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# ABSTRACT

## Two-dimensional Layered Hydroxides from Synthesis to Industrial Applications

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Layered Hydroxides (LHs) are versatile materials with applications in electrocatalysis, energy storage, and magnetism. This talk presents the latest advances from the 2D-Chem research group (www.icmol.es/2dchem) in synthesizing and characterizing two-dimensional (2D) LHs. We present a microfluidic reaction-diffusion strategy for fabricating self-supported layered double hydroxide (LDH) hollow structures,[1] enabling control over crystallographic phases—critical for the electrochemical performance of LH materials.[2] Furthermore, covalent modification of anions within the simonkolleite framework enhances magnetic tunability[3,4] and electronic properties.[5] For industrial scalability, we introduce a room-temperature, atmospheric-pressure synthesis route for NiFe-LDHs via homogeneous alkalinization. Using chloride nucleophilic attack on an epoxide ring, we obtain low-dimensional, highly defective NiFe-LDHs featuring cation clustering. Spectroscopic analyses (XANES, EXAFS, SAXS) combined with ab initio calculations reveal the pivotal role of Fe clustering in optimizing catalytic performance.[6] This energy-efficient, scalable method offers a cost-effective alternative to noble metal catalysts, advancing the industrial deployment of LDH-based materials in water splitting, energy storage, sensing, and environmental remediation.

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