Supplementary Information

Enhanced Removal of Toxic Cr(VI) and Pb(II) from Water Using Carboxylic Terminated $Ti_3C_2T_x$ Nanosheets

Table S1
Stock solutions of batch-1 and their further analysis under various sonication and temperatures conditions. An aliquots of 10 mL from each sub-sample solution # was collected with a regular interval of 2 min. Likewise 400 ppm and 600 ppm stock solutions and their sub-sample solutions were prepared and evaluated.

Conditions	**200 ppm - $Pb(NO_3)_2$ Solutions (600 mL)**			**200 ppm - $K_2Cr_2O_7$ Solutions (600 mL)**		
Temperature	**25** ℃	**50** ℃	**75** ℃	**25** ℃	**50** ℃	**75** ℃
Sonication (10 min)	Sample #1 (60 mL)	Sample #4 (60 mL)	Sample #7 (60 mL)	Sample #1 (60 mL)	Sample #4 (60 mL)	Sample #7 (60 mL)
Sonication (20 min)	Sample #2 (60 mL)	Sample #5 (60 mL)	Sample #8 (60 mL)	Sample #2 (60 mL)	Sample #5 (60 mL)	Sample #8 (60 mL)
Sonication (30 min)	Sample #3 (60 mL)	Sample #6 (60 mL)	Sample #9 (60 mL)	Sample #3 (60 mL)	Sample #6 (60 mL)	Sample #9 (60 mL)

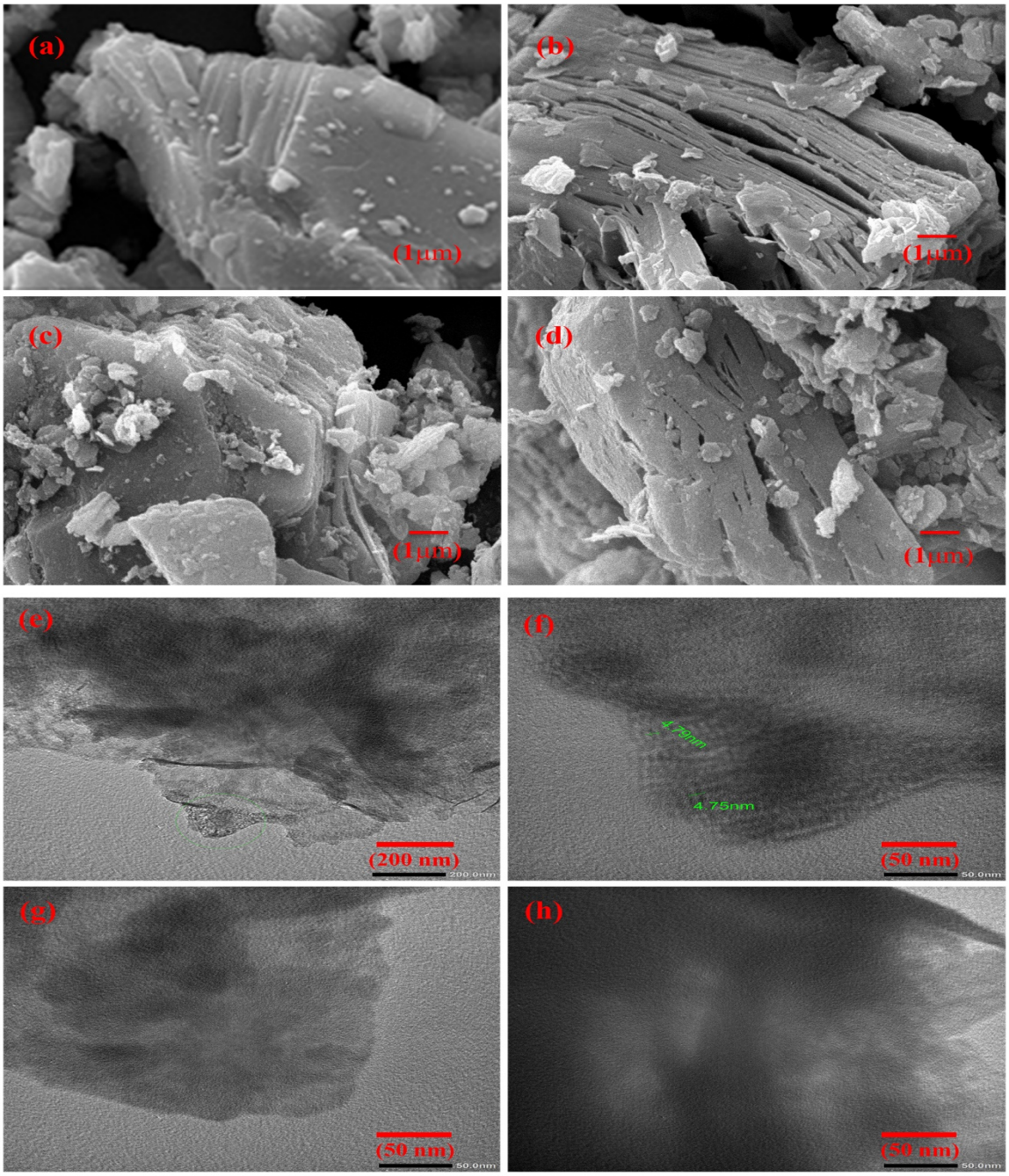


Figure S1. SEM images of (a) Ti_3AlC_2 MAX phase (b) $Ti_3C_2T_x$ MXenes (c) Cr-$Ti_3C_2T_x$ and (d) Pb-$Ti_3C_2T_x$ nanosheets., and TEM images of (e) and (f) $Ti_3C_2T_x$ MXenes (g) Cr-$Ti_3C_2T_x$ and (h) Pb-$Ti_3C_2T_x$ nanosheets.

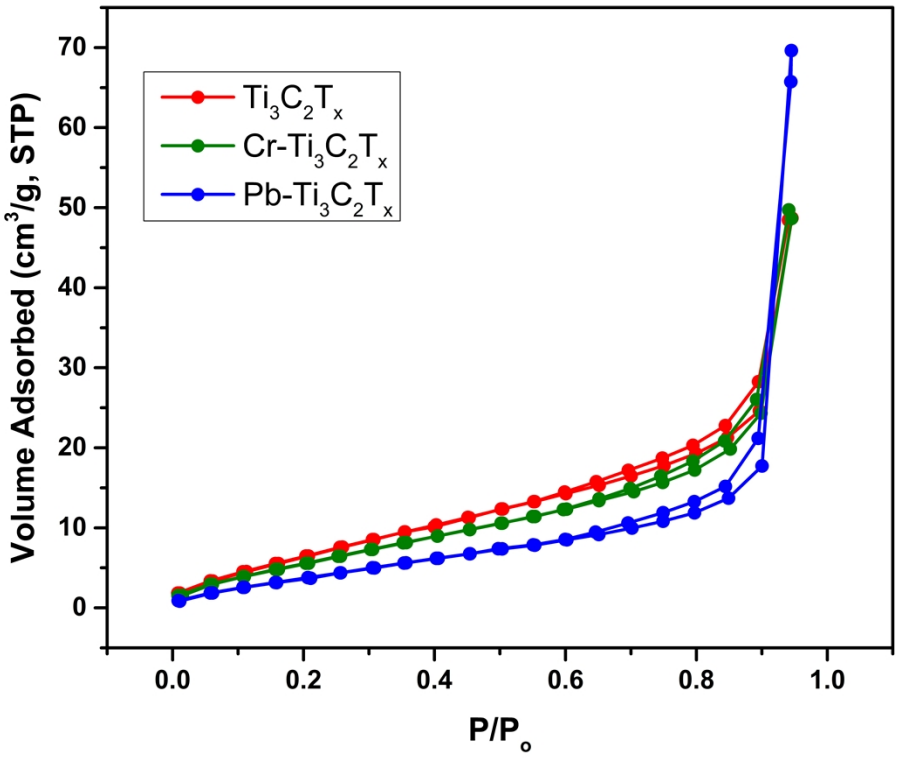


Figure S2. N_2 adsorption-desorption isotherms of the MXenes nanosheets before and after metal ions adsorption.

Table S2
EDX results of Ti_3AlC_2 MAX phase and pre and post adsorption $Ti_3C_2T_x$ samples.

Samples	Elements (At.%)							
	Ti	Al	C	O	F	N	Cr	Pb
Ti_3AlC_2	30.5	20.9	48.6	-	-	-	-	-
$Ti_3C_2T_x$	25.3	-	28.2	30.1	9.4	6.9	-	-
Cr-$Ti_3C_2T_x$	37.2	-	25.0	29.7	3.5	2.4	2.3	-
Pb-$Ti_3C_2T_x$	35.2	-	27.4	26.5	3.8	5.8	-	1.3

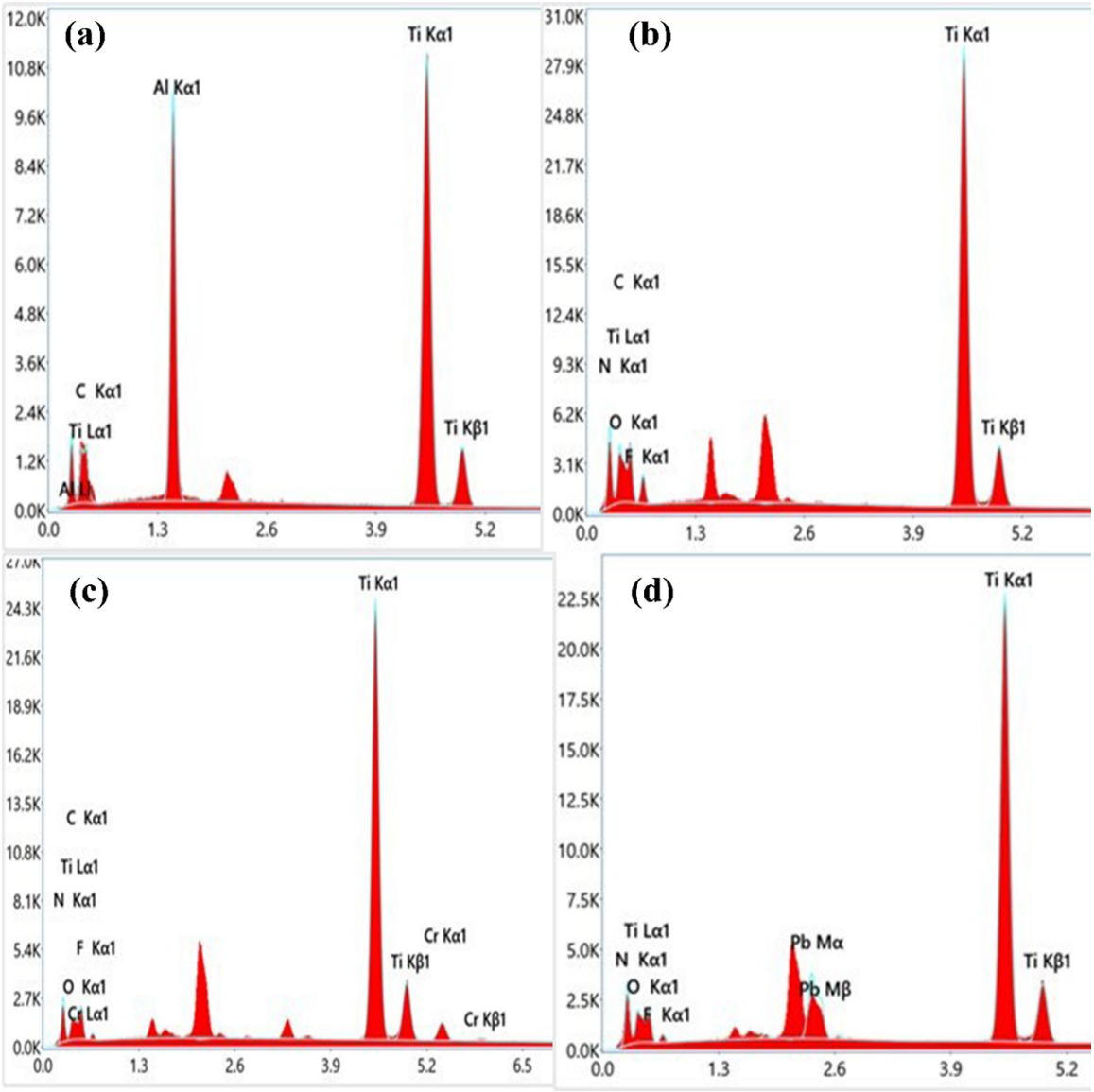


Figure S3: EDX spectrums of (a) Ti_3AlC_2 MAX phase (b) $Ti_3C_2T_x$ MXenes (c) Cr-$Ti_3C_2T_x$ and (d) Pb-$Ti_3C_2T_x$ nanosheets.

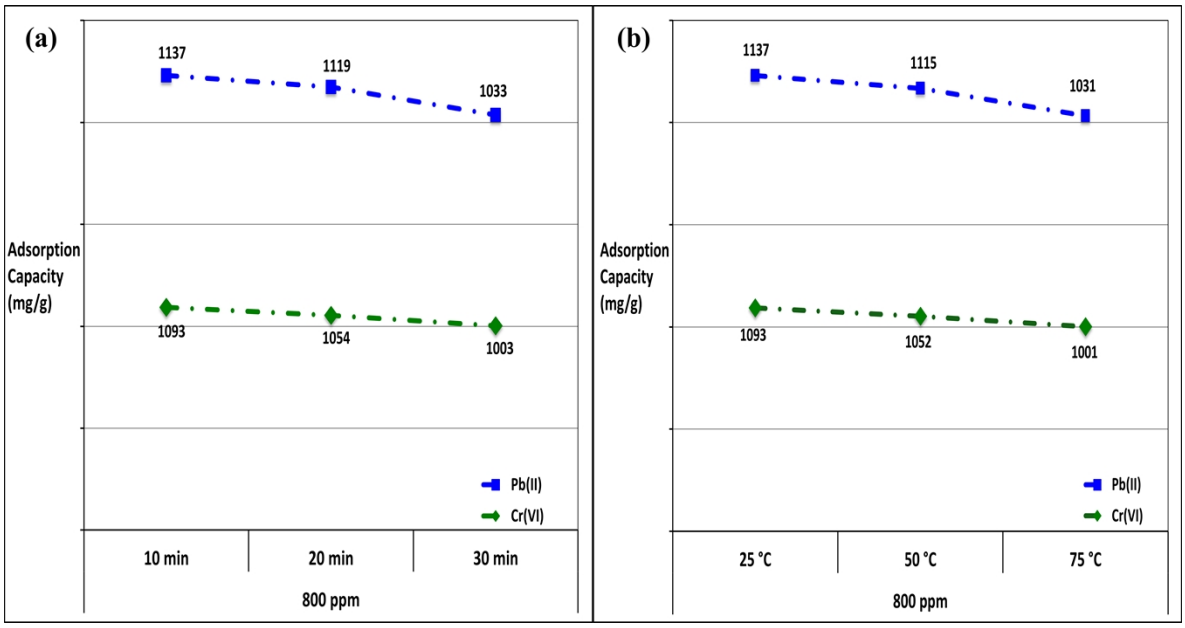
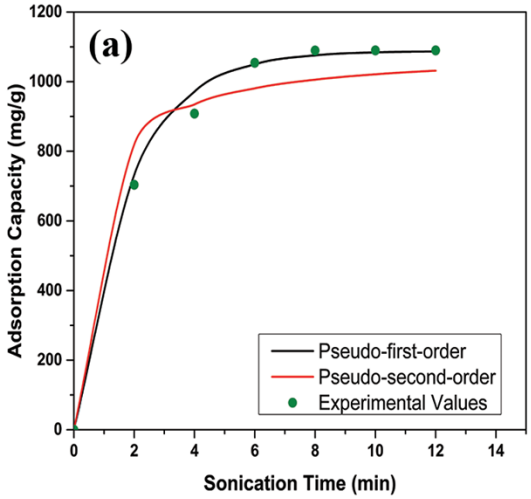
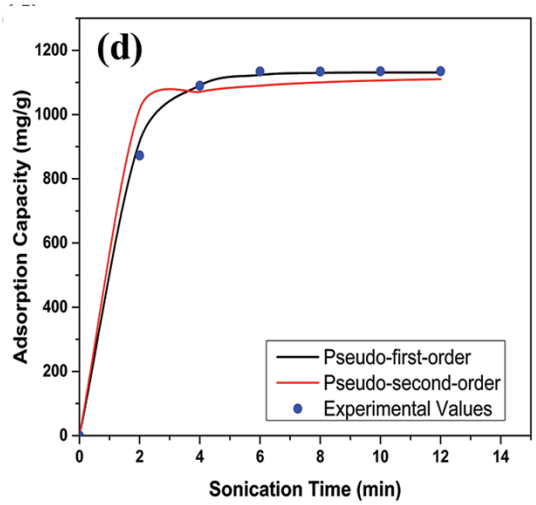
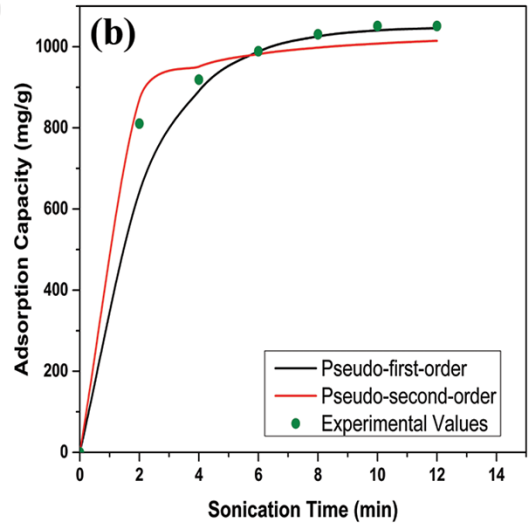
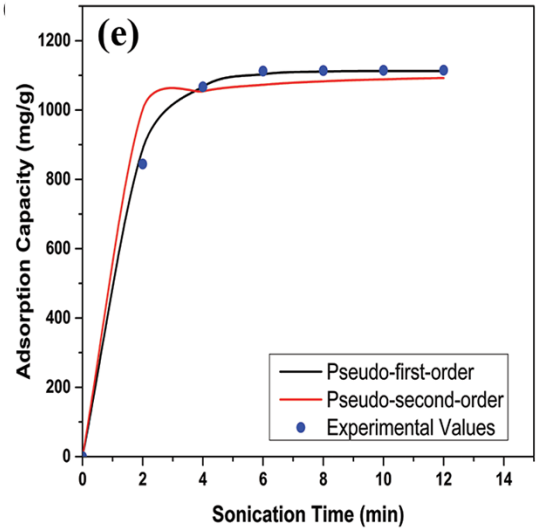


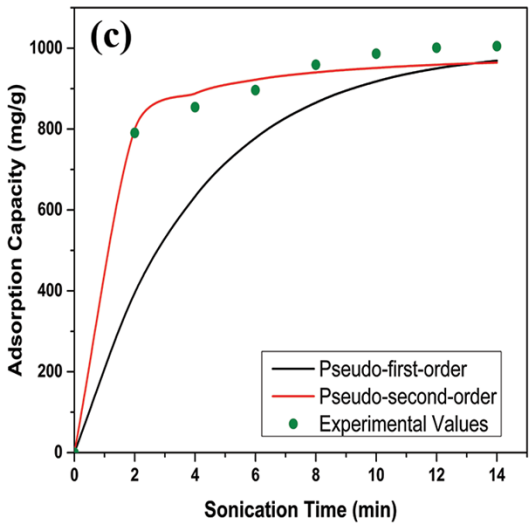
Figure S4: The effect of 800 ppm dosage on the adsorption capacity of $Ti_3C_2T_x$ nanosheets at various sonication duration and temperatures range.


(a)
Adsorption Capacity (mg/g)
Sonication Time (min)
Pseudo-first-order
Pseudo-second-order
Experimental Values


(d)
Adsorption Capacity (mg/g)
Sonication Time (min)
Pseudo-first-order
Pseudo-second-order
Experimental Values


(b)
Adsorption Capacity (mg/g)
Sonication Time (min)
Pseudo-first-order
Pseudo-second-order
Experimental Values


(e)
Adsorption Capacity (mg/g)
Sonication Time (min)
Pseudo-first-order
Pseudo-second-order
Experimental Values


(c)
Adsorption Capacity (mg/g)
Sonication Time (min)
Pseudo-first-order
Pseudo-second-order
Experimental Values

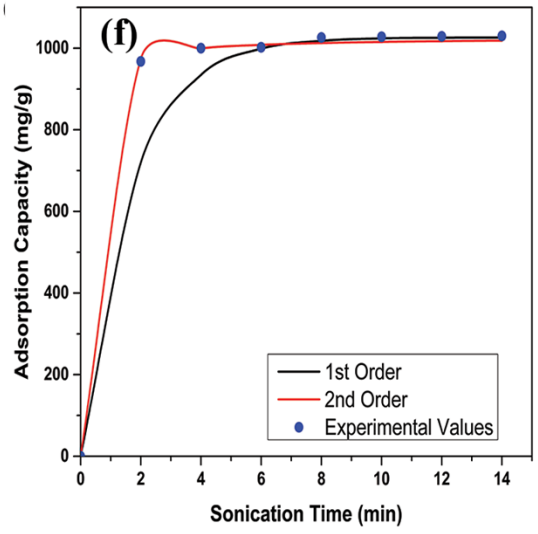

(f)
Adsorption Capacity (mg/g)
Sonication Time (min)
1st Order
2nd Order
Experimental Values

Figure S5. Pseudo orders reactions and equilibrium achieved for Cr (VI) adsorption at (a) 25 ℃, (b) 50 ℃ (c) 75 ℃ and for Pb(II) adsorption at (d) 25 ℃, (e) 50 ℃ (f) 75 ℃.

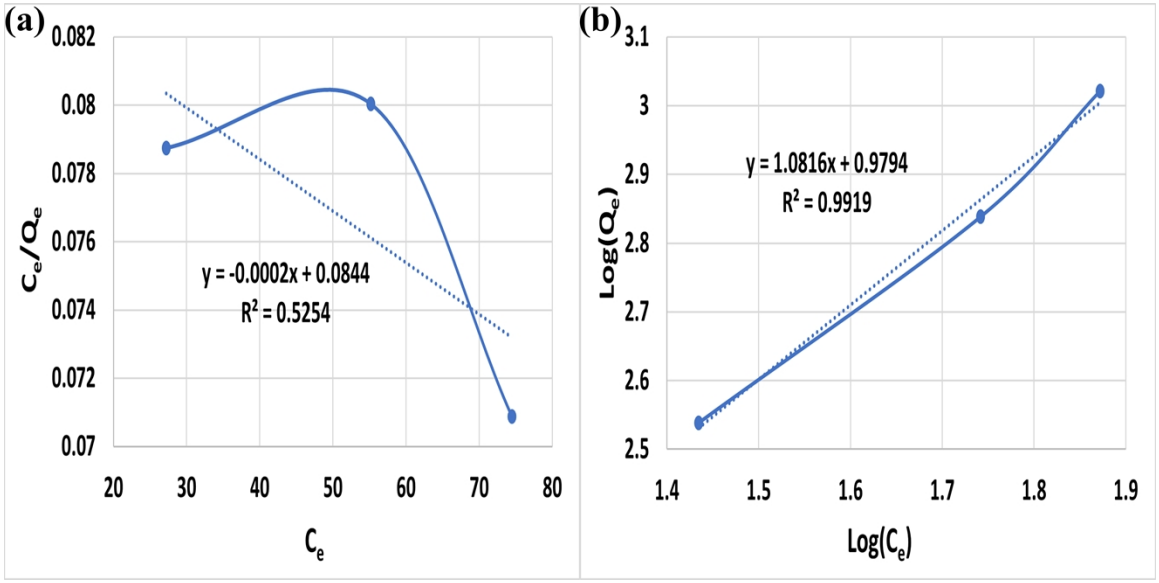


Figure S6. (a) Langmuir and (b) Freundlich adsorption isotherms for Cr(VI).

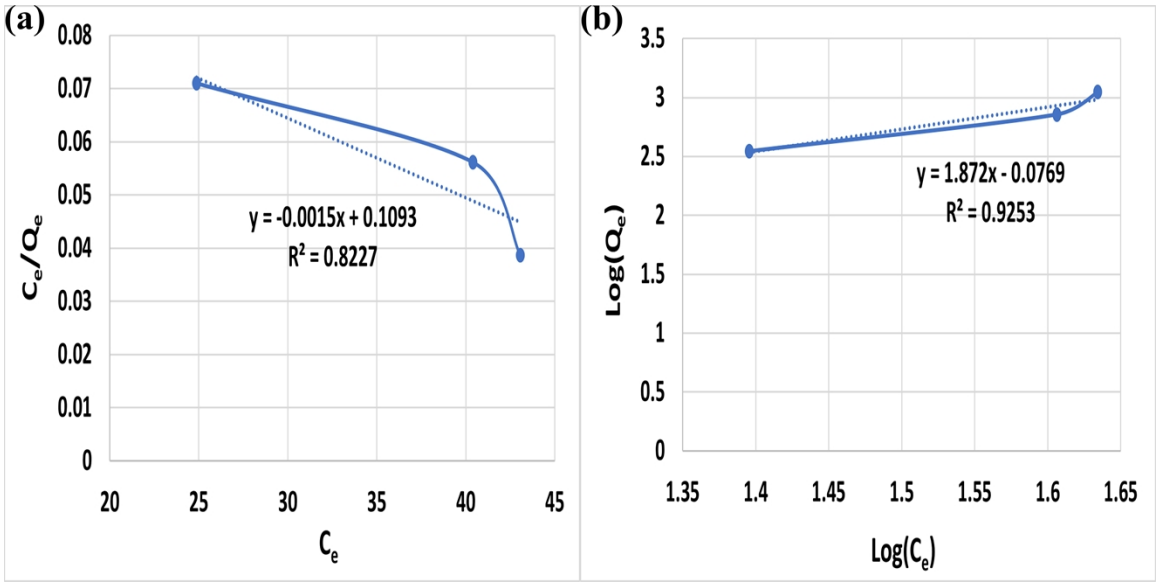


Figure S7. (a) Langmuir and (b) Freundlich adsorption isotherms for Pb(II).