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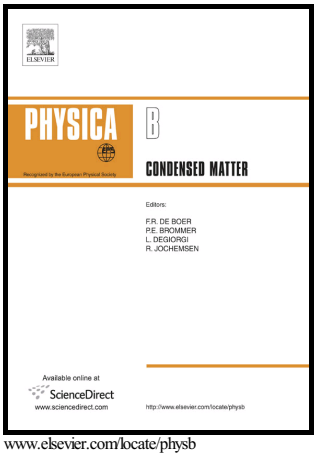


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# Surface functionalization of magnetite nanoparticle: A new approach using condensation of alkoxysilanes

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## ABSTRACT

In this study we report on successful production of two samples (BR15 and BR16) comprising magnetite ($Fe_3O_4$) nanoparticles (~10 nm) surface-functionalized via hydrolysis and condensation of alkoxysilane agents, namely 3-aminopropyl-trimethoxisilane (APTS) and N-propyl-trimethoxisilane (NPTS). The as-produced samples were characterized using transmission electron microscopy (TEM), x-ray diffraction (XRD), magnetization measurements (5 K and 300 K hysteresis cycles and zero field-cooled/field-cooled measurements), and Mössbauer spectroscopy (77 and 297 K). The Mössbauer data supported the model picture of a core-shell magnetite-based system. This material system shows shell properties influenced by the surface-coating design, either APTS-coated (BR15) or APTS+NPTS-coated (sample BR16). Analyses of the Mössbauer spectra indicates that the APTS-coated sample presents Fe(III)-rich core and Fe(II)-rich shell with strong hyperfine field; whereas, the APTS+NPTS-coated sample leads to a mixture of two main nanostructures, one essentially surface-terminated with APTS whereas the other surface-terminated with NPTS, both presenting weak hyperfine fields compared with the single surface-coated sample. Magnetization measurements support the core-shell picture built from the analyses of the Mössbauer data. Our findings emphasize the capability of the Mössbauer spectroscopy in assessing subtle differences in surface-functionalized iron-based core-shell nanostructures.

***Keywords:*** Magnetite nanoparticles, surface-functionalization, hydrolysis and condensation reactions, X-ray diffraction, Mössbauer spectroscopy, zero-field-cooled/field-cooled traces.