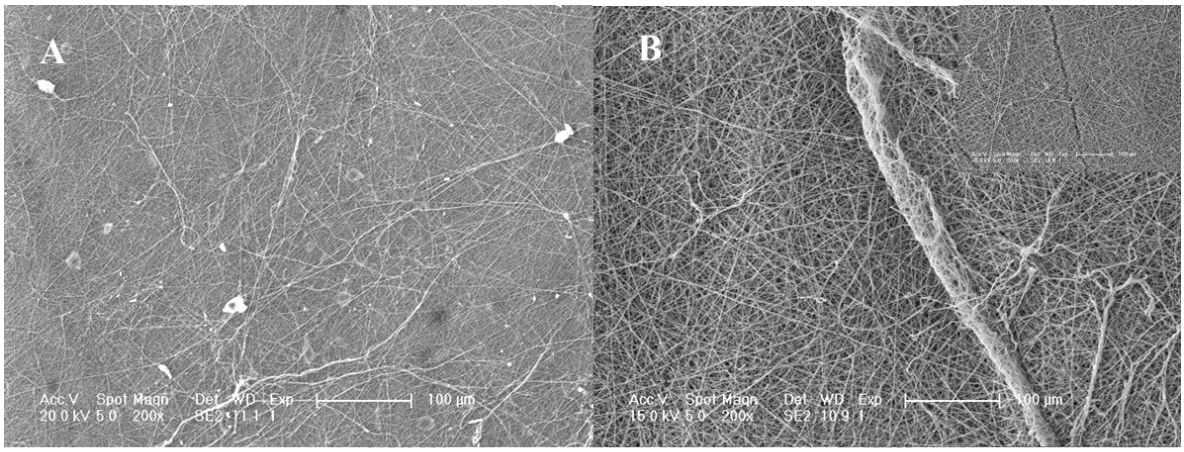

Figure S8. The SEM image of PVA layer (A) and PEO layer (B) after friction measurement with 0.6kg pressure.

8. The photographs of rabbit ear after implantation

The photographs of rabbit ear after implantion of indwelling needles for 6 day were shown in Figure S9. In image (a), the implantation was used a commercial indwelling needle, Intima Ⅱ™ . And in image (b) the implantation was used with the modified indwelling needle. The arteries in (a) was found blockedy, but the arteries in (b) remained reddish and nearly intact.

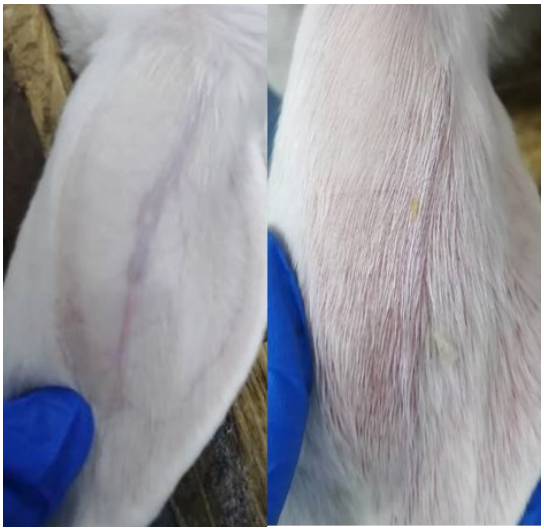

Figure S9. The photographs of rabbit ear after implantion of indwelling needles for 6 days. (a) the commercial indwelling needle Intima Ⅱ™, (b) modified indwelling needle.

9. Double-layer fabrication with electrospinning

Table S2. The parameters of electrospinning

Solution	Distance(cm)	Voltage (kv)	Flow rate (ml/h)	Abbreviation
PVA 5 wt% in H_2O	12	15	1	PVA
PCL-PEG-PCL 20 wt% in DMF	12	22	2	PCL-PEG-PCL
PVA 5 wt% + PBA 0.5 wt% in H_2O and THF(10：1)	12	15	1	Out layer

Core solution	Sheath solution	Distance(cm)	Voltage(kv)	Flow rate (ml/h)		Abbreviation
				core	sheath	
IDM 0.05 wt% in acetone	PCL-PEG-PCL 20 wt% +0.2mg Au-Hep in acetic acid, THF and water (3:2:1) blend solvent	12	22	0.3	1.5	Inner layer

Inner layer	Outer layer	Abbreviation
The same with Outer layer	The same with Inner layer	ECM