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Zwitterionic Nanocomposite Hydrogels as Effective Wound Dressings

Kang-Ting Huang^a, Yun-Lung Fang^{a, c}, Pai-Shan Hsieh^c, Chun-Chang Lee^{c,*}, Niann-Tzyy Dai^{c,*},

Chun-Jen Huang a,b,*

- a. Department of Biomedical Sciences and Engineering, National Central University, Jhong-Li, Taoyuan 320, Taiwan.
- b. Department of Chemical & Materials Engineering, National Central University, Jhong-Li, Taoyuan 320, Taiwan.
- c. Division of Plastic and Reconstructive Surgery, Department of Surgery, Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan.

*Corresponding authors: Email: cjhuang@ncu.edu.tw (C.-J. H.) niantzyy_dai@hotmail.com (N.-T. D); miho0402@gmail.com (C.-C. L.)



2-hydroxyethyl methacrylate (HEMA)

Scheme S1. Chemical structures of monomers. (a)SBMA, (b) SBAA, and (c) HEMA.

Preparation of hydrogels for compressive test:

To synthesize the zwitterionic nanocomposite hydrogels, nanoclay (from 0 to 11.43 wt%), monomer (2 M), crosslinker (1% the monomer mole), potassium peroxodisulfate (KPS) (10 mg), and N,N,N',N'-tetramethylethylenediamine (TEMED) (1 μ L) were prepared in deionic water in a glass vial, protected in nitrogen at 0 °C. Radical polymerization was then allowed to proceed at 25 °C for 20 h.The hydrogel, afterward, can be prepared.



Figure S1. Photographs of nanocomposite hydrogels before (a) and after polymerization (b).

The photographs of the nanocomposite hydrogels before and after polymerization were taken in Figure S1. The prepared hydrogels were used for the compressive tests. The diameter of the gel is 17 mm in Figure S2a and thickness of gel is 8 mm in Fig. S2b.



Figure S2. Appearance of nanocomposite hydrogels on top (a) and lateral (b).

Water Vapor Transmission rate of hydrogels:

The water vapor transmission rate for pSBAA/15 hydrogels was evaluated at 35 °C for 3 days. The moisture permeability of the hydrogel was determined by the weight loss of cylindrical bottle (10 mm in diameter) containing 5 mL of DI water. The bottle was capped with a hydrogel disc (15 mm diameter) and kept in an oven at 35 °C for 72 hr. The WVTR was calculated using the following formula:

$$WVTR = \frac{(W_i - W_t)}{A \times 72} \times 10^6 \ (gm^{-2}h^{-1})$$

Where, A is the area of the bottle mount (mm²), W_i and W_t are the weight of bottle before being placed in the oven and after being removed from the oven, respectively. In Figure S3, the WVTR of SBAA/15 hydrogel and uncovered (as control) were 111.2±7.5 gm⁻²h⁻¹ and 131.8±4.4 gm⁻²h⁻¹, respectively. The water vapor transmission rate of pSBAA/15 hydrogel was comparable with 2-acrylamido-2-methylpropane sulfonic acid (AMPS) based hydrophilic hydrogel.¹



Figure S3. Water vapor transmission rate of the gels for 3 days.

The swelling kinetics of hydrogels:

The swelling kinetic test of pSBAA/15 hydrogels has been implemented in an artificial wound exudate solution (2% bovine albumin, 0.02 M calcium chloride dihydrate, 0.4 M sodium chloride, 0.08 M tris methylamine in de-ionized water, pH 7.5) at 35 °C for 550 min. The results indicated that pSBAA/15 hydrogels rapidly swelled within 60 min and gradually reach to equilibrium until 180 min in Figure S4.



Figure S4. Swelling kinetic curve of hydrogel in mimic wound exudate solution.

The sterile efficacy of hydrogel:

The sterile efficacy has been evaluated by immersing the hydrogels in sterile LB broth solution at 35 °C for 24 h. Obviously, the solution with sterile hydrogels was yellowish transparent after incubation as the same as sterile fresh LB broth solution in Figure S5a. In contrast, the solution with non-sterile hydrogel became turbid. Furthermore, the turbidity was measured by a

spectrophotometer (Synergy 2, BioTek) at a wavelength of 670 nm in Figure S5b. The optical densities of LB broth solutions have no statistic difference between the LB broth solutions with and without sterile hydrogels.



Figure S5. a) Fresh LB broth solutions (1) and that after incubation with sterile hydrogel (2), and non-sterile (3) hydrogels. **b)** OD670 of LB broth solutions. The fresh sterile LB broth solution as control. $^{\#}p > 0.05$, $^{**}p < 0.01$.

Independent dressing test:

We have conducted a 3-day in vivo test (number of samples = 4) in which the pSBAA/15 hydrogels on wounds were covered with gauze. On Day 3, the hydrogels lost weight by 60% as shown in Table S1, likely due to water evaporation and absorption by the gauze. However, the hydrogels did not totally dry out and still exhibited nonsticking property to the wounds in Figure S6.

Sample code	1	2	3	4	Mean±SD
Weight on Day 0 (g)	0.25	0.25	0.25	0.26	0.25 ± 0.01
Weight on Day 3 (g)	0.08	0.06	0.11	0.12	0.09 ± 0.03
Weight loss (g)	0.17	0.19	0.14	0.14	$\textbf{0.16} \pm \textbf{0.02}$
Weight loss (%)	68	76	56	53.85	63.46 ± 10.42

 Table S1. Weight of hydrogels after 3 days on wound.



Figure S6. The appearance of the prepared hydrogel at Day 0 (a) and the hydrogel on wound of an animal model without Tegaderm covered on Day 3 (b). Scale bar = 1 cm.

Refernce:

1. B. Boonkaew, P. Suwanpreuksa, L. Cuttle, P. M. Barber and P. Supaphol, J Appl Polym Sci, 2014, **131**.