

Supplementary Information

Preparation of polyoxometalate-based composite by solidification of high-active-cobalt-containing polytungstate on polymeric ionic liquid for the efficient isolation of Proteinase K

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N,N-dimethyl-dodecyl-(4-vinylbenzyl) ammonium chloride (DDVAC): yellow wax solid. ^1H NMR (500 MHz, CDCl_3) δ 7.54 (d, $J=8.0$ Hz, 2H), 7.36 (d, $J=8.0$ Hz, 2H), 6.67 (dd, $J=17.6, 10.9$ Hz, 1H), 5.77 (d, $J=17.6$ Hz, 1H), 5.32 (d, $J=10.9$ Hz, 1H), 4.96 (s, 2H), 3.42 (dd, $J=28.0, 19.7$ Hz, 2H), 3.24-3.09 (m, 6H), 1.76 (s, 2H), 1.36-1.10 (m, 18H), 0.85 (t, $J=7.0$ Hz, 3H).

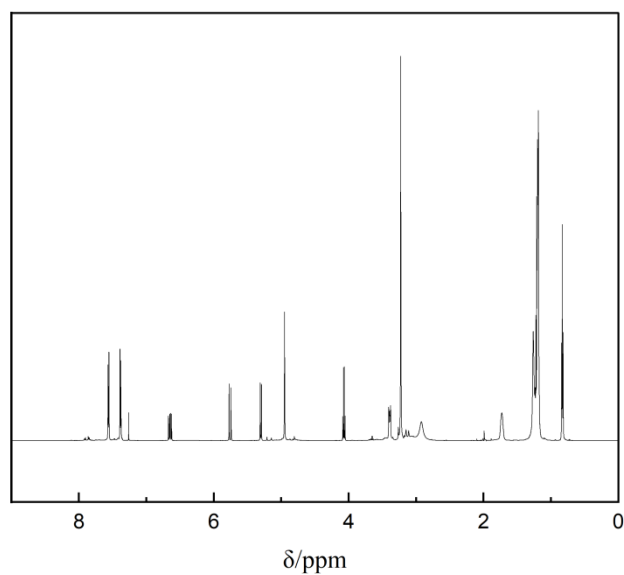


Figure S1. ^1H -NMR spectra of ionic liquid DDVAC.

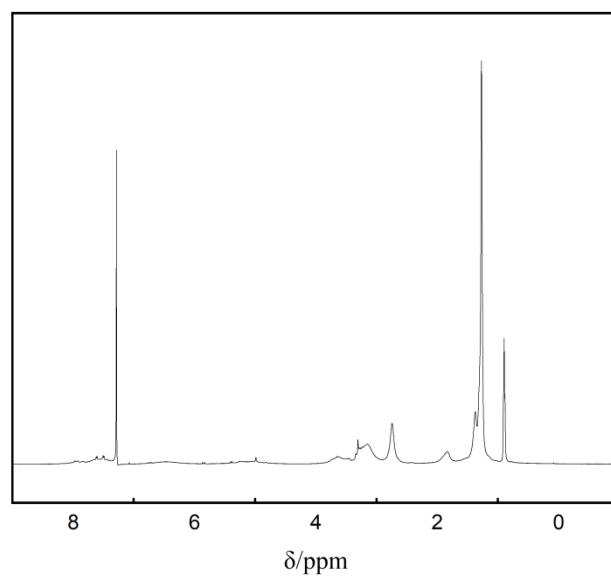


Figure S2. ¹H-NMR spectra of polymeric ionic liquid PDDVAC.

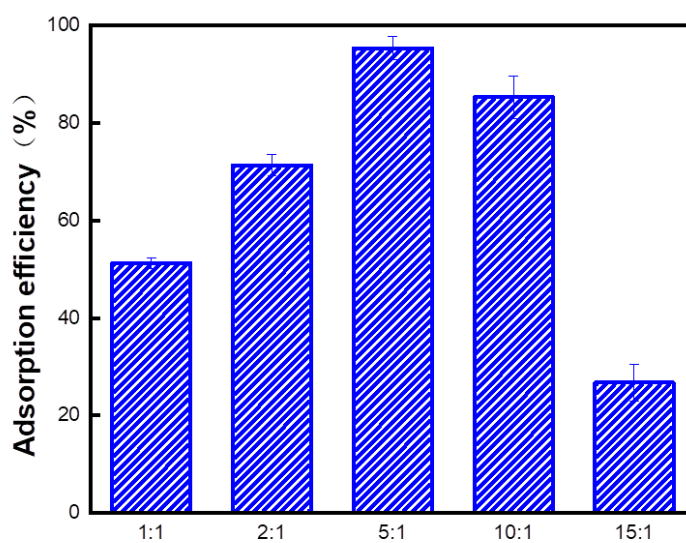


Figure S3. Adsorption efficiency of proteinase K on PDDVAC/Co₄PW molar ratio prepared from PDDVAC/Co₄PW ratio of 1:1, 2:1, 5:1, 10:1, and 15:1. Protein solution: 100 $\mu\text{g mL}^{-1}$, 1.0 mL; Co₄PW-PDDVAC composite: 0.2 mg; pH: 4.0.

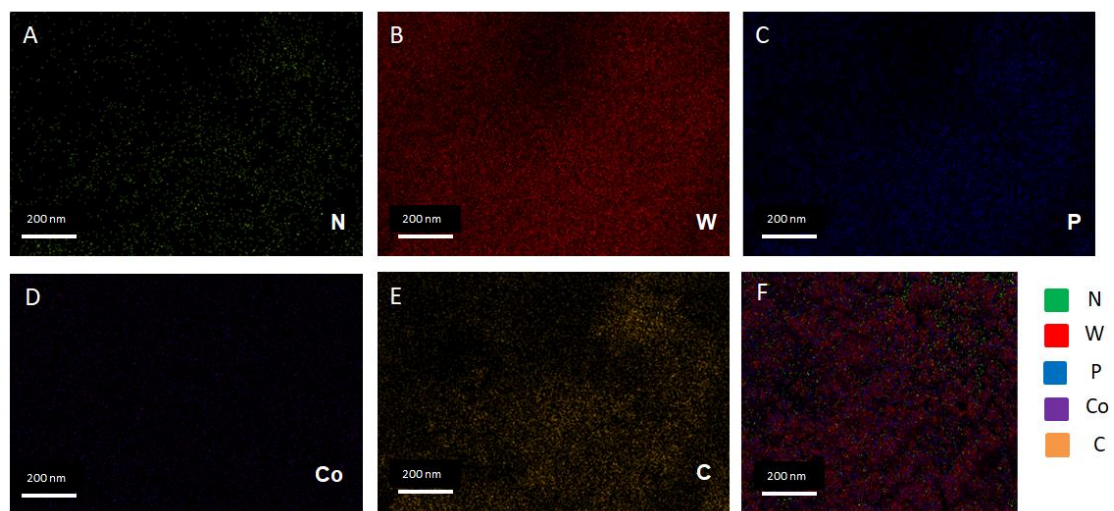


Figure S4. EDS mappings of element N (A), W (B), P (C), Co (D), C (E) and Co₄PW-PDDVAC composite (F).

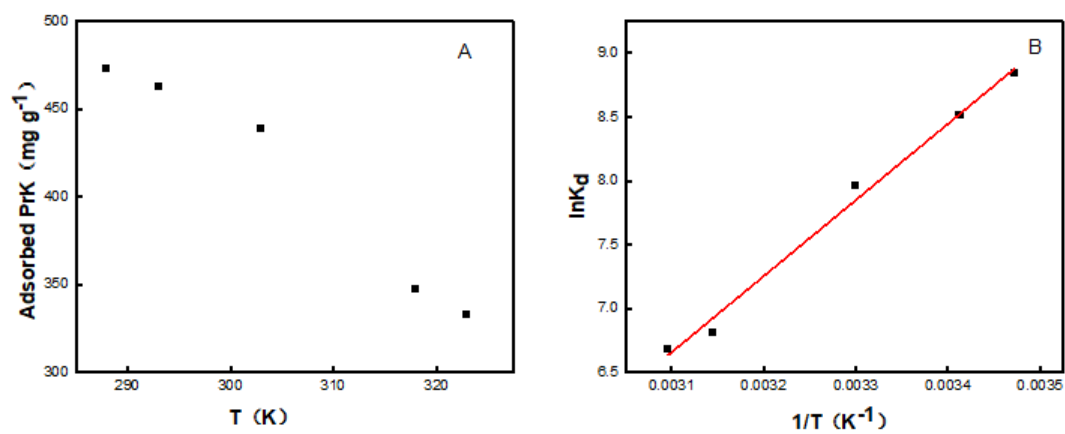


Figure S5. (A) The amount of adsorbed PrK on Co₄PW-PDDVAC composite under different temperature. (B) The corresponding thermodynamic curve.

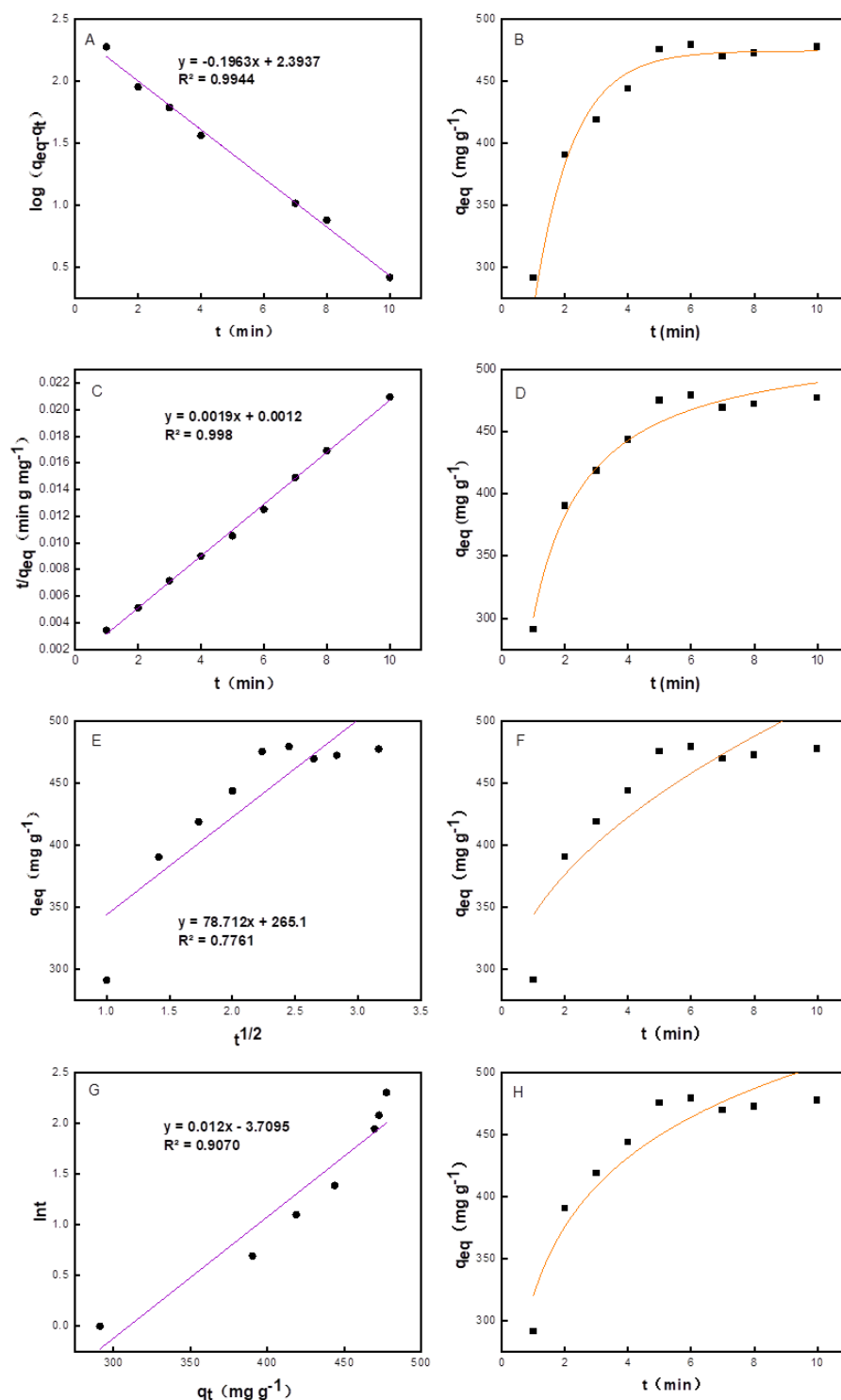


Figure S6. Linear and non-linear plots of pseudo first order equation kinetic model (A-B), pseudo second order equation kinetic model (C-D), intra particle kinetic model (E-F), Elovich kinetic model (G-H) of PrK adsorption on Co₄PW-PDDVAC composite.

Table S1. Elemental analysis results of POM-PDDVAC composites.

Element	CoPW-PDDVAC	Co ₄ PW-PDDVAC	Co ₉ PW-PDDVAC
Co/%	4.0	5.0	6.0
N/%	1.0	1.0	2.0
P/%	11.0	14.0	11.0
W/%	62.0	62.0	56.0
C/%	22.0	18.0	26.0
POM percentage/%	89.7	84.0	67.0