Sonochemical and mechanochemical as green routes for the preparation of nano layered double hydroxides

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Layered double hydroxides, (L DH) with general formula $[M(II)1-xM(III)x(OH)_2](A-n)x/n.mH_2O$, were M(II) is a divalent cation (i.e. Zn, Mg, Cu, Co), M(III) a trivalent cation (i.e. Al, Ga, Fe) and An- the anions that balance the positive charges of the lamellae, have attracted great interest thanks to the great variability of the intra- and interlayer composition. Catalytically active metal ions can be incorporated into the layer or immobilised on the surface through defect site engineering These materials can be used as catalysts or catalyst precursors to promote water splitting [1], Fischer-Tropsch reaction [2], biomass conversion [3], among others. Conversely, biomaterials can be obtained if the metal ions with therapeutic properties, such as anti-microbial and/or osteoconductive properties [4], are used as a component of the structure. Therapeutic efficacy can be enhanced by intercalation of bioactive species in the interlayer region. More recently, a new application of LDH has been envisaged as an additive to conventional cement pastes to improve durability. All of these applications at an industrial level can be actually realized through the implementation of green and scalable synthesis methods. Therefore, the possibility of producing LDH and modulating their layer composition and particle size using sustainable synthesis methods (especially in terms of production time and costs) is a task to be pursued. In this study, ultrasound-assisted and mechanochemical synthesis methods, considered green and efficient were employed for LDH preparation. The results were compared with those obtained using conventional co-precipitation at high supersaturation. LDH containing M(II) as Mg, Cu, Zn, Ni, Co and M(III) as Al, Ga, Fe have been prepared by the different methods and compared in terms of composition, phase purity, particle dimensions.
Furthermore, the impact on the reactivity of LDH prepared by different methods has been studied for NiFe LDH evaluating their catalytic performance as electrocatalysts for the oxygen evolution reaction (OER). These materials have been investigated for OER in alkaline media with various electrochemical measurements using in a single compartment three electrode cell.

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