

Supporting Information

Recovery of metal ions (Cd²⁺, Co²⁺, and Ni²⁺) from nitrate and sulfate on laser-induced graphene film using applied voltage and its application

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Experimental

The adsorption capacity (Q) and removal rate (W) were calculated by Eq. 1 and Eq. 2, respectively.

$$Q = \frac{(C_0 - C_t)V}{m} \quad (1)$$

$$W = \frac{(C_0 - C_t)}{C_0} \times 100\% \quad (2)$$

where

Q is the amount of adsorption (mg g⁻¹) at the adsorption time t ,

C_0 is the initial mass concentration of ions (mg L⁻¹),

C_t is the mass concentration of ions in the solution (mg L⁻¹) at the adsorption time t ,

V is the volume of the solution (L),

m is the mass of the LIG film (g),

W is removal rate of ions (%) at the adsorption time t .

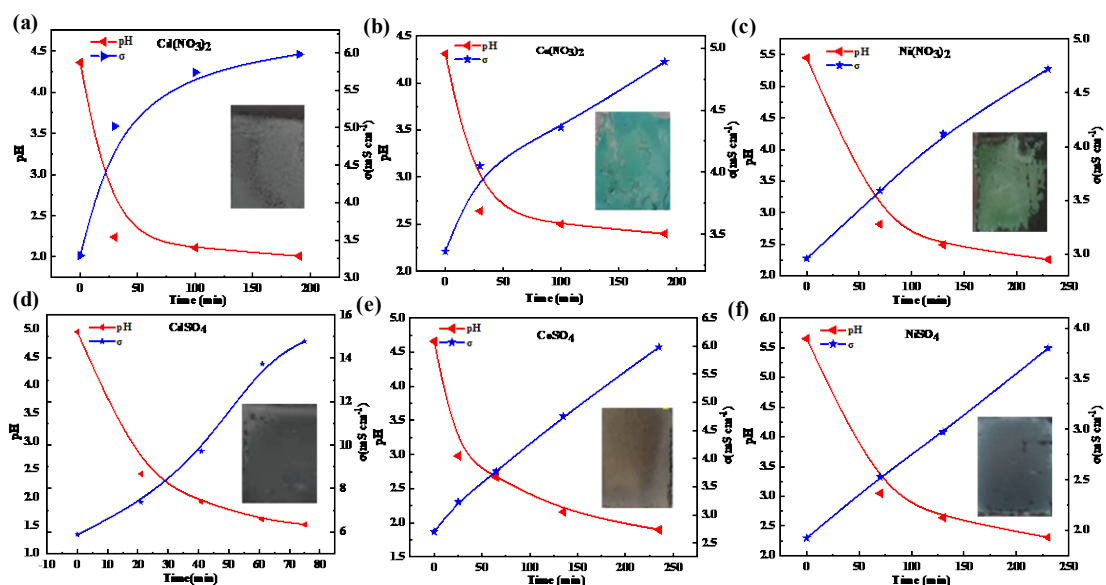


Figure S1. Changes in pH and conductivity during the electro adsorption process (-1.5 V). (a) $\text{Cd}(\text{NO}_3)_2$, (b) $\text{Ni}(\text{NO}_3)_2$, (c) $\text{Co}(\text{NO}_3)_2$, (d) CdSO_4 , (e) NiSO_4 , and (f) CoSO_4 .

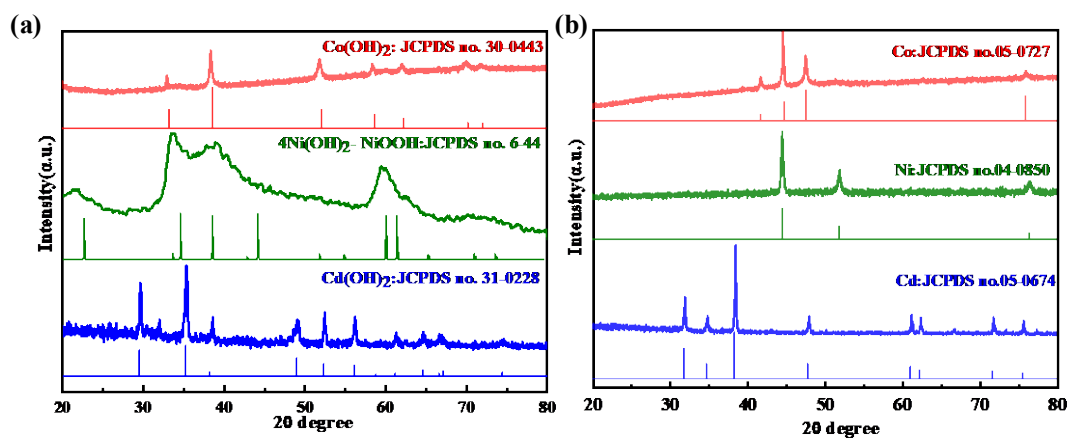


Figure S2. XRD pattern of electrode surface products in (a) nitric acid and (b) sulfate solutions with a voltage of -1.5 V.

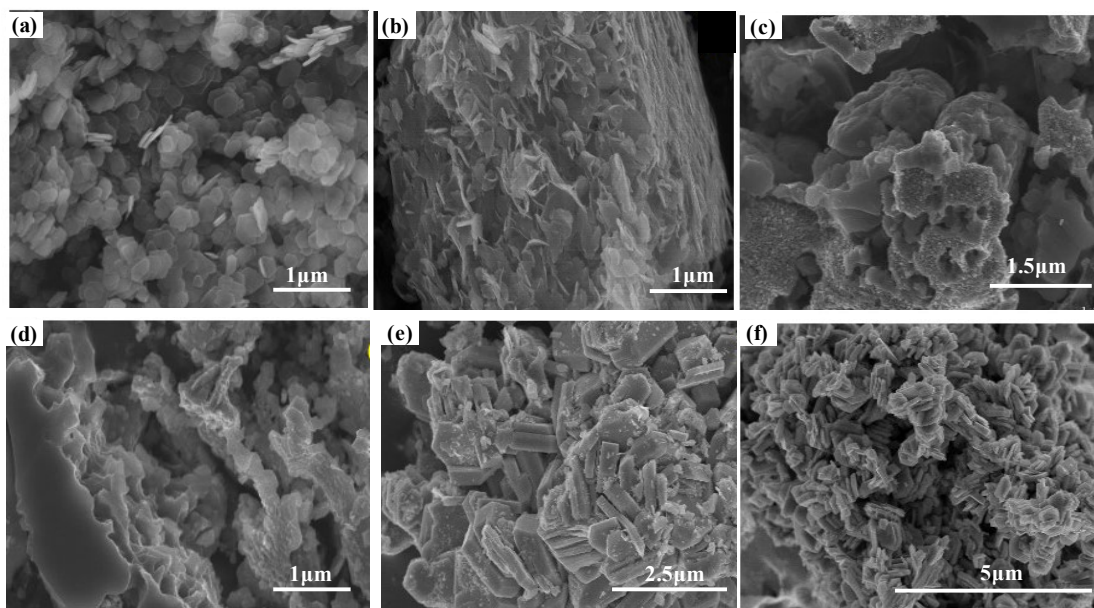


Figure S3. SEM of the product in (a-b) $\text{Co}(\text{NO}_3)_2$, (c-d) $\text{Ni}(\text{NO}_3)_2$, (e-f) $\text{Cd}(\text{NO}_3)_2$ solution (-1.5 V).

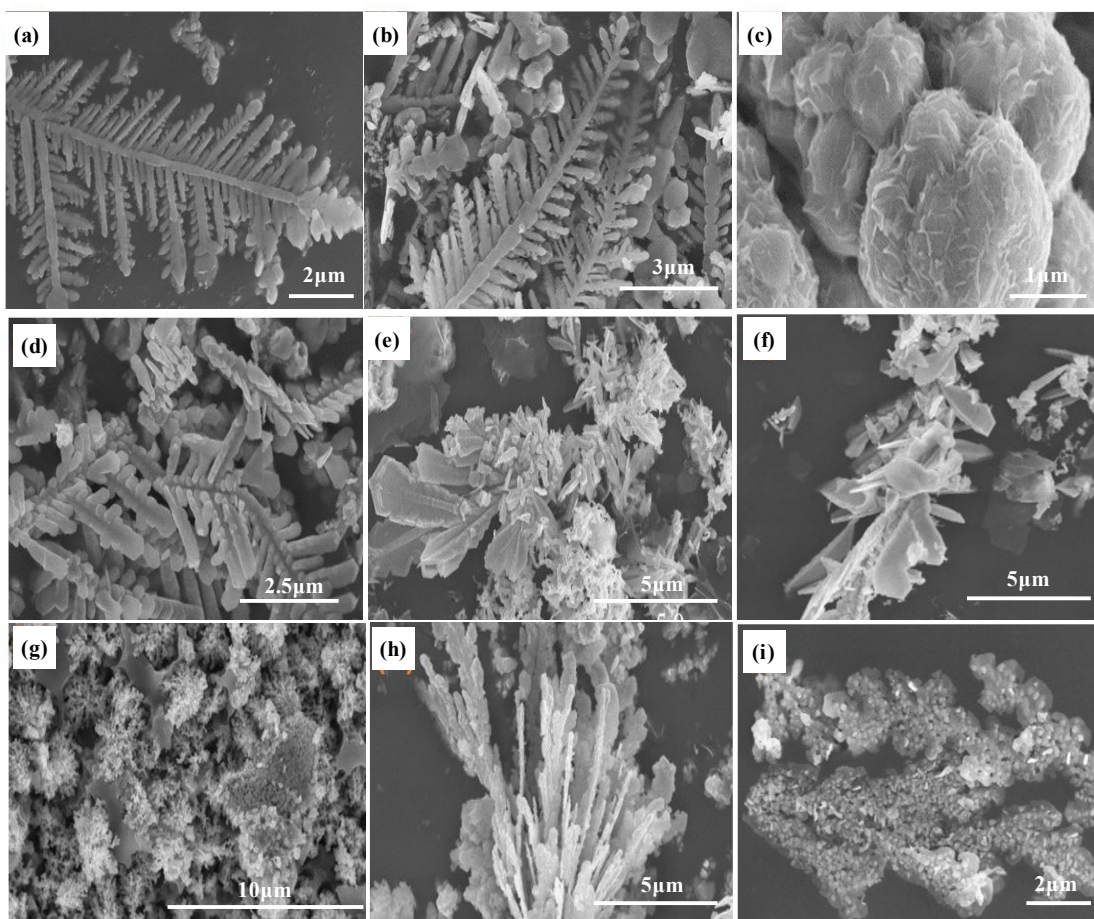


Figure S4. SEM of the product in (a-c) CoSO_4 , (d-f) CdSO_4 , and (g-i) NiSO_4 solution (-1.5 V).

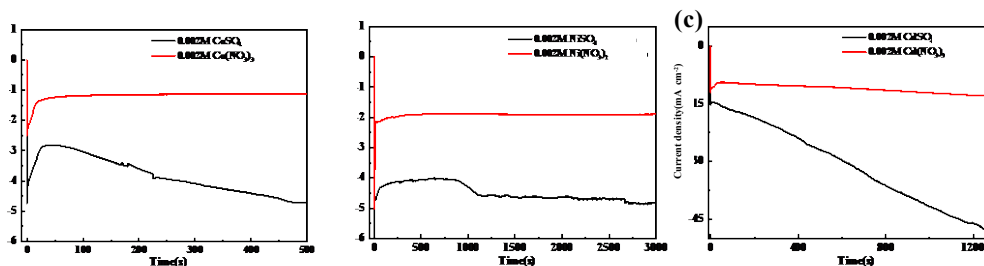


Figure S5. Current changes in nitrate solution and sulfate solution (-1.5 V).

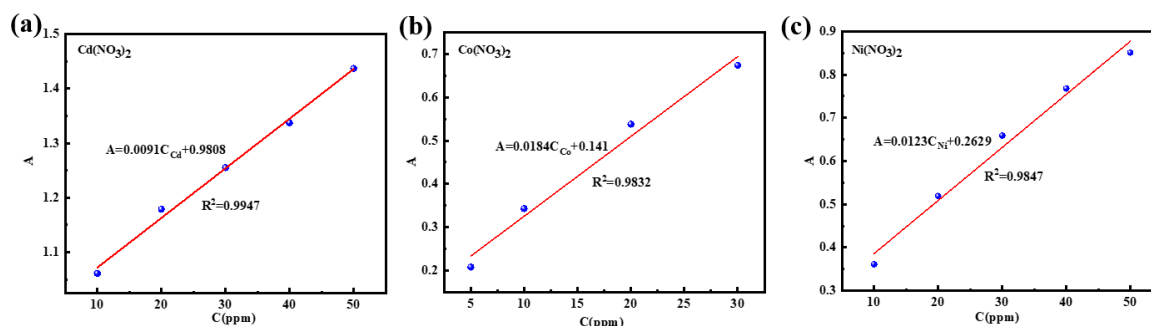


Figure S6. Standard Curve of (a) Cd(NO₃)₂, (b) Co(NO₃)₂, (c) Ni(NO₃)₂ solution (-1.2 V).

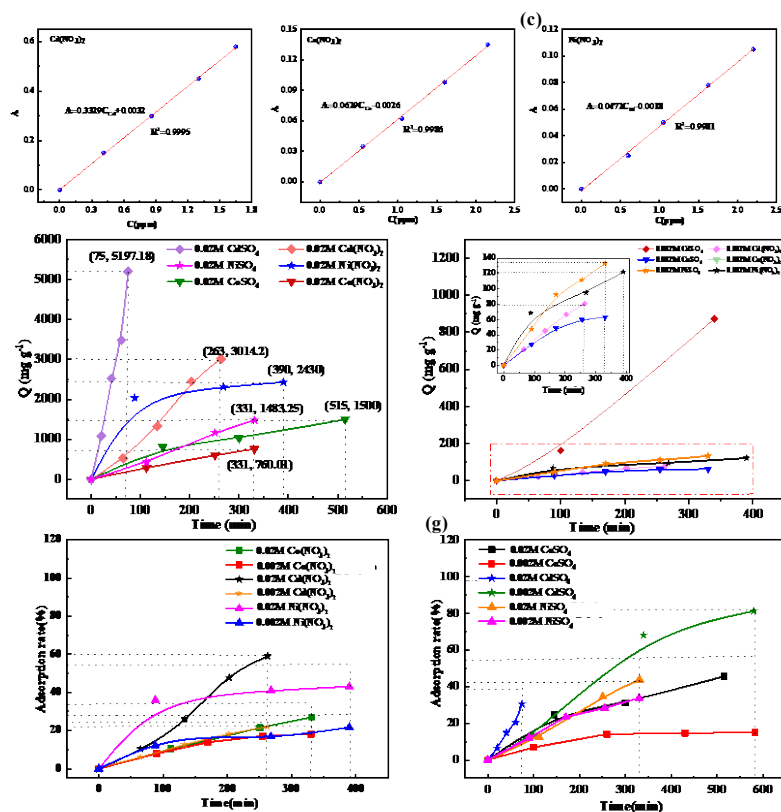


Figure S7. Standard Curves of (a) Co(NO₃)₂, (b) Cd(NO₃)₂, (c) Ni(NO₃)₂ solution (-1.5 V), (d-e) Change in adsorption capacity over time at different concentrations, (f-g) Change in removal rate over time.