

# Separation and recovery of heavy metal ions and salty ions from wastewater by 3D graphene-based asymmetric electrodes via capacitive deionization

Tingting Yan, Peiying Liu, and Dongsong Zhang

Research Center of Nano Science and Technology, Shanghai University, Shanghai 200444, China

A novel concept for the separation and recovery of heavy metal ions and salty ions from wastewater by 3D graphene-based asymmetric electrodes via capacitive deionization is presented for the first time. Instead of the traditional practice to adsorb heavy metal by stirring method, we rationally designed functional 3D graphene by grafting ethylenediamine triacetic acid (EDTA) and 3-aminopropyltriethoxysilane on the 3D graphene surfaces, respectively, and take advantage of capacitive deionization for wastewater treatment.

In this process, the  $\text{Pb}^{2+}$  was adsorbed by EDTA through chelation reaction and the  $\text{Na}^+$  was adsorbed into the 3D graphene pores by electrosorption. Meanwhile the aminated 3D graphene with 3-aminopropyltriethoxysilane was used as an anode to minimize the co-ion effects and improve the removal efficiency. This research investigated the adsorption and desorption behaviors of  $\text{Pb}^{2+}$  and  $\text{Na}^+$ , and investigates the influences of operation conditions, such as pH, voltage, concentration and time on the  $\text{Pb}^{2+}$  and  $\text{Na}^+$  removal. The removal efficiency was 99.9% at pH 6.0 for  $\text{Pb}^{2+}$  and 98.7% for  $\text{Na}^+$ . It is worth noting that the  $\text{Pb}^{2+}$  and  $\text{Na}^+$  can be separated and recovered in the desorption process by two steps depending on the different adsorption mechanism between  $\text{Pb}^{2+}$  and  $\text{Na}^+$ . The

desorption rates were  $\sim 99.6\%$  for  $\text{Pb}^{2+}$  and  $\sim 97.2\%$  for  $\text{Na}^+$ , respectively, and remained at  $\sim 94.3\%$  and  $\sim 88.2\%$  without further degradation after the 8 cycles. Overall, the CDI with 3D graphene-based asymmetric electrodes is a promising route for the separation and recovery of heavy metals and salty ions from wastewater.

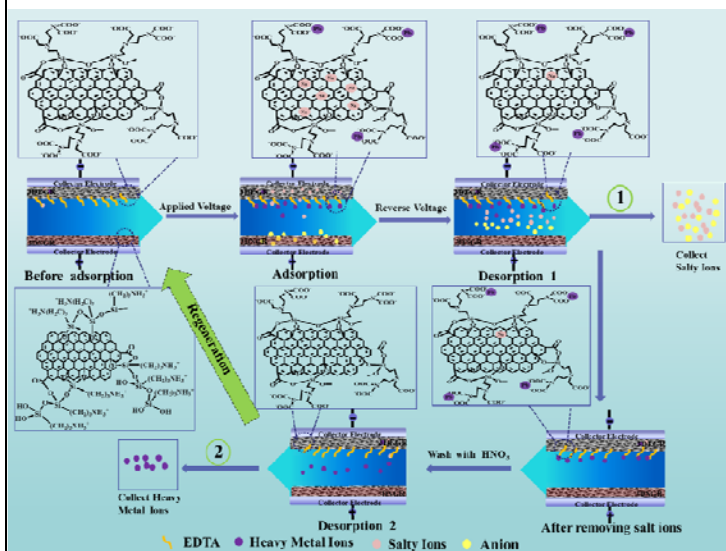


Figure 1: Schematic illustration of separation and recovery of heavy metal ions and salty ions from wastewater by CDI, and the insets are the 3DEGR and 3DNGR structure.

## References:

- [1] Z. Wang, T. Yan, L. Shi and D. S. Zhang, ACS Appl. Mater. Inter. **9**, 15068–15078 (2017).
- [2] P. Liu, T. Yan, J. Zhang, L. Shi and D. S. Zhang, J. Mater. Chem. A **5**, 14748 (2017).
- [3] P. Liu, T. Yan, L. Shi, H. S. Park, X. Chen, Z. Zhao and D. S. Zhang, J. Mater. Chem. A **5**, 13907 (2017).
- [4] H. Duan, T. Yan, G. Chen, J. Zhang, L. Shi and D. S. Zhang, Chem. Commun. **53**, 7465 (2017).

Email: [tingtingyan@shu.edu.cn](mailto:tingtingyan@shu.edu.cn)