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Self-Assembled ZnFeAl Layered Double Hydroxides as Highly Efficient Fenton-Like Catalysts

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Abstract : Ibuprofen is a non-steroidal anti-inflammatory drug (NSAIDs) and is among the most frequently detected pharmaceuticals in environmental samples and among the most widespread drug in the world. Its concentration in the environment is reported to be between 10 and 160 ng L-1. In order to improve the abatement efficiency of this compound for water source prevention and reclamation, the development of innovative technologies is mandatory. AOPs (advanced oxidation processes) are known as highly efficient towards the oxidation of organic pollutants. Among the promising combined treatments, photo-Fenton processes using layered double hydroxides (LDHs) attracted significant consideration especially due to their composition flexibility, high surface area and tailored redox features. This work presents the self-supported Fe, Mn or Ti on ZnFeAl LDHs obtained by co-precipitation followed by reconstruction method as novel efficient photo-catalysts for Fenton-like catalysis. Fe, Mn or Ti/ZnFeAl LDHs nano-hybrids were tested for the degradation of a model pharmaceutical agent, the anti-inflammatory agent ibuprofen, by photocatalysis and photo-Fenton catalysis, respectively, by means of a lab-scale system consisting of a batch reactor equipped with an UV lamp (17 W). The present study presents comparatively the degradation of Ibuprofen in aqueous solution UV light irradiation using four different types of LDHs. The newly prepared Ti/ZnFeAl 4:1 catalyst results in the best degradation performance. After 60 minutes of light irradiation, the Ibuprofen removal efficiency reaches 95%. The slowest degradation of Ibuprofen solution occurs in case of Fe/ZnFeAl 4:1 LDH, (67% removal efficiency after 60 minutes of process). Evolution of Ibuprofen degradation during the photo Fenton process is also studied using Ti/ZnFeAl 2:1 and 4:1 LDHs in the presence and absence of H2O2. It is found that after 60 min the use of Ti/ZnFeAl 4:1 LDH in presence of 100 mg/L H2O2 leads to the fastest degradation of Ibuprofen molecule. After 120 min, both catalysts Ti/ZnFeAl 4:1 and 2:1 result in the same value of removal efficiency (98%). In the absence of H2O2, Ibuprofen degradation reaches only 73% removal efficiency after 120 min of degradation process. Acknowledgements: This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS - UEFISCDI, project number PN-II-RU-TE-2014-4-0405.

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