Supporting Information for

Charge-switchable zwitterionic nanomagnets for wastewater remediation

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Determination of isoelectric point (IEP):

The isoelectric point of the NTA@SPIONs was determined by recording the zeta potential of the particle dispersions over a range of pH from 3 to 7. The medium pH was adjusted by the addition of 0.1M HCl. The obtained zeta potential was plotted against pH. The pH at which the plot intersects $\zeta=0$ is taken as the isoelectric point.

Reusability tests:

After adsorption, the magnetically collected adsorbent material was dispersed in proper eluting mediums, followed by bath sonication, to desorb the loaded dye species. For MB, an HCL solution (pH=3) was used, and for CR, a NaOH solution (pH=11) was employed as the eluting medium. Following the elution, the adsorbent material was collected with a bar magnet. The whole eluting process was repeated twice. Finally, the adsorbent material was washed thoroughly with miliQ water and dried overnight. For the reusability test, the adsorption-desorption cycle was repeated five times. After each cycle, the supernatant was analyzed to estimate the removal efficiency of the adsorbent.

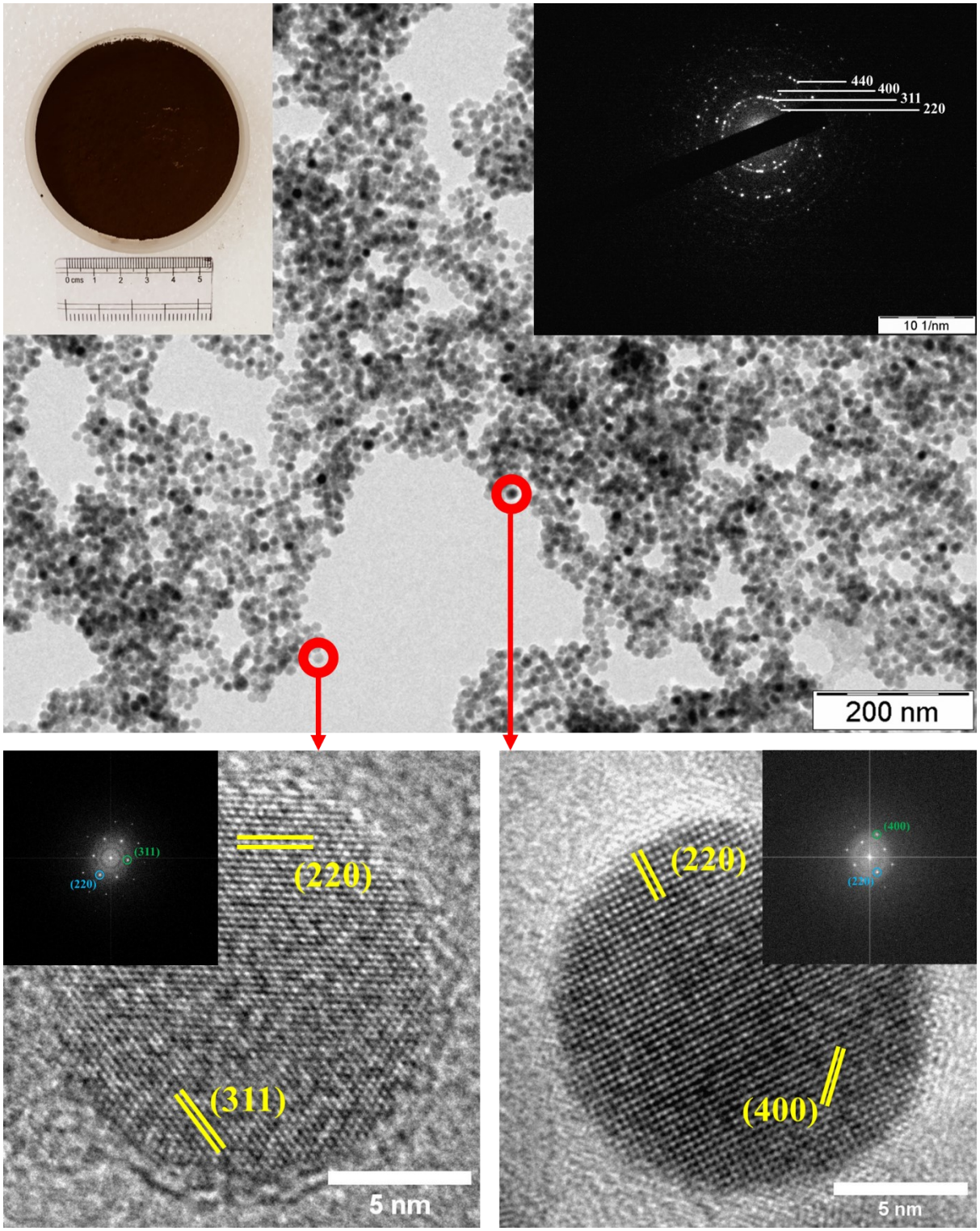

Figure S1: Large-area TEM image of NTA@SPIONs with a photograph of material obtained from a single batch (left inset) and indexed SAED pattern matching with spinel magnetite phase (right inset). HRTEM and corresponding FFT (inset) for a particle with (a) light, and (b) dark contrast. Indexed planes match with the spinel magnetite phase.

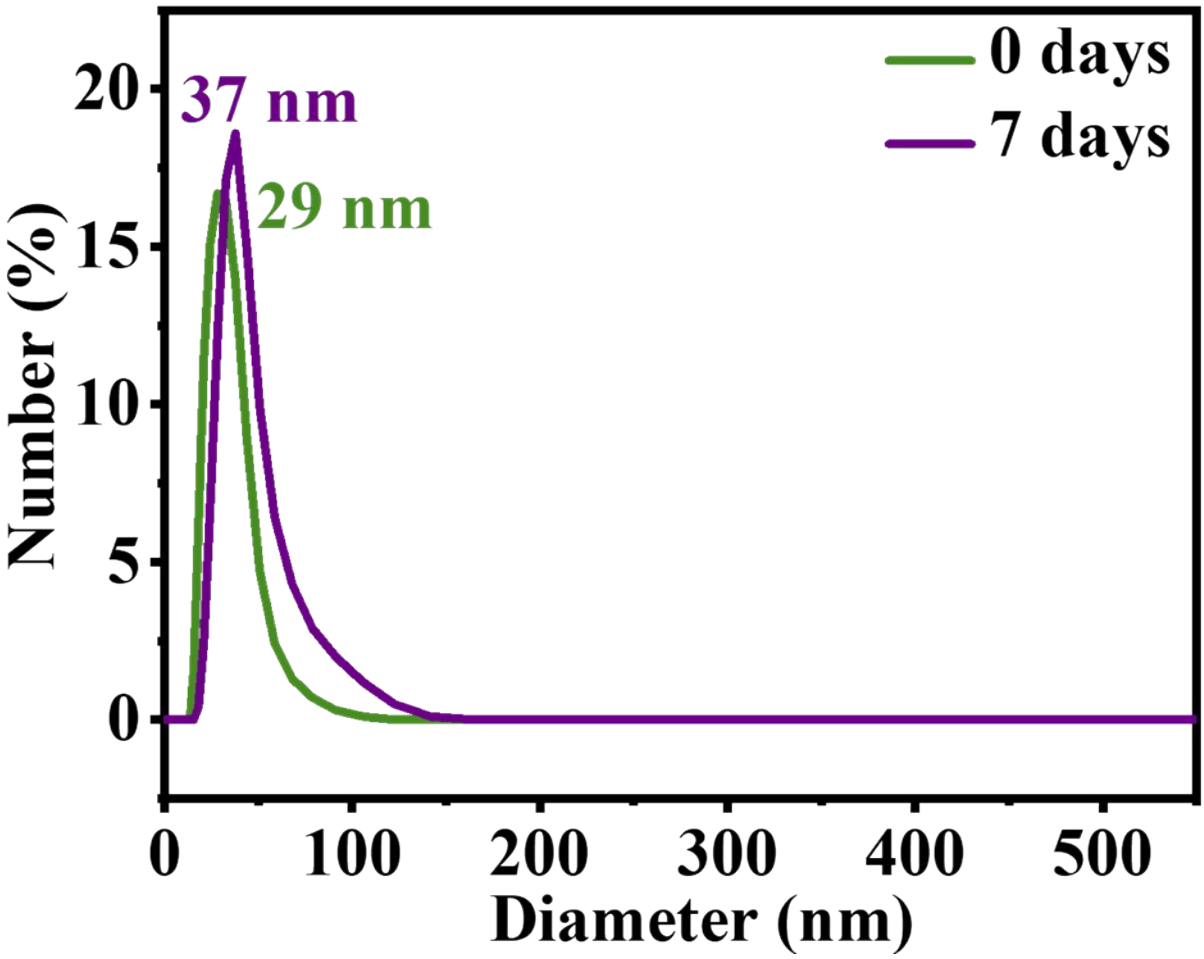

Figure S2: Hydrodynamic particle size measurement (DLS) of NTA@SPIONs immediately after preparation and after a gap of seven days.

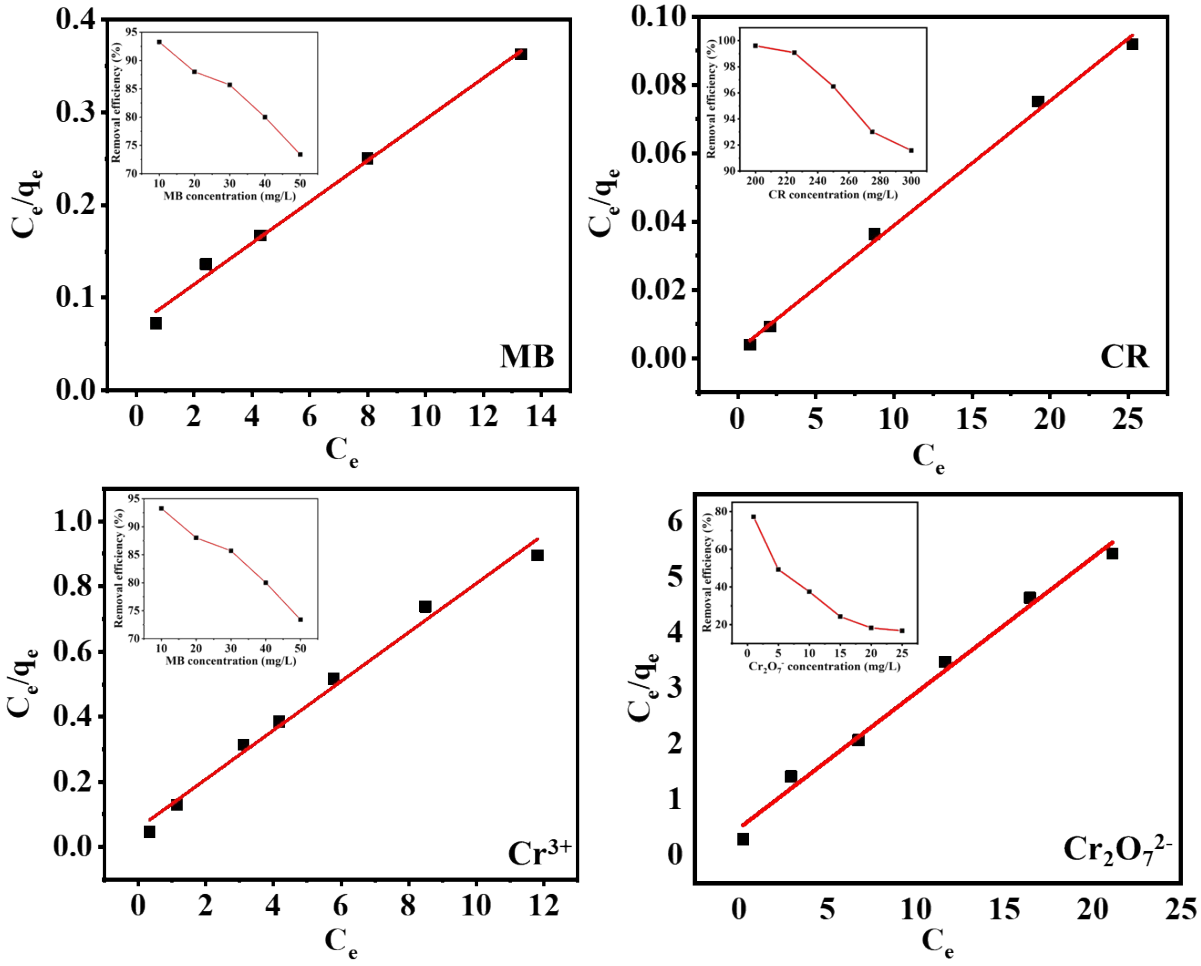

Figure S3: Langmuir isotherm fitting for MB, CR, Cr^{3+} and $Cr_2O_7^{2-}$. Inset shows the dependency of removal efficiency on adsorbate concentration.

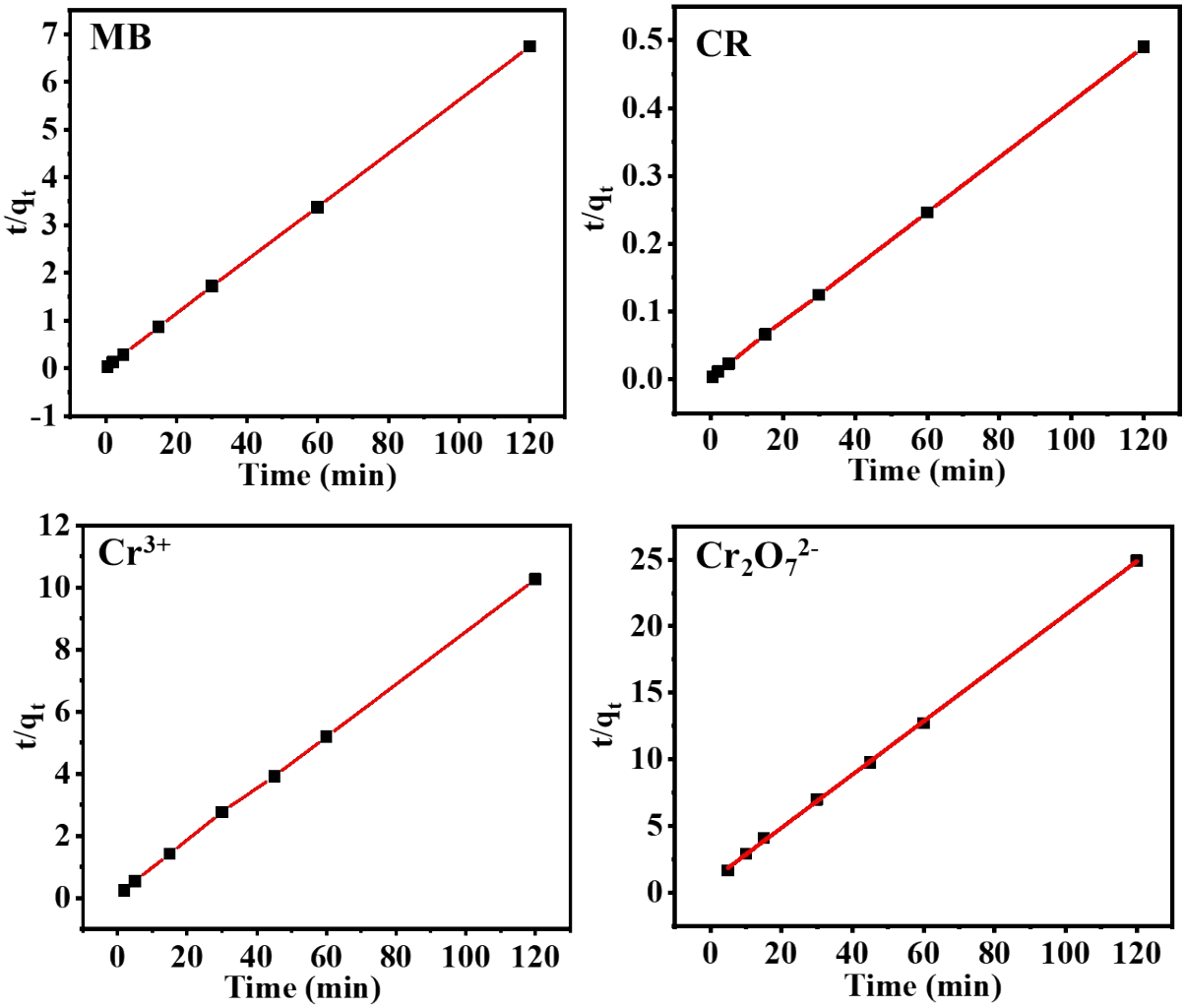

Figure S4: Pseudo-second order kinetics fitting for MB, CR, Cr^{3+} and $Cr_2O_7^{2-}$.

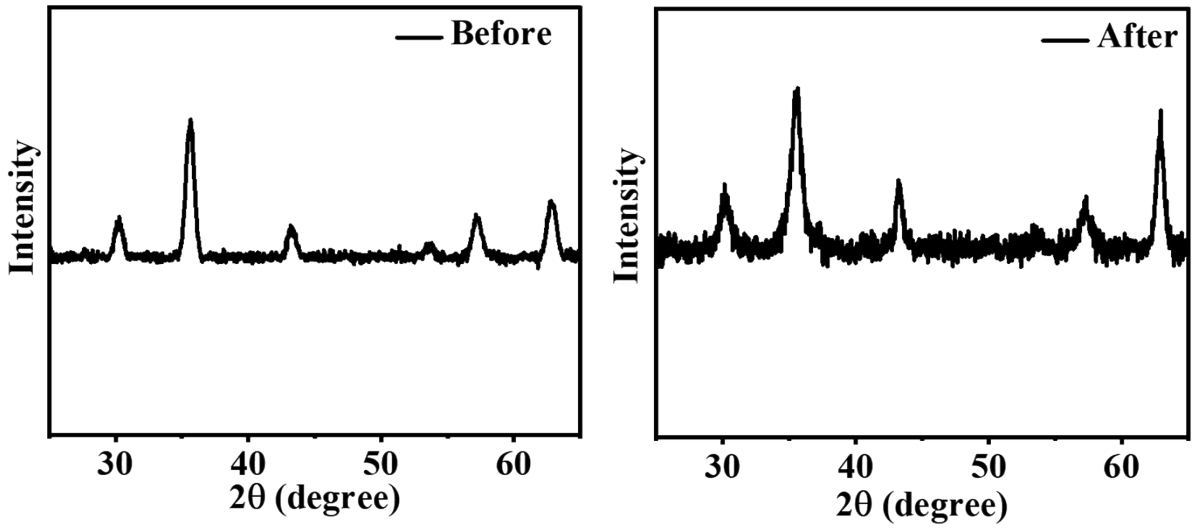

Figure R5: PXRD of the NTA@SPIONs before and after $Cr_2O_7^{2-}$ adsorption.

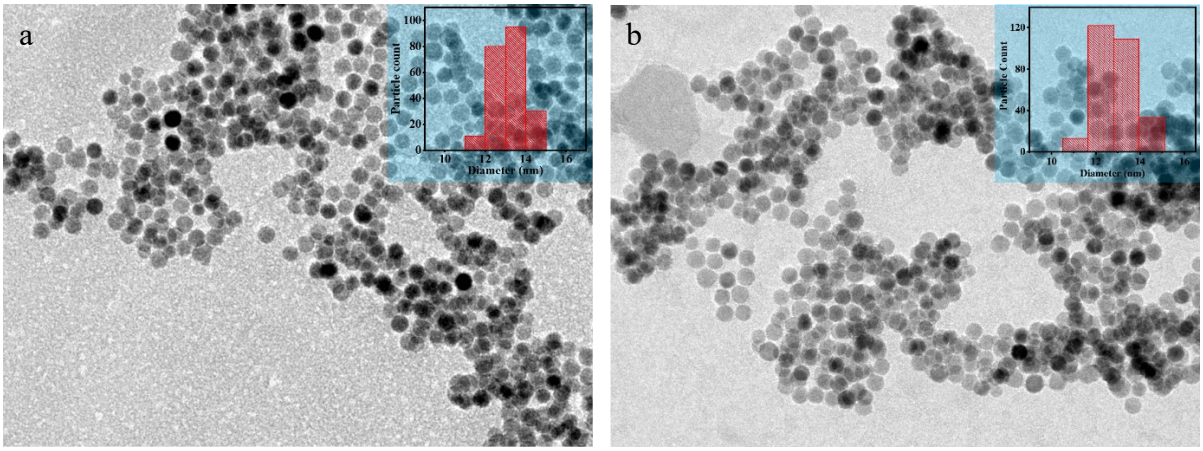

Figure R6: TEM images of the NTA@SPIONs (a) before and (b) after $Cr_2O_7^{2-}$ adsorption.

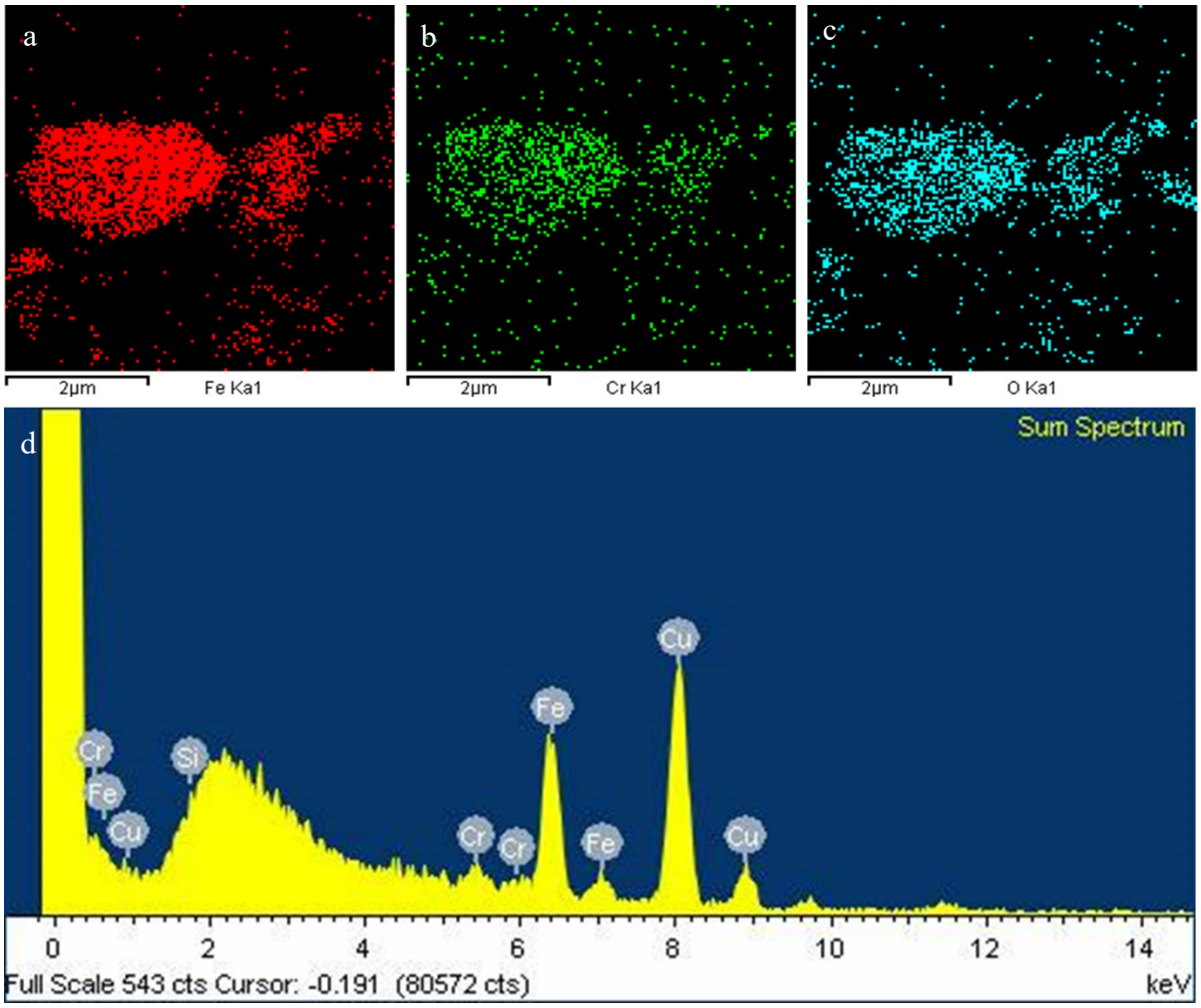

Figure R7: EDS elemental mapping of the NTA@SPIONs after $Cr_2O_7^{2-}$ adsorption at pH 4 (a) Fe, (b) Cr, and (c) O. (d) EDS spectrum of the NTA@SPIONs after $Cr_2O_7^{2-}$ adsorption.

Model	Langmuir		
Parameters	q_m	b	R^2
MB	**44.98**	**0.32**	**0.99**
CR	**273.79**	**1.51**	**0.99**
Cr^{3+}	**13.31**	**1.29**	**0.98**
$Cr_2O_7^-$	**4.10**	**0.49**	**0.98**

Table S1: Langmuir isotherm fitting parameter for the pollutants.

Model	Pseudo-second order	
Parameters	k	R^2
MB	**0.202**	**0.99**
CR	**0.052**	**0.99**
Cr^{3+}	**0.054**	**0.99**
$Cr_2O_7^-$	**0.046**	**0.99**

Table S2: Pseudo-second order fitting parameter for the pollutants.

References:

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