Electronic Supplementary Material (ESI) for Biomaterials Science.

Supporting Information

Engineering of Hemocompatible and Antifouling Polyethersulfone Membranes by Blending with Heparin-Mimicking Microgels

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Experimental details

Ultrafiltration experiment

Ultrafiltration of BSA solution through the membranes was carried out to investigate its antifouling property. Firstly, BSA solution was prepared by dissolving BSA in phosphate buffer saline solution (pH=7.4) with a concentration of 1.0 mg/mL. Then the membranes were placed in a dead-end ultrafiltration cell with an effective membrane area of 3.9 cm^2. For the test, the membrane was firstly pre-compacted by PBS solution at a pressure of 0.06 MPa for 20 min to reach a steady flux. Then the pressure was adjusted to 0.08 MPa, and the PBS flux within 5 min was measured (and this measurement was repeated for 5 times). After the filtration of PBS, the feed solution was switched to 1.0 mg/mL BSA solution, and the operation was the same as that for the PBS solution ultrafiltration. After the BSA solution filtration, the membrane was immersed in PBS solution for 1 h, and then the above process was repeated again.

Plasma collection

Healthy human fresh blood (man, 25 years old) was collected using vacuum tubes (5 mL, Jiangsu Kangjian Inc., China) containing sodium citrate as anticoagulant (anticoagulant-to-blood ratio, 1:9 (v/v)). The blood was centrifuged at 1000 rpm for 15 min to obtain platelet-rich plasma (PRP) or at 4000 rpm for 15 min to obtain platelet-poor plasma (PPP). The same donor blood samples were used all through the

blood tests.

Protein adsorption

Protein adsorption experiments were carried out with BSA and BFG solutions under static condition. Firstly, the membranes with an area of 1×1 cm^2 were immersed in PBS solution, containing BSA (or BFG) with the concentration of 1 mg/mL, and incubated at 37 °C for 1 h; then the membrane was rinsed slightly with PBS and ultrapure water. Then the membranes were placed in a washing solution (2 % sodium dodecyl sulfate (SDS), 0.05 M NaOH) at 37 °C, and shaken for 2 h to remove the adsorbed protein. The adsorption and desorption times were carefully determined in preliminary experiments. The protein concentration in the washing solution was determined by using the Micro BCA TM Protein Assay Reagent Kit (Pierce). More than 95 % of the adsorbed protein could be eluted into the SDS solution, and then the adsorbed protein amount was calculated.

Platelet adhesion

In order to eliminate the interference of other components in blood, such as erythrocyte and leucocyte, PRP was used for studying platelet adhesion on the modified PES membranes. The pristine and modified PES membranes were immersed in PBS and equilibrated at 37 °C for 1 h. Then, the PBS solution (PH=7.4) was removed and 1 mL of fresh PRP was introduced. The membranes were incubated with PRP at 37 °C for 2 h. Then, the PRP was decanted off and the membranes were rinsed

three times with PBS solution. Finally, the membranes were treated with 2.5 wt. % glutaraldehyde in PBS solution at 4 °C for 1 day. The samples were washed with PBS solution, subjected to a drying process by passing them through a series of graded alcohol-PBS solutions (30, 50, 70, 80, 90, 95 and 100%) and isoamyl acetate–alcohol solutions (30, 50, 70, 80, 90, 95 and 100%). Platelet adhesion was observed using a FE-SEM (JSM-7500F, JEOL, Japan).

Clotting time

For testing the antithrombogenicity of the membranes, activated partial thromboplastin time (APTT) and thrombin time (TT) were measured by a semi-automatic blood coagulation analyzer CA-50 (Sysmex Corporation, Kobe, Japan). The testing process was as follows: the membranes (1×1 cm^2 for each) were immersed in a 96-well plates with 200 μL PBS in each well at 4 °C for 24 h, then the PBS was removed and 100 μL PPP was introduced. After incubating at 37 °C for 30 min, 50 μL of the incubated PPP was added into a test cup, followed by the addition of 50 μL of APTT agent (incubated at 37 °C 10 min before using). After incubating at 37 °C for 3 min, 50 μL of 25 mM $CaCl_2$ solution was added, and then the APTT was measured. At least three measurements were averaged to get a reliable value, and the results were analyzed by statistical method. For the TT test, 100 μL of TT agent was added into the test cup (containing 50 μL of the incubated PPP), and then the TT was measured.