

Synthesis of Fe-based (oxy)hydroxide nanosheets for oxygen evolution reaction (OER) electrocatalyst

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Two-dimensional (2D) nanosheets beyond graphene such as metal dichalcogenides, oxides and hydroxides, carbides have received widespread attention for potential applications in various fields including electronics, optics, magnetism, and catalysis due to their unique structural anisotropy and compositional tunability. Among them, 3d transition metal (Fe, Co, Ni)-based (oxy)hydroxides nanosheets exhibit promising electrocatalytic properties in water splitting under alkaline conditions. In our previous reports, we have systematically studied the synthetic chemistry of layered double hydroxide (LDH) nanosheets based on the combination of different transition elements (Ni(Co)-Fe, Co(Ni)-Ni, and Co-Co).¹⁻³ However, the synthesis of pure Fe hydroxide nanosheets is still challenging.

In the current work, we have succeeded in preparation of pure Fe (oxy)hydroxide (FeO_xH_y) nanosheets with a unilamellar thickness of 1 nm and lateral dimension of several hundred nm by using highly crystalline Green Rust (GR) as parent layered material. GR, a Fe^{2+} - Fe^{3+} LDH with a general formula of $[\text{Fe}_{1-x}^{2+}\text{Fe}_x^{3+}(\text{OH})_2]^{+x} [\text{A}^{n-}/m \cdot m\text{H}_2\text{O}]^{-x}$ where A representing interlayer anions (OH^- , CO_3^{2-} , Cl^- , SO_4^{2-} , etc.), can be conventionally synthesized through co-precipitation of ferrous and ferric salts. However, low crystallinity and small lateral size of the co-precipitation product pose a great hurdle for obtaining well-defined nanosheets. We employed a topochemical oxidation and intercalation process to prepare highly crystalline GR intercalated with iodide (I^-) based on brucite-like $\text{Fe}(\text{OH})_2$. Taking advantage of facile anion exchangeability, GR intercalated with dodecyl sulfate (DS^-) were converted for the delamination into FeO_xH_y nanosheets. As synthesized nanosheets were explored as electrocatalysts for oxygen evolution reaction (OER) under alkaline conditions.

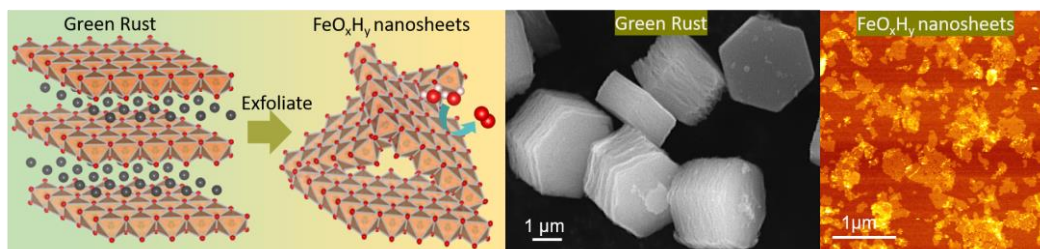


Fig. 1 Exfoliate Green Rust to unilamellar FeO_xH_y nanosheets

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