Glow discharge electrolysis plasma induced synthesis of cellulose-based ionic hydrogels and their multiple response behaviors

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**Figure S1.** Photographs of wet hydrogel (a), dried hydrogels (b), and hydrogel after swelling equilibrium (c).
Figure S2. Nitrogen sorption isotherm of cellulose-based ionic hydrogel (the discharge voltage and discharge time is 570 V and 90 s, respectively).

Figure S2 shows the N$_2$ sorption isotherm of the freezed dried cellulose-based ionic hydrogel after absorbing water sufficiently. The sample was measured using automated surface area and pore size analyzer (Quantachrome Autosorb-1 MP). The surface area was 2.131 m$^2$/g.
Figure S3. FT-IR of cellulose-based ionic hydrogels after adsorbing heavy metal ions (a) Na\(^+\), (b) Zn\(^{2+}\), and (c) Fe\(^{3+}\).

Figure S3 shows the infrared spectrogram of cellulose-based ionic hydrogels after adsorbing heavy metal ions. As the Na\(^+\), Zn\(^{2+}\), Fe\(^{3+}\) ions were adsorbed by cellulose-based ionic hydrogels, the peak at 1722 cm\(^{-1}\) (C=O stretching vibration) (Fig. 7b) was disappeared completely implying that complexation was possible and new peaks appeared at 1644, 1625, 1635 cm\(^{-1}\) on curve (a), (b) and (c), respectively.\(^1\) In addition, the peaks at 1543 and 1456 cm\(^{-1}\) (the stretching vibration of COO\(^-\)) (Fig. 7b) were shifted to lower wavenumbers after adsorbing Na\(^+\), Zn\(^{2+}\) metal ions, or even disappeared after adsorbing Fe\(^{3+}\). Besides, the intensity of the peaks of Zn\(^{2+}\) was weaker than Na\(^+\).

All results indicated that oxygen atoms in cellulose-based ionic hydrogels donated unshared electron pairs to the metal ions to form coordinate-covalent bonds and the coordination between Fe\(^{3+}/Zn^{2+}\) and carboxyl group was obvious stronger than that Na\(^+\).\(^2-4\)

References:

1. Wang, X. G., Gao, J. Z. and Yang, W., Polymer Engineering and Science, 2012, 52, 2217-
