Co-Precipitation Method Optimisation for the Synthesis of Superparamagnetic Copper ferrite Nanoparticles for Water Treatment

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In recent years, copper ferrite nanoparticles (CF) have attracted many researcher's attention due to their potential application in water purification. Copper ferrite nanoparticles are low-cost magnetic materials and stable under different conditions. Consequently, not easily leachable during wastewater treatment and easily recovered using an external magnetic field and reused for several cycles. This study placed an emphasis on understanding the influence of pH, reaction time, surfactants and reaction temperature on the co-precipitation synthesis of CF. Amongst the properties of interest, the superparamagnetic property, phase of CF produced, and surface area were investigated in detail using p-XRD, VSM, BET, XPS and other techniques. The p-XRD analysis results of the synthesised CF showed the formation of a cubic phase at pH above 11 while at pH 9 and 10 a tetragonal phase was produced. CF nanoparticles synthesised within 3 h, at 60 ºC, pH 12 and calcined for 3h at 500 ºC exhibited a superparamagnetic behaviour with a saturation magnetisation of 26.5 emu g^{-1}. The highest surface area achieved was 57.4 m^2 g^{-1} for the sample synthesised at pH 10, 3h reaction time at 60 ºC and calcined for 3h at 500 °C. The influence of calcination was also looked in detail. Therefore, optimising the reaction conditions enabled us to fine-tune the properties of CF to produce the desired characteristics needed for water treatment. Hence, using magnetically recycled, visible-light-driven CF at industrial scale for water purification can go a long way in lowering the costs of water treatment.

Keywords: Copper ferrite nanoparticle; superparamagnetic; coercivity, co-precipitation.