Área: MAT

Synthesis of Cu-functionalized NiFe layered double hydroxide and derived double oxides for catalytic reduction of 4-Nitrophenol

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Highlights

CuNiFe LDH was synthesized, calcined and characterized.
Reduced 4-NP in 30 seconds, while the oxide took 10 minutes.
Magnetic property enabled reuse with high efficiency after five cycles.

Resumo/Abstract

The development of efficient and low-cost catalysts has received attention due to the need for sustainable processes for environmental remediation. In this context, layered double hydroxides (LDHs) are promising materials, as they possess a layered structure composed of metal cations stabilized by anions and intercalated water molecules, in addition to exhibiting a memory effect that allows the reconstruction of the lamellar structure after calcination [1]. This treatment also imparts magnetic properties to the material, facilitating its recovery and reuse without the need for additional synthesis with other magnetic compounds. Thus, this work aimed to synthesize NiFe LDH, calcine it, and subsequently restructure it upon contact with an aqueous copper solution to functionalize it with Cu species (CuNiFe LDH). Part of these materials was then calcined again to form its oxide (CuNiFeO). The catalytic activity of these materials was evaluated in the reduction of 4-Nitrophenol (4-NP), a toxic pollutant, into 4-Aminophenol (4-AP) [2], a less toxic intermediate employed in the synthesis of paracetamol, using $NaBH_4$ as the reducing agent. The structural characterization of the catalyst was performed using X-ray diffraction (XRD), which evidenced the typical peaks of LDH [3,4]. Additionally, EDS mapping analysis indicated the incorporation of Cu into the material, with homogeneous distribution of it on the surface. The CuNiFe LDH showed high catalytic efficiency, promoting the reduction of 4-NP to 4-AP in only 30 seconds, whereas the calcined material (oxide) achieved the same conversion in approximately 10 minutes. Furthermore, reuse tests were conducted over five cycles, in which the separation of the catalyst from the reaction medium was facilitated by its magnetic character. The results indicate that CuNiFe LDH and its oxide show potential as efficient catalysts for the reduction of nitrocompounds. Further studies will be conducted using other nitrocompounds to assess reaction selectivity and expand the applicability of these materials in catalytic processes.

References

[1] ABDALLAH, I. A. *et al*. **Microchemical Journal**, v. 192, p. 108916, 2023.
[2] ORFEI, E. *et al*. **Catalysis Today**, v. 419, p. 114153, 2023.
[3] TANG, J. *et al*. **Journal of Cleaner Production**, v. 172, p. 673-685, 2018.
[4] SUN, Z. *et al*. **Journal of the American Chemical Society**, v. 144, n. 20, p. 8204–8213, 2022.

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