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Catalysts based on copper- cysteamine supported on bacterial cellulose and layered double hydroxides: a novel approach for simultaneous degradation of pharmaceuticals in the Fenton processes

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Pharmaceutical residues in water sources can detrimentally impact water quality. This study investigated the catalytic performance of copper-cysteamine supported on bacterial cellulose (Cu-Cys/BC) and Layered Double Hydroxides (LDHs) based on MgMnFe for the removal of antibiotics sulfamethazine (SMZ) and sulfadiazine (SDZ), as well as anticancer 5-Fluorouracil (5-FU) from water. The materials were synthesized according to the methodology adapted from Pandey et al., 2019[1] and Costa-Serge et al., 2022[2]. The synthesized materials exhibited phase purity and crystallinity, as confirmed by XRD. SEM images revealed that the Cu-Cys were uniformly distributed within the cellulose fibers, while the LDHs exhibited a flower ball morphology, characteristic of these materials. In the Cu-Cys/BC system, both antibiotics were reduced to below detection limits after 60 minutes of reaction in dark conditions. In the MgMnFe-LDH system, total removal of the anticancer drug 5-FU was observed after 10 minutes at the natural pH of the solution (Fig. 1). The stability and catalytic efficiency of Cu-Cys/BC and MgMnFe-LDH make these materials potential candidate for heterogeneous Fenton processes aimed at the effective degradation of pharmaceuticals from wastewater.

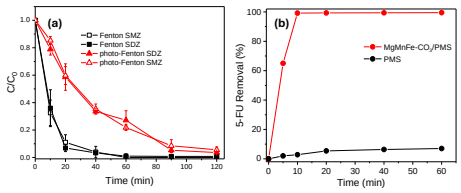

Fig. 1. (a) Simultaneous degradation of SMZ and SDZ in the Fenton and photo-Fenton processes and (b) 5-FU removal in the MgMnFe-LDH system. Conditions: 500 µg L^{-1} of SDZ, SMZ and 5-FU; 4 mM of H_2O_2, 0,4 mM of PMS and 0.5 g L^{-1} of Cu-Cys/BC and MgMnFe-LDH.

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