Synthesis and characterization of MnFe2O4 nanoparticles: influence of β-cyclodextrin on their microstructure

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Manganese ferrite has a wide interest in the photocatalytic degradation of organic contaminants in water, due to its high stability and strong magnetic property, in addition to being friendly due to its low toxicity [1].
In this work we report a simple way to synthesize manganese ferrite ($MnFe_2O_4$) nanostructures by the coprecipitation method, using Fe chloride and Mn sulfate as metals precursors, and β-cyclodextrin (β-CD) acting as coating agent. Synthesis was accompanied by the hydrothermal method at different temperatures 120 and 140°C for 24h. These samples were named as β-CD-$MnFe_2O_4$. For comparison, pure $MnFe_2O_4$was also prepared by a similar procedure, without the addition of β-CD. X-ray diffraction (XRD) analysis of the β-CD-$MnFe_2O_4$sample prepared without a reactor and the sample at 120°C indicated little crystallinity of the material, while the sample at 140°C indicated the presence of a single phase. crystal corresponding to $MnFe_2O_4$. The crystallite size of these samples increased with temperature from 2.7 nm to 4.7 nm. On the other hand, the sample obtained at 140°C is mesoporous with a high value of specific surface area 240 m^2g^{-1}. The XRD of the samples without cyclodextrin showed good crystallinity at all synthesized temperatures, however, the size of the crystallite was 23 nm, much larger than the samples obtained with cyclodextrin. In the degradation of methylene blue, the samples obtained with cyclodextrin presented a better catalytic performance than pure $MnFe_2O_4$ in terms of activation of hydrogen peroxide (H_2O_2) to degrade methylene blue at neutral pH.

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[1] Wang, X., Wang, A., et.al. Mater. 81–92, 2017.