**Supporting information**

# Hyaluronic acid-based Fabric with Blood induced Network Densification and Tissue Adhesion for Bleeding Control

Zhibo Xu,[a,#] Linyu Wang,[a,#] Xinwei Zheng,[a] Ziying Wang,[a] Yunxiang Weng,[a] Qinhui Chen,[a] Haiqing Liu,[a*] and Yan Fang[a*]

[a] Fujian Key Laboratory of Polymer Materials, College of Chemistry and Materials Science, Fujian Normal University, Fujian 350007, China

# Zhibo Xu and Linyu Wang contributed equally.

*Correspondence to: Haiqing Liu (E-mail: **haiqingliu@fjnu.edu.cn**)

Yan Fang (E-mail: **fangyan_YWJ@fjnu.edu.cn**)

## Experimental section

### *Ex vivo* blood clotting index

Fresh anticoagulated rat blood (50 μL) was added dropwise onto material samples (10×10 mm²) and incubated at 37°C for 5 minutes. After gentle rinsing with 10 mL PBS to remove unclotted components, 200 μL supernatant was transferred to a 96-well plate. Absorbance at 540 nm was measured using a microplate reader. A mixture of 200 μL of anticoagulated blood with 10 ml of PBS was used as a negative control. The BCI was calculated as follows:

$$BCI\ (\%) = A_s/A_b \times 100\%$$

where $A_s$ is the absorbance of the supernatant of the mixture of the material and blood, and $A_b$ is the absorbance of a mixture of 50 μL rat blood and 10 mL PBS.

### Erythrocytes and platelets adhesion

For adhesion of erythrocyte, samples (10×10 mm²) in 5 mL tubes were incubated with 2 mL diluted blood (37°C, 1 hours), washed with PBS, then fixed in 2.5% glutaraldehyde for 4 hours. For adhesion of platelet, platelet-rich plasma (PRP) was obtained by centrifuging whole blood (1200 rpm, 10 minutes). Samples were incubated with 2 mL PRP (37°C, 1 hours). Following the incubation period, each sample was rinsed thrice using PBS and then immersed in a 2.5% glutaraldehyde fixative for 1.5 hours. Erythrocytes and platelets were then dehydrated through a gradient ethanol (0% to 100% in 10% increments, with two final steps at absolute ethanol), spending 10 minutes at each concentration. Following dehydration, samples were dried at 37°C for 48 hours and subsequently examined using SEM.

## *Ex vivo* blood coagulation time test

The 10×10 mm square samples were placed separately in individual wells of a 24-well cell culture plate, with 20 μL of anticoagulated whole blood added to each well. At predetermined time points, PBS was added to each well for washing to remove unbound blood components. The coagulation endpoint of each sample was recorded when the eluent became colorless and transparent.

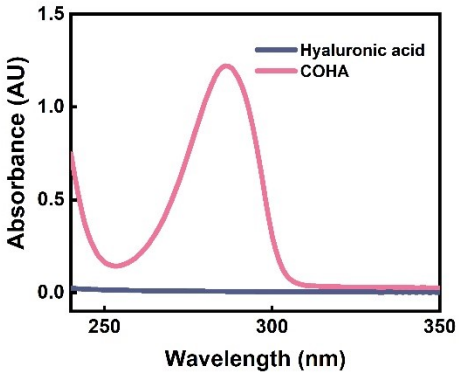



Figure S1 UV-vis spectra of hyaluronic acid and COHA.

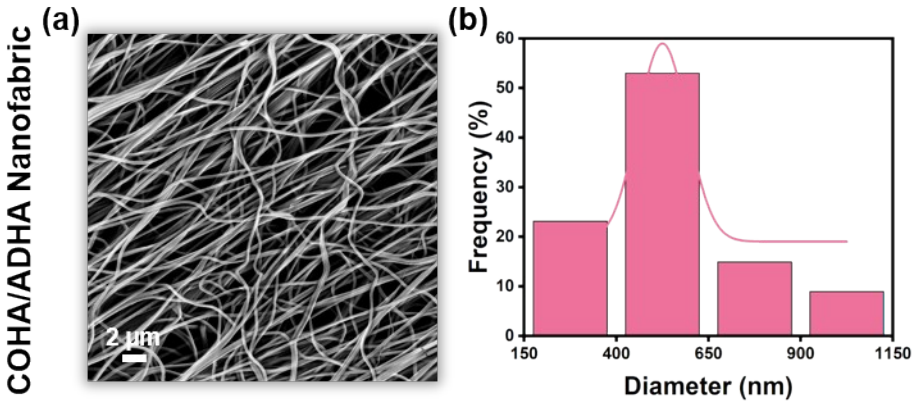



Figure S2 SEM images of COHA/ADHA nanofabric and histogram of diameter distribution of COHA/AHDA nanofabric.

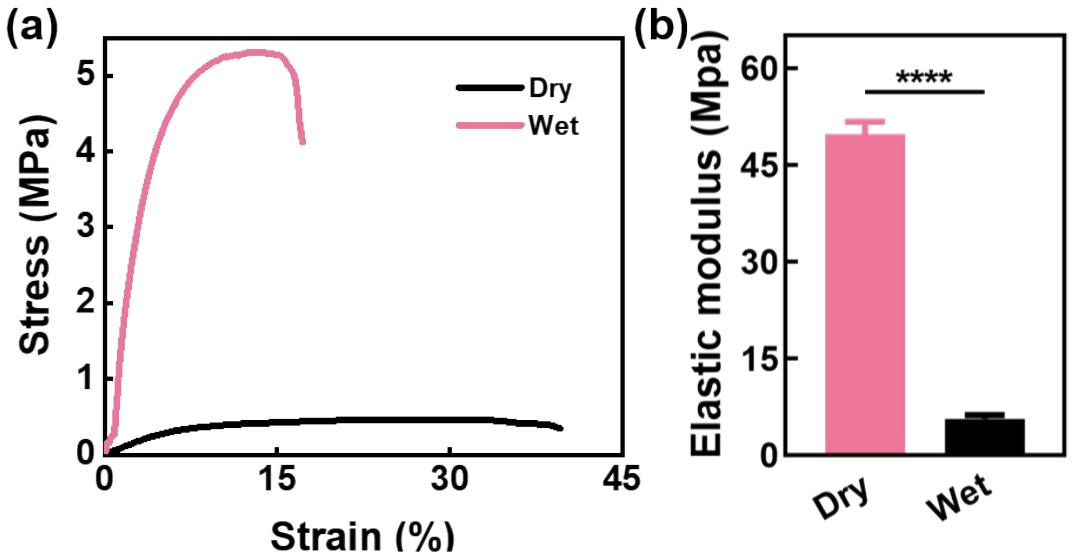



Figure S3 Mechanical properties of COHA/ADHA nanofabric before and after blood contact. (a) Tensile stress-strain curves; (b) Bar charts of elastic modulus.

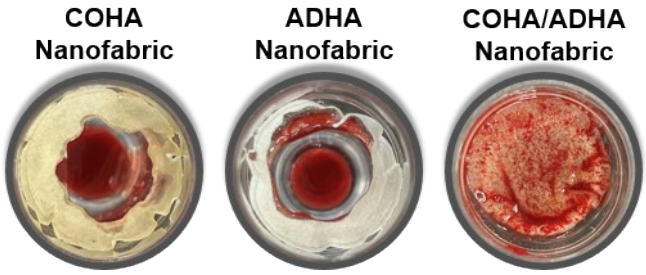



Figure S4 The photographs of COHA nanofabric, ADHA nanofabric, COHA/ADHA nanofabric after the experiment of the blood blocking.

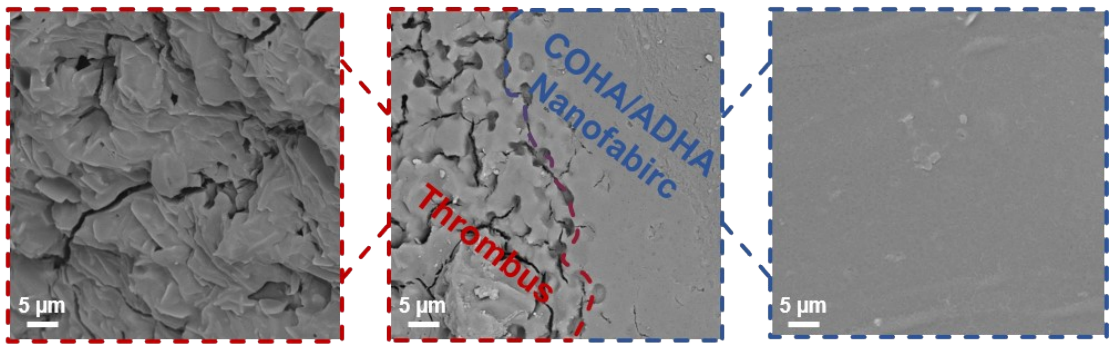
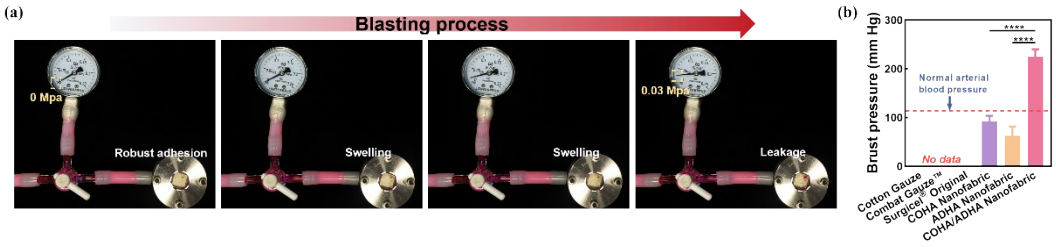



Figure S5 Post-blood contact SEM images of COHA/ADHA nanofabric.

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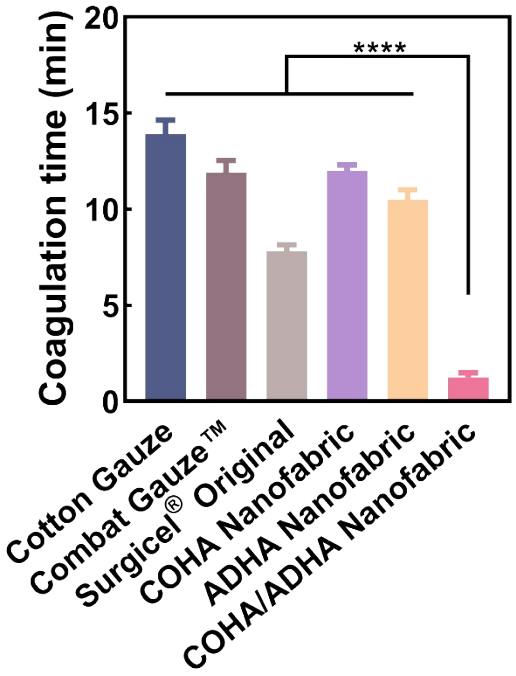
65 Figure S6 (a) The images of the bursting pressure test of COHA/ADHA nanofabric; (b)

66 Bursting pressure of COHA nanofabric, ADHA nanofabric, COHA/ADHA nanofabric.

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68 Figure S8 Coagulation time of cotton gauze, Combat Gauze™, Surgicel® Original,

69 COHA nanofabric, ADHA nanofabric, and COHA/ADHA nanofabric.

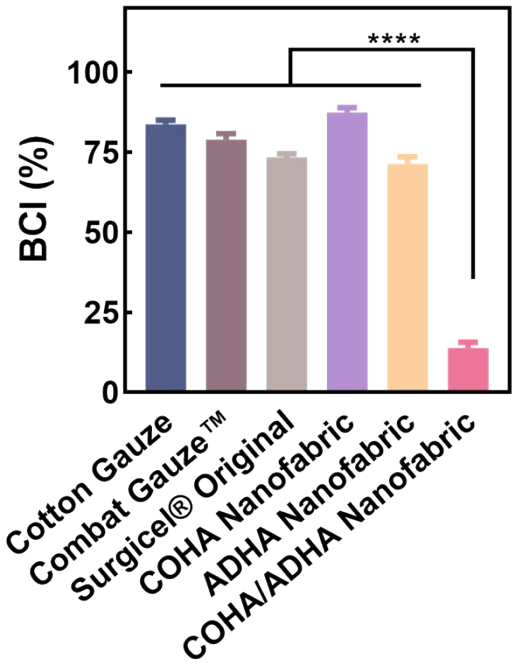


Figure S8 BCI values of cotton gauze, Combat Gauze™, Surgicel® Original, COHA nanofabric, ADHA nanofabric, and COHA/ADHA nanofabric.

Supplementary Table 1: Comparison of hemostatic performance between the present COHA/ADHA nanofabric and representative nanofibrous materials from the literature.

| Material Composition | Key Hemostatic Metrics (*Ex vivo*) | Key Hemostatic Metrics (*In vivo*) |
|---|---|---|
| Chitosan, PEO, and Kaolin[1] | Clotting time: ca. 43 seconds<br>SEM: Adhesion and activation of erythrocytes and platelets observed on CPK10 surface. | Hemostasis time: ca. 57.3 seconds; Blood loss: ca. 0.131 g.<br>Notes: Relies on kaolin's pro-coagulant activity; the non-degradable component may |

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| | | raise considerations for long-term implantation. |
| κ-Carrageenan, CMCS, PVA and Tranexamic Acid[2] | Clotting time: ca. 429 seconds<br>SEM: Formation of a "fiber-clot" hybrid structure promoting erythrocyte adhesion; TXA loading enhanced platelet adhesion. | Hemostasis time: ca. 38.4 seconds; Significant reduction in blood loss.<br>Notes: Functions primarily via drug release ("chemical intervention"); may have limited active tissue adhesion, posing potential interface bleeding risk. |
| Chitosan, N-alkylated Chitosan and PEO[3] | Clotting time: ca. 58.8 seconds<br>SEM: Extensive adhesion of erythrocytes and platelets, attributed to electrostatic interaction and platelet activation. | Hemostasis time: ca. 87 seconds; Blood loss: ca. 0.087 g.<br>Notes: Mechanism is coagulation-pathway independent; may require secondary removal, adding procedural complexity. |
| Gelatin, Polycaprolacton | Clotting time: ca. 526 seconds<br>SEM: Hydrophilic layer captures | Hemostasis time: ca. 59 seconds; Blood loss: ca. 0.18 |

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|---|---|---|
| e, Zeolite and Dopamine[4] | blood cells; PCL layer acts as a penetration barrier. | g.<br>Notes: Dual-layer design physically manages blood absorption and penetration; may rely more on physical sealing than active coagulation activation. |
| This Work: COHA, ADHA and PEO | Extremely short clotting time: ca. 60 seconds<br>SEM: High adhesion ratios for erythrocytes (77%) and Platelets (82%). Mechanism: Catechol groups enhance platelet binding and erythrocyte aggregation; cross-linked network via Schiff base reaction effectively entraps blood cells. | Immediate physical sealing. Blood loss: 0.044 g.<br>Notes: Synergistic mechanism: rapid hydrophilic absorption, protein interaction, fibrin-mimetic cross-linking, and dual-adhesive barriers. Fully degradable, eliminating secondary removal. |

(1) Liu, T.; Zhang, Z.; Liu, J.; Dong, P.; Tian, F.; Li, F.; Meng, X. Electrospun kaolin-loaded chitosan/PEO nanofibers for rapid hemostasis and accelerated wound healing. *Int. J. Biol. Macromol.* **2022**, *217*, 998-1011.

(2) Salmasi, S. S.; Ehsani, M.; Zandi, M.; Saeed, M.; Sabeti, M. Polysaccharide-based (kappa carrageenan/carboxymethyl chitosan) nanofibrous membrane loaded with

antifibrinolytic drug for rapid hemostasis- in vitro and in vivo evaluation. *Int. J. Biol. Macromol.* **2023**, *247*, 125786.

(3) Liu, T.; Liu, S.; Shi, Y.; Zhang, Z.; Ding, S.; Hou, K.; Zhang, W.; Meng, X.; Li, F. Electrospun nanofiber membranes for rapid liver hemostasis via N-alkylated chitosan doped chitosan/PEO. *Int. J. Biol. Macromol.* **2023**, *258*, 128948.

(4) Song, Y.; Zhu, Y.; Wang, Q.; Chen, X.; Chen, Y.; Han, G.; Lu, W.; Guo, Y. One-step Preparation of Antibacterial Gelatin/Polycaprolactone Nanofibrous Janus Membranes for Efficient Hemostasis. *ACS Appl. Polym. Mater.* **2023**, *5*, 7364–7374.