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Conversion of iron oxide nanosheets to advanced magnetic nanocomposites

Abstract

This study aims at developing magnetic materials through the combination of cobalt and iron oxide at the nanoscale for producing facile and environmentally friendly techniques to remove crude oil from water. A series of cobalt iron oxides with different molar ratios of Co/Fe were prepared and characterized using X-ray diffraction, thermal analyses and electron microscopy. X-ray diffraction results indicated that the prepared iron oxides have a hematite structure with a particle size of 100 nm. By adding cobalt, spinel structures of cobalt iron oxides were observed and their particle size sharply decreased to be 10 nm. TEM images confirmed that the prepared cobalt iron oxide nanocomposites have particle sizes of 5–10 nm. While, 100 nm nanosheets were observed for the prepared iron oxide. The surface texture of the prepared iron oxide nanosheets was also affected by the addition of cobalt and the formation of nanocomposites. Where, a low surface area (8.9 m2 g1) was observed for the prepared iron oxides. By adding and increasing the percentage of cobalt, the surface area sharply increased to be 133 m2 g1. The magnetization behavior of the prepared nanomaterials was investigated and showed that the ferromagnetic behavior of a-Fe2O3 is shifted to superparamagnetic behavior when doping iron

oxide with cobalt. Due to the small nanosize, the high surface area and the superparamagnetic behavior, the prepared cobalt iron oxide nanocomposites were very effective in the removal of crude oil from water. It was concluded that the magnetic materials meet the special requirements to be useful in oil spill removal.