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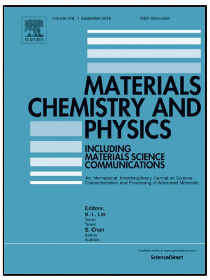

Facile bulk preparation and structural characterization of agglomerated γ-Fe_2O_3 /SiO_2 nanocomposite particles for nucleic acids isolation and analysis

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Facile bulk preparation and structural characterization of agglomerated γ-Fe_2O_3/SiO_2 nanocomposite particles for nucleic acids isolation and analysis

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Abstract

Two facile methods for the bulk preparation of γ-Fe_2O_3/SiO_2 agglomerated magnetic nanocomposite (MNC) particles for magnetic separation of nucleic acids (NAs) are compared together. Different silica coating approaches were used for iron oxide silanization: Stöber method and sodium silicate dense-liquid process. Additional thermal treatment at 750 °C provided thermal and structural stability to the MNCs. The structural characteristics, magnetic properties, size and morphology of the synthesized materials have been studied. To validate the synthesized materials, the MNCs were used for the isolation of nucleic acids from human buccal epithelium cells and two human biosamples (whole blood and plasma) with addition of pathogenic viruses. It was shown that the prepared near-micron sized agglomerates of superparamagnetic (M_s = 40–45 emu/g) γ-Fe_2O_3/SiO_2 MNC particles are fully coated with silica. The synthesized materials combine the advantages of nanosized (superparamagnetism) and micron-sized objects (separability, average precipitation stability). Both types of the MNCs described in the paper have demonstrated similar effectiveness of NAs isolation, comparable with commercial MAGNO-sorb® total NAs isolation kit (InterLabService, Russia) used as a reference. The appropriate structural stability, high magnetization and proper purity of the isolated NAs (A260/A280 ratio near 1.9) make the studied MNCs promising materials for magnetic bioseparation.

Highlights

- γ-Fe_2O_3/SiO_2 nanocomposites were synthesized via two sol-gel methods
- Silanization and calcination provide structural stability to the obtained materials
- The nanocomposites have demonstrated similar effectiveness of DNA isolation
- The isolated nucleic acids are pure enough to be used for molecular biology

Keywords: magnetic particles; bioseparation; silica; nucleic acids; sol-gel synthesis.