Supporting Information

Electronic supplementary information (ESI) available: materials, experimental details, and supplementary figures.

Synthesis of as-prepared PAM, microunits, as-reformed PAM

For as-prepared PAM, AAM (6.8 g), APS (100 mg/mL, 9.9 μL) and TEMED (100 mg/mL, 13.2 μL) were mixed with 24 mL deionized water in a nitrogen environment until the monomers were completely dissolved. The solution was then polymerized at 37 ℃ overnight.

For microunits, the as-prepared PAM were dried at 70 ℃, then the dried solids were smashed by a multifunctional pulverizer (200 T) (Yongkang Boou Hardware Products Co., Ltd.) to obtain the microunits, which were screened by standard steel sieves (sieve mesh sizes were 150 μm and 230 μm, Yongkang Boou Hardware Products Co., Ltd).

The as-reformed PAM were prepared by adding deionized water to the microunits (microunits content: 22 wt%). In detail, the microunits were put into an injector and mixed with water. After the microunits were hydrated, they were extruded into the mold (2 mL centrifuge tube or 1 mL syringe tube) at 37 ℃ overnight.

Hemostatic test

The use, care, and handling of animals was approved by the Institutional Animal Care and Use Committee of Yi Shengyuan Gene Technology (Tianjin) Co., Ltd. The large-puncture liver injury model (Sprague-Dawley rats, 180-250 g) and the femoral artery injury model were used to study *in vivo* the hemostatic ability of microunits. Firstly, each rat was injected with anesthetic and fixed onto the surgical corkboard. After disinfection with iodine and alcohol cotton ball, their abdominal cavity was opened along the midline of the abdomen to expose the liver. In one lobe of their liver, the wound about 1 cm in length and 0.3 cm in depth was made with a standard injector needle and ~60 mg of microunits were immediately sprinkled on the surface of the

bleeding site. The pre-weighed filter paper was placed under the liver. The wounds without treatment were used as controls. In the femoral artery injury model, the femoral artery was exposed by the incision. Then the femoral artery was punctured by a standard injector needle. ~60 mg of microunits were immediately sprinkled on the surface of the bleeding site, followed by the exertion of pressure using medical gauze. The wounds treated by pressure with medical gauze were used as controls. In all tests, the mass of blood from the injuries was determined by the weight change in the filter paper before and after the blood absorption. All experiments were performed in triplicate.

Adhesion strength test

The adhesive strength of hydrogel was studied with porcine skin as the substrate by lap shear test. In short, fresh porcine skin was cut into rectangles (50 × 10 mm^2), and the water of surface was removed by the filter paper. Subsequently, the as-reformed PA-N were tiled on the porcine skin with an area of 1 × 1 cm^2 , and immediately another porcine skin was covered on it. After about 5 min, the bond strength was measured with universal testing machine (UTMS2102, Shenzhen SUNS) at a tensile rate of 50 mm/min. Each sample was tested three times and the averaged adhesive strength was calculated. Fibrin glue was tested as control.

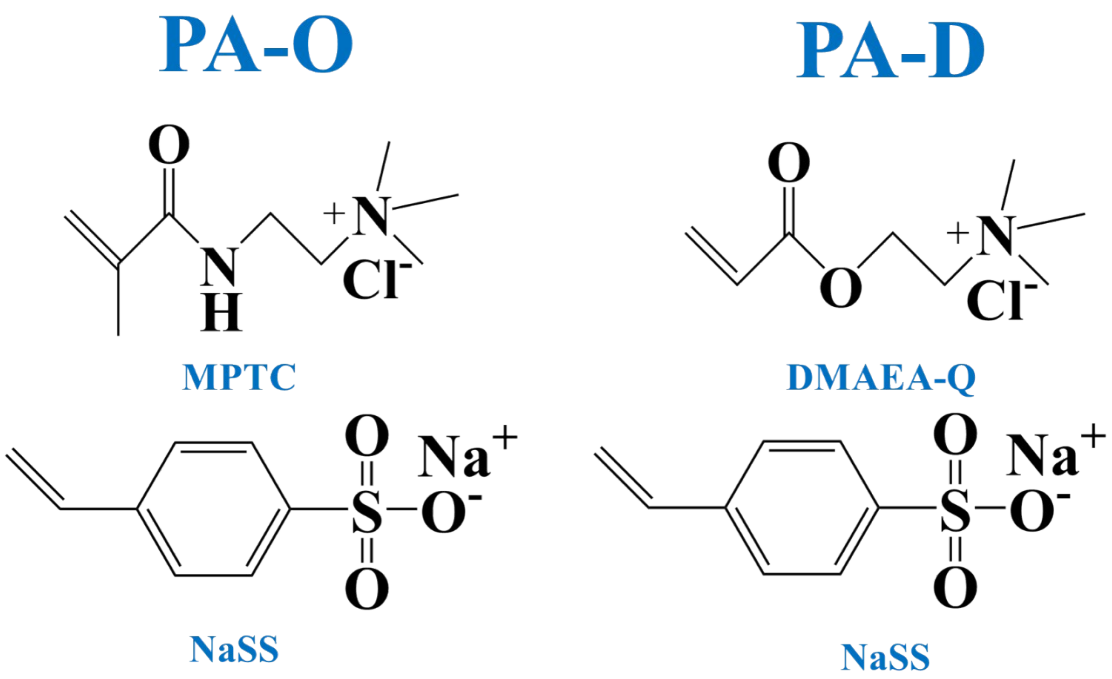

Figure. S1 Monomers for as-prepared PA-O and as-prepared PA-D.

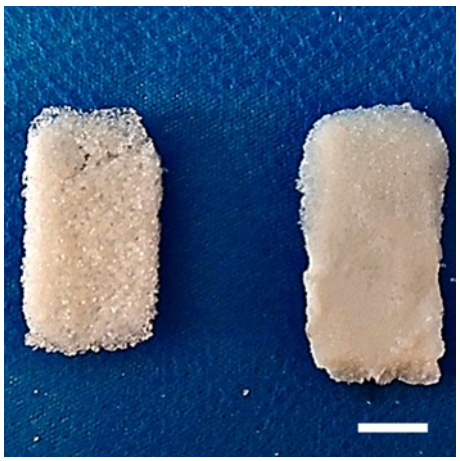

Figure. S2 The photographs of as-reformed PA-N formed by different sizes (left: 230 μm -270 μm, right: 180 μm- 230 μm). Scale bar: 0.5 cm.

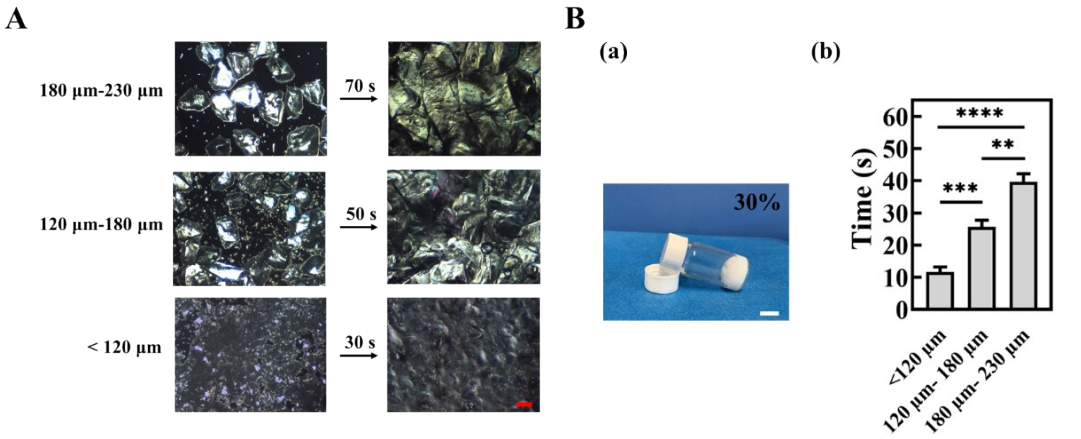

Figure. S3 (A) Microscope photographs of the hydration process. Scale bar: 100 μm. (B) (a) Macroscope photographs of the hydration process. (b) Hydration time of different sized-microunits. The significant differences were considered when $^{**}p < 0.01$, $^{***}p < 0.001$ and $^{****}p < 0.0001$.

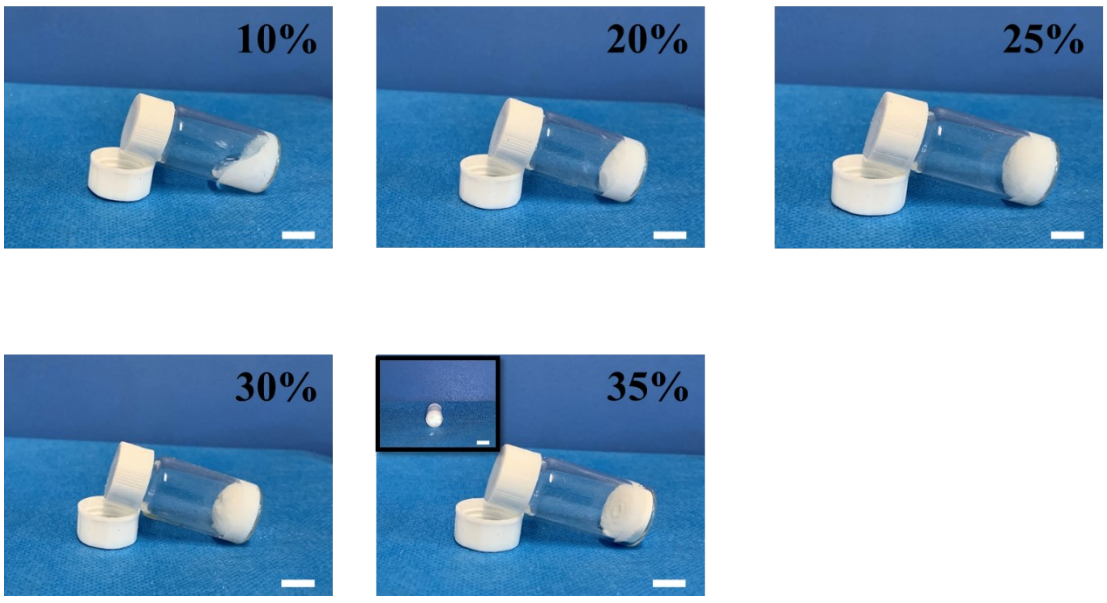

Figure. S4 Photographs of appropriate microunits content for reformation. Scale bar: 1 cm.

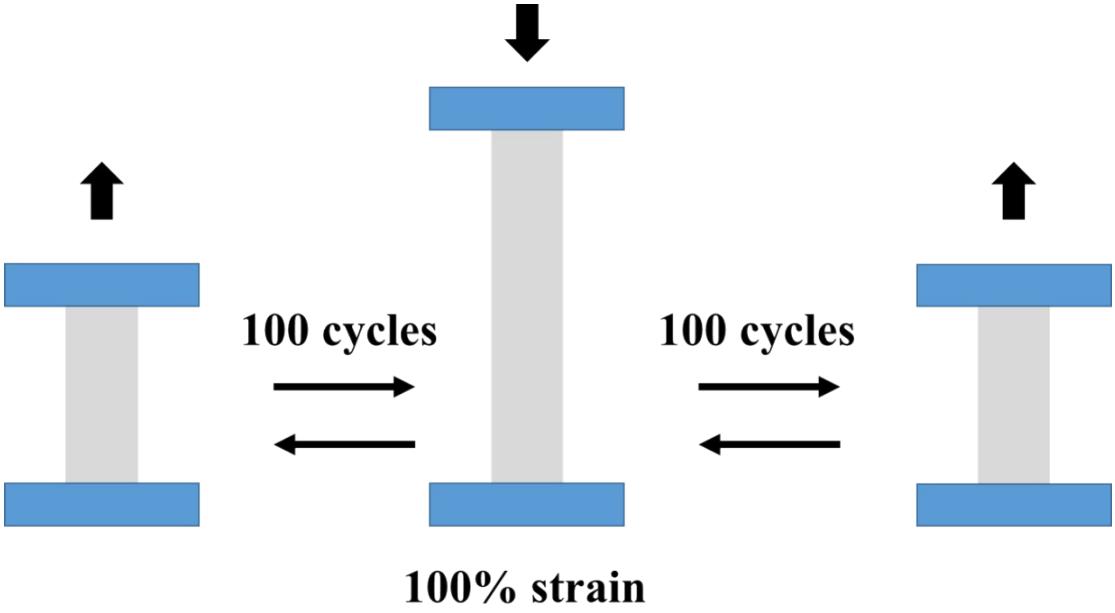

Figure. S5 Schematic representation of the cyclic tensile tests of as-reformed PA.

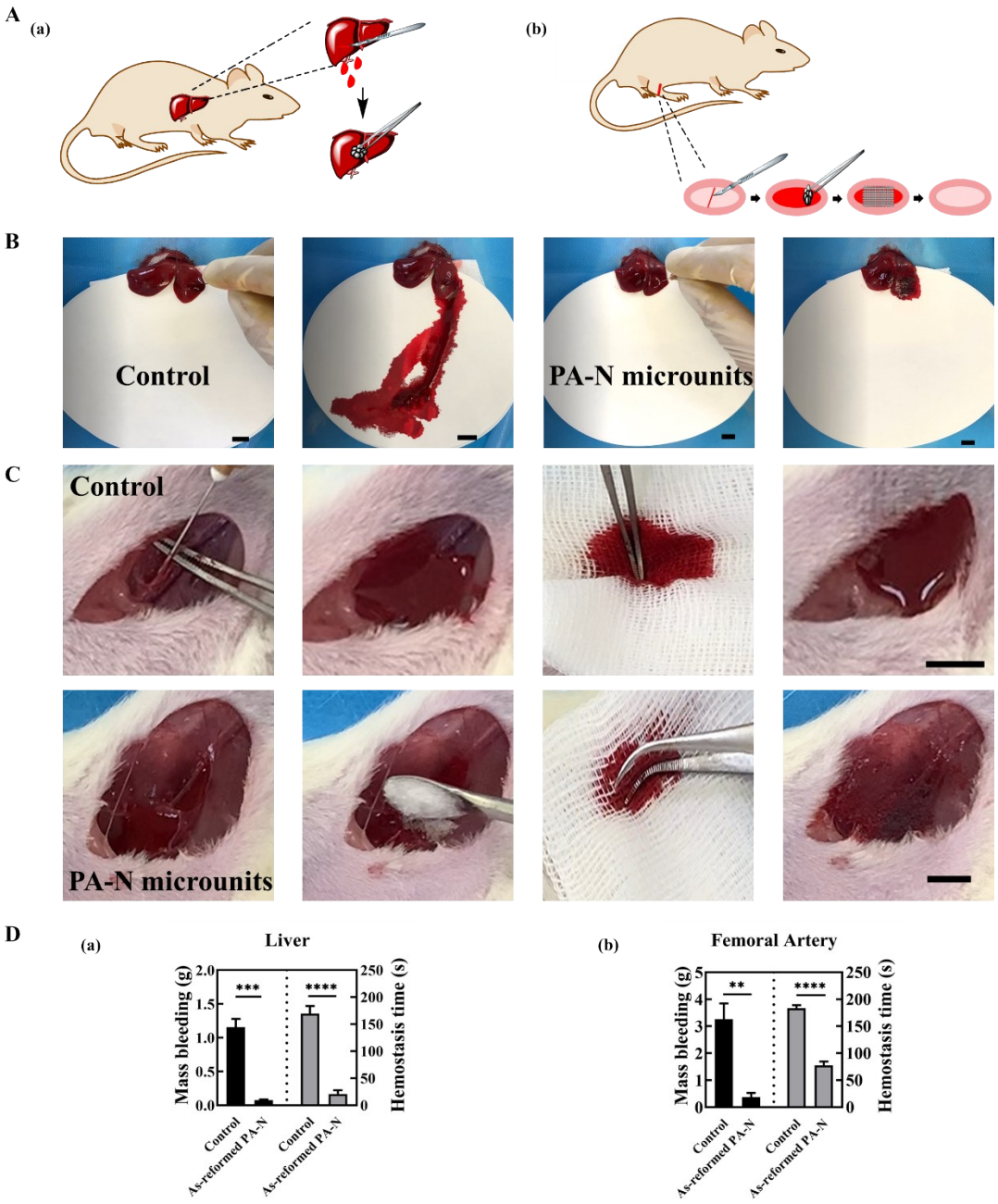

Figure. S6 (A) (a) Schematic representation of the large-puncture liver injury models and hemostasis process of PA-N microunits. (b) Schematic representation of the femoral artery injury models and hemostasis process of PA-N microunits. (B) Photographs of PA-N microunits applied on the large-puncture liver injury models. (C) Photographs of PA-N microunits applied on femoral artery injury models. Scale bar: 1 cm. (D) Mass bleeding and hemostasis time. The significant differences were considered when $^{**}p < 0.05$, $^{***}p < 0.001$, or $^{****}p < 0.0001$.

The evaluation of hemostasis ability was constructed by a large-puncture liver injury

bleeding model (ESI† Fig. S6A (a)) and the femoral artery injury (ESI† Fig. S6A (b)). The bleeding was quickly stopped in about 20 s, much shorter than the untreated groups (about 169 s) and the blood loss was significantly reduced (ESI† Fig. S6B and ESI† Fig. S6D (a)). Hemorrhage from femoral artery injury is more severe. In the current method of hemostasis, hemostatic gels must be used immediately after the injury occurs. However, in the case of an accidental injury, it is difficult to operate in the accidental injury because blood flows rapidly from the artery and the vessels are often quickly submerged in blood. The bleeding in the untreated groups were more serious and the bleeding point could not be found. Simple press of the injury site by gauze was also hard to completely stop the bleeding. After applying the microunits, the injury site was able to stop bleeding effectively after compression. The blood loss was significantly reduced and the hemostasis time was significantly shortened (ESI† Fig. S6C and ESI† Fig. S6D (b)). These results demonstrated that the microunits of as-reformed PA-N possessed good hemostasis ability.

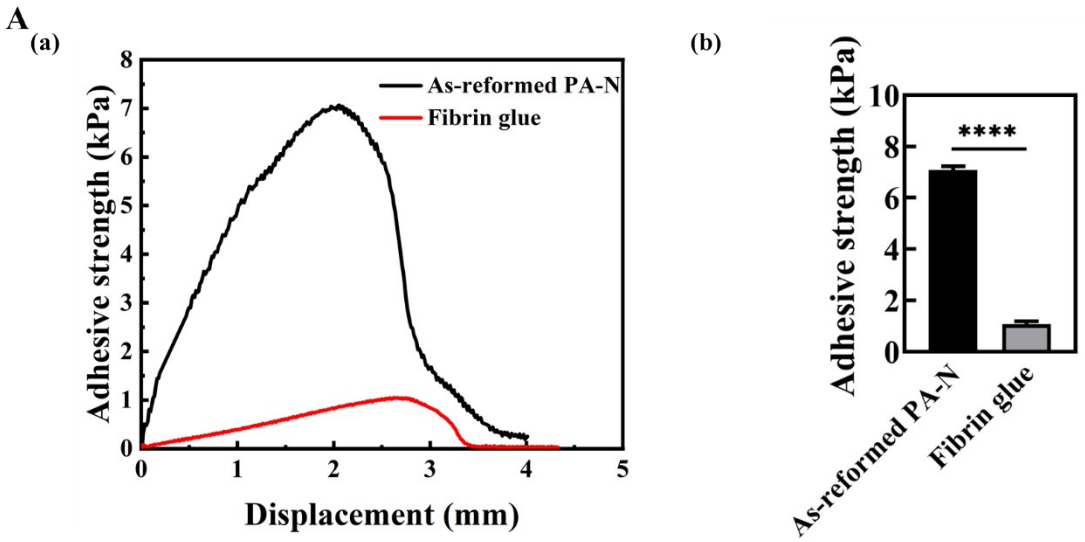

Figure. S7 (A) (a) Stress–displacement curves of porcine skin bonded by the as-reformed PA-N. (b) Adhesive strength of the as-reformed PA-N. The significant differences were considered when ****$p < 0.0001$.