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Supporting information

Synthesis of new kind of macroporous polyvinyl-alcohol formaldehyde based sponges and its water superabsorption performance

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1. ***G*rafting percentage (*GP*) and grafting efficiency (*GE*)**

The nitrogen content of as-prepared PVF-g-PAM was also measured by elementary analysis, and the *GP* and *GE* were also calculated as the following equation:

$$GP = \frac{W_2 \times a\%}{W_0} \times 100 = \frac{W_2 \times a\%}{W_2 - W_2 \times a\%} \times 100 = \frac{W_2 \times a\%}{W_2 - W_2 \times a\%} \quad 10 \qquad (1)$$

$$GE = \frac{W_2 \times a\%}{W_1} \times 100 \qquad (2)$$

where W_0, W_1, W_2 and $a\%$ are the weight (g) of pristine PVF sponge, AM monomer, dried PVF-g-PAM after removing the homopolymer , the grafted PAM content (w/w) in the PVF-g-PAM, respectively.

In the term of relationship between $a\%$ in the PVF-g-PAM and nitrogen content ($N\%$) obtained using the elementary analysis can be written as follow;

$$N\% = \frac{W_2 \times a\% \times 14.0/71.1}{W_2} = \frac{14.0}{71.1} \times a\% \qquad (3)$$

where the *N%*, 14.0 and 71.1 are the nitrogen content of as-prepared PVF-g-PAM, the standard weight of nitrogen atom and the molar mass of acrylamide, respectively. Substitution of Eq. (3) into the Eq. (1) and Eq. (2) leads to

$$GP = \frac{N\% \times 71.1/14.0}{1 - N\% \times 71.1/14.0} \times 100 = \frac{N\%}{0.197 - N\%} \times 100 \qquad (4)$$

$$GE = \frac{W_2 \times N\% \times 71.1/14.0}{W_1} \times 100 = \frac{W_2 \times N\%}{0.197W_1} \times 100 \qquad (5)$$

2. Hydrolysis degree (*HD*)

$$n = x + y \qquad (6)$$

$$HD = \frac{y}{n} \times 100 \qquad (7)$$

where the *n*, *x* and *y* is the total molar amount of AM in a particular sample, the molar amount of residue AM and hydrolyzed AM under alkaline condition, respectively. The nitrogen content for a specific sample can also be calculated as the following equation:

$$N\% = \frac{14.0n}{m_0 + 71.1n} \qquad (8)$$

while the m_0 is the weight of one particular sample. Thus, the Eq. (8) is reduced to

$$n = \frac{m_0.N\%}{14.0 - 71.1.N\%} \qquad (9)$$

After hydrolysis under alkaline condition, the nitrogen content ($N_1\%$) of sample can be expressed as:

$$N_1\% = \frac{14.0x}{71.1x + 94.0y + m_0} \qquad (10)$$

where 94.0 is the molar mass of sodium acrylate formed after hydrolysis. After reducing the Eq. 10, the *y* can be expressed as follow:

$$y = \frac{14.0x - 71.1x.N_1\% - N_1\%.m_0}{94.0.N_1\%} \qquad (11)$$

Substitution of Eq. 7 and Eq.9 into Eq. 10 or 11, we have the following equation:

$$HD = \left(1 - \frac{23 + 14/N\%}{23 + 14/N_1\%}\right) \times 100 \tag{12}$$

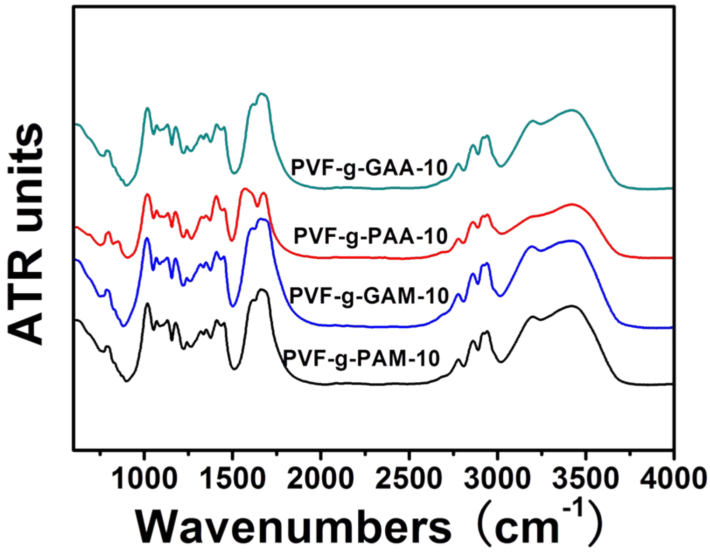

Fig S1. FTIR spectra of PVF-g-PAM-10, PVF-g-PAA-10, PVF-g-GAM-10 and PVF-g-GAA-10.

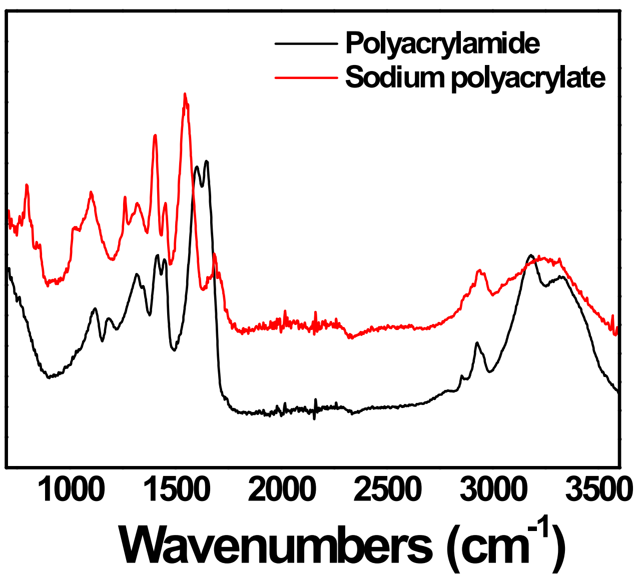

Fig S2. FTIR spectra of pure PAM (polyacrylamide (non-ionic, *Mw*=5 to 6000, Acros organics)) and PAANa (sodium polyacrylate, Mw= 20000, International Laboratory USA) sodium.

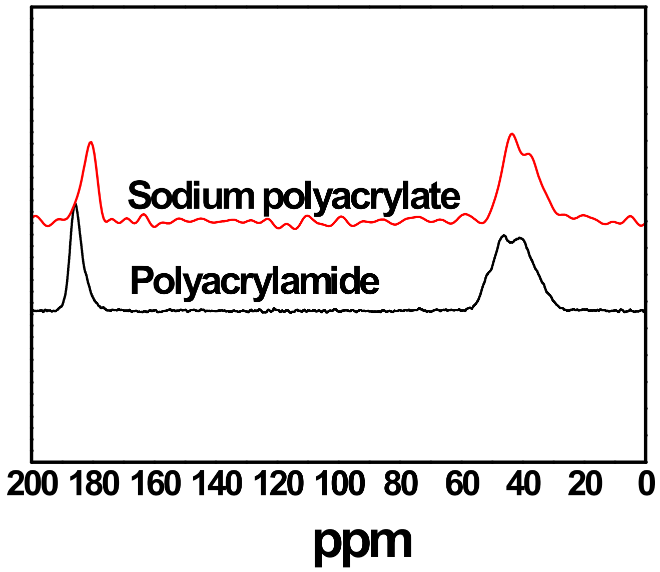

Fig S3. Solid-state CP/MAS ^{13}C NMR spectra of polyacrylic acid and polyacrylamide.

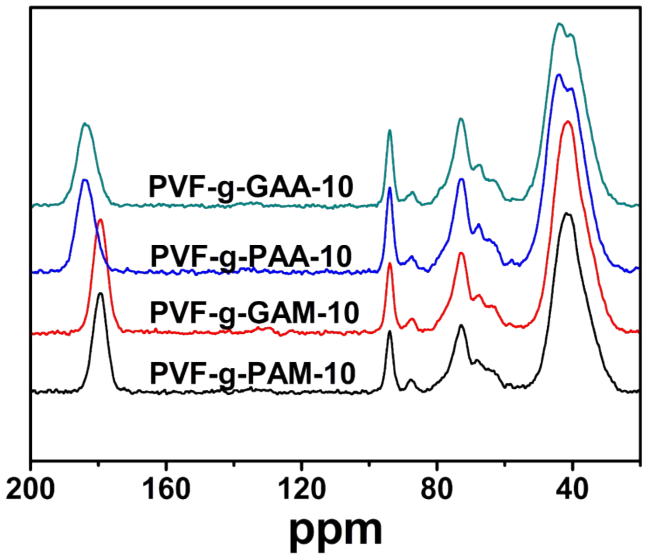

Fig S4. Solid-state CP/MAS ^{13}C NMR spectra of PVF-g-PAM-10, PVF-g-GAM-10, PVF-g-GAA-10 and PVF-g-GAA-10 at 25 ^{o}C.

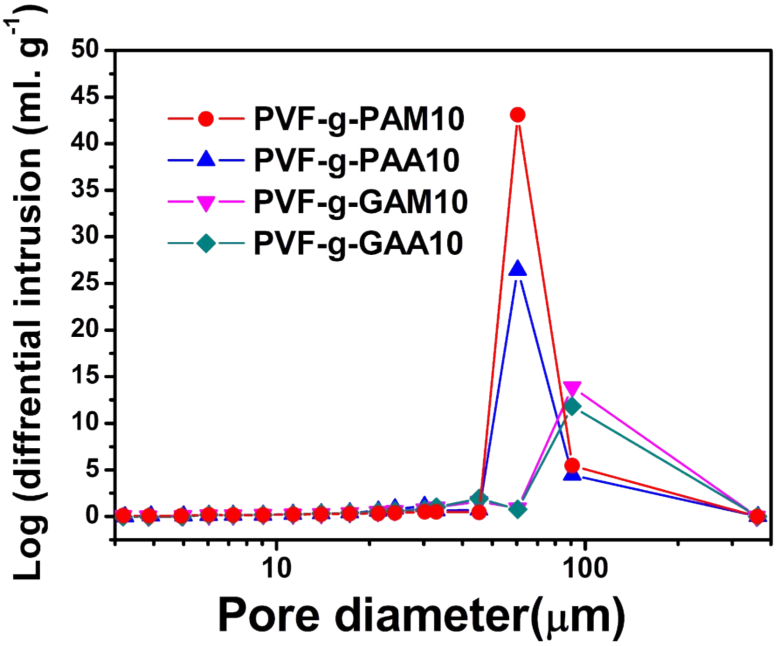

Fig S5. Pore size distributions of PVF-g-GAM-10, PVF-g-PAM-10, PVF-g-PAA-10 and PVF-g-GAA-10

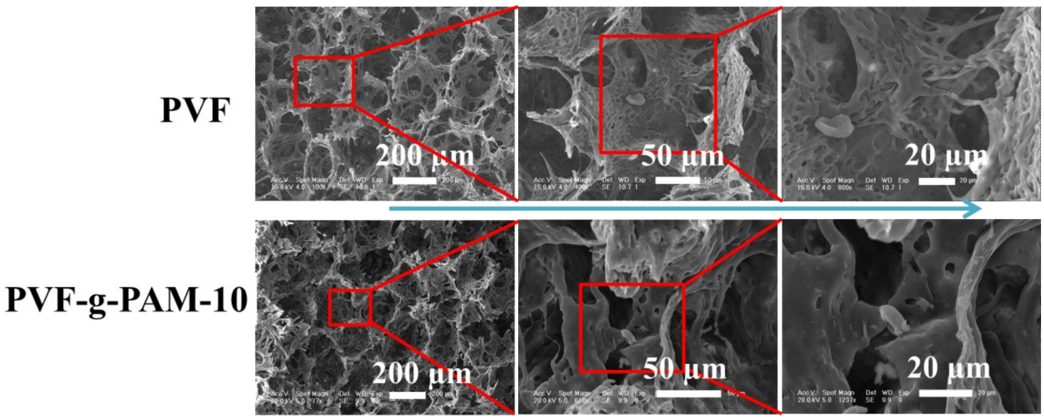

Fig S6. SEM images of original PVF and PVF-g-PAM-10 (from left to right: enlarge view of local structure in left)