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Anions inserted into graphite interlayers enhancing the electrodeposited metal hydroxides for oxygen evolution

Electrochemical deposition is an easy-controlled method to prepare thin films of functional and energy materials. As for energy storage and conversion applications, freestanding films electrodeposited on varied conducting substrates are more competent than their conventional counterparts relied on binder and conducting additives. However, the weak deposit-substrate interaction makes it tough to achieve robust and high-mass deposition especially on flat substrates, which hinders their practical application. Here we report a universal strategy with interface enhancement via insertion and reduction of oxyacid anions to electrosynthesize a variety of metal hydroxides/oxides. Specifically, nitrate ions intercalate into the graphene layers of a graphite substrate driven by electric field, and then are reduced by cathodic current to form hydroxyls, which in-situ precipitate the metal cations from the electrolyte. Thus, the nanocrystalline cerium dioxide and amorphous nickel hydroxide co-electrodeposited on graphite feature a rather tight interface and considerable mass loading after elaborate manipulation. When employed as electrocatalyst for oxygen evolution reaction in alkaline electrolyte, it exhibits a low overpotential of 177 mV@10 mA cm^{-2} and sustains long-term durability over 300 h at a large current density of 1000 mA cm^{-2}, surpassing the state-of-the-art RuO_2 benchmark. The superior electrocatalytic performance of the interface-enhanced self-supporting metal hydroxide/oxide composite indicates promising generalization of this efficient technique to fabricate practical robust and high-activity water splitting electrodes based on low-cost graphite substrates.

References

[1] Yan, Z.; Sun, H.; Chen, X.; Liu, H.; Zhao, Y.; Li, H.; Xie, W.; Cheng, F.; Chen, J. *Nat. Commun.* 2018, 9, 2373.

Figures

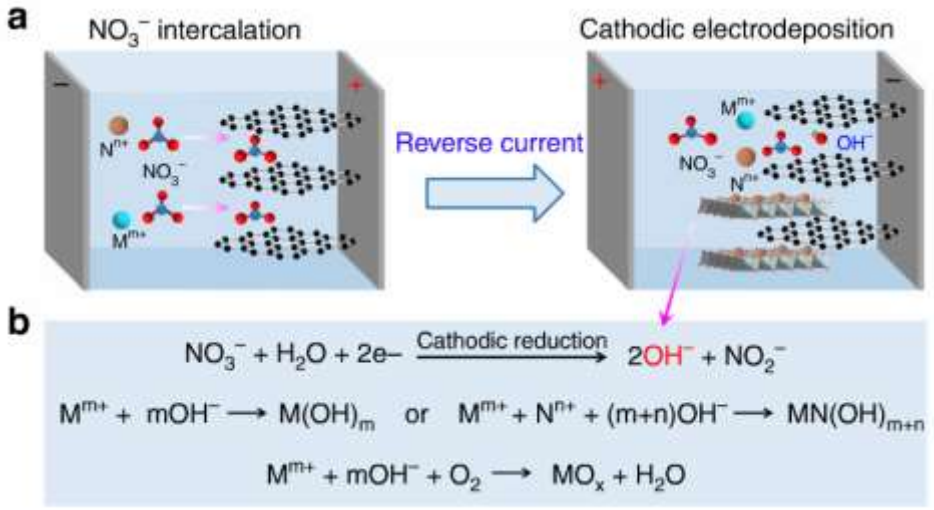

Figure 1: (a) schematic two-step synthesis using graphite substrate and nitrate precursors. **(b)** the reaction mechanisms of the cathodic electrodeposition of metal hydroxides ($M(OH)_m$ or $MN(OH)_{m+n}$), and oxides (MO_x). M^{m+} and N^{n+} are metal cations.