

Solution-processed Layered Double Hydroxides for Energy Applications

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Layered double hydroxides (LDHs) are a class of anionic clays consisting of positive charged brucite-like layers spaced by water molecules and counterbalancing anions[1]. In particular, transition metals LDHs have drawn attention for energy storage and conversion applications[2] because of their electrocatalytic properties for water splitting[3], and pseudocapacitive behaviour[4][5]. Contrarily to other layered materials, LDH layers are held together by electrostatic forces and a dense network of hydrogen bonds[6]. For these reasons, a careful choice of solvent is pivotal for an efficient exfoliation of the LDHs. One of the most effective is formamide[1][7]. However, due to formamide toxicity and its high boiling temperature, other solvent options are recommended for the processing of LDHs[8][9]. Although dispersions of LDH nanoplates in water or alcohols are stable, they result in an ineffective material exfoliation[1]. To overcome the aforementioned issues, we will report the treatment with aqueous acetate solution of NiFe-LDH hexagonal nanoplatelets, synthesized with Jaśkaniec's method[10], to produce a stable dispersion in ethanol (see Figure 1). Transmission electron microscopy (TEM) analysis reveals the exfoliation of the LDH nanoplatelets, whilst the ultraviolet-visible light spectroscopy (UV-Vis) measurements suggest that the presence of the acetate plays a key role for the stability of LDH ethanol dispersion. The as-produced LDH dispersion can be deposited onto conductor substrates (e.g., graphite paper, nickel foam) to form catalytic films for electrochemical applications. Finally, LDHs are combined with graphene-based materials and/or transition metal dichalcogenides to create composites or hybrid superlattices with superior electrochemical properties compared to single component materials[2].

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FIGURES

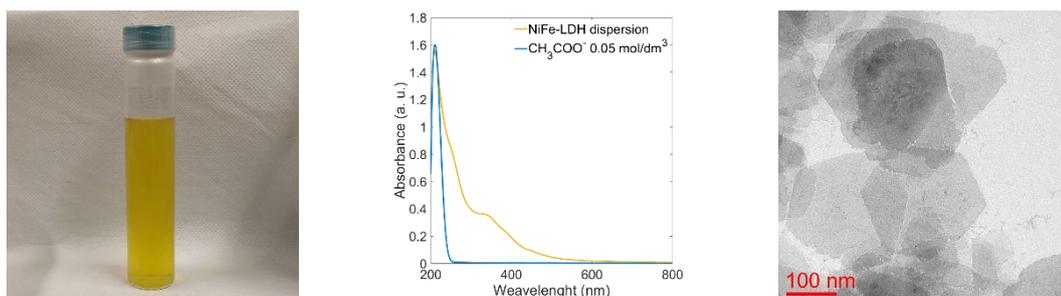


Figure 1: A picture of the NiFe-LDH dispersion in ethanol (left). Comparison between UV-Vis spectra of the LDH dispersion and a sodium acetate solution in ethanol (middle). TEM image of LDH hexagonal flakes (right).