Study on co-precursor driven solid state thermal conversion of iron(III)citrate to iron oxide nanomaterials

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Streszczenie

We explore the solventless synthesis of iron oxide nanomaterials obtained on thermal conversion of iron(III)citrate in presence of malonic acid and glucose as co-precursors in varying weight ratios and physical characterization of the materials obtained. Pure phase of hematite was found only for a particular combination of precursor and co-precursor and else a mixture of hematite and magnetite. Significant effect of the co-precursors on the nature and size of the synthesized materials was noticed. Gradual conversion of hematite to magnetite with increasing amount of co-precursor was established. Morin transition was observed in the temperature dependent magnetization study for the hematite materials. Absorption spectroscopy exhibited three different electronic transitions that take place within the 3d5
shell of the octahedrally coordinated Fe3+ions for hematite materials. The optical (direct and indirect) band gaps estimated from the Tauc's plot showed particle size dependence. From photoluminescence study the transitions of trapped electrons in various defect states of oxygen vacancies were observed which led to the appearance of nonradiative peaks. In the Raman spectra the significant bands of hematite (A1g and Eg bands) were noted. From morphology study the hematite nanomaterials appear as clusters of large irregular shaped particles of various sizes. Formation of hematite nanomaterials as observed by XRD studies was supplemented by the SAED patterns obtained in the HRTEM study. Present study established that nano-sized pure hematite materials can be thermally synthesized at comparatively lower temperature on thermal decomposition of iron(III)citrate by varying the weight ratio of suitable
co-precursors.