Supporting information

Highly Efficient Macroporous Adsorbents for Toxic Metal Ions in Water System Based on Polyvinyl Alcohol-Formaldehyde Sponges

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Part I

1. Grafting 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:

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

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

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;

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

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

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

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

2. **Hydrolysis degree (*HD*)**

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

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

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:

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

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

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

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

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

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:

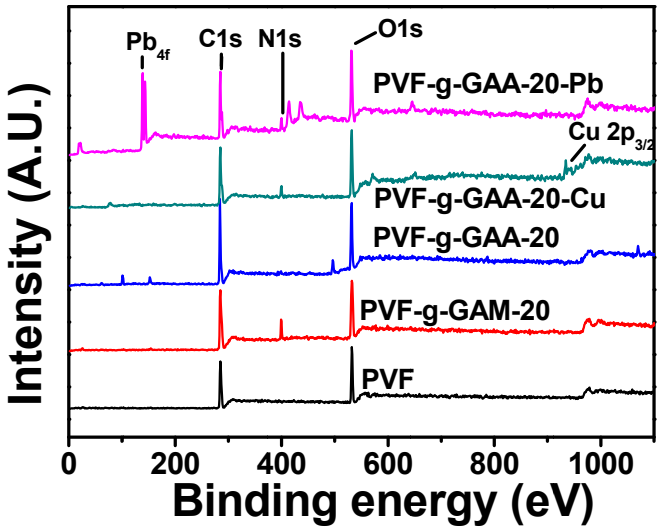
$$\mathrm{y} = \frac{14.0x - 71.1x.N_1\% - N_1\%.m_0}{94.0.N_1\%} \quad (11)$$

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

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

Part II

a)



b)

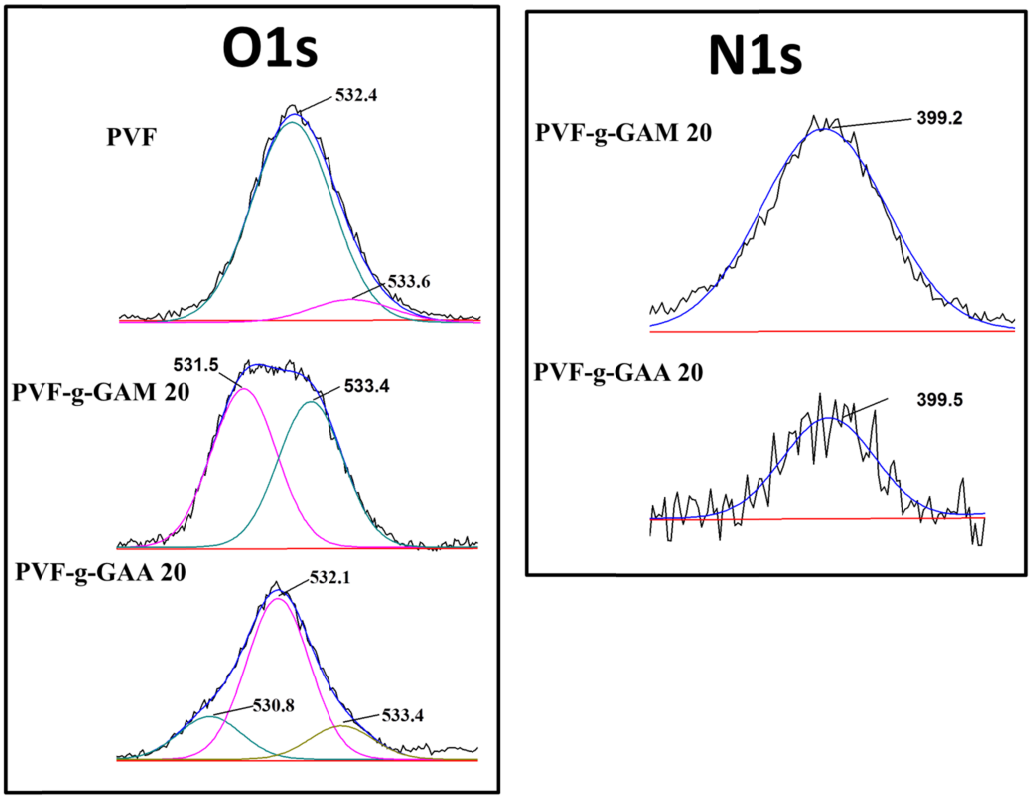


Figure S1. XPS spectra of samples,(a) survey scanning of PVF, PVF-g-GAM-20, PVF-g-GAA-20,PVF-g-GAA-20-Cu, PVF-g-GAA-20-Pb, (b) N and O assignment for PVF, PVF-g-GAM-20, PVF-g-GAA-20.