SAS and SAR studies of nanosized $Ga_xFe_{3-x}O_4$ coated with chitosan

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The variety of properties of magnetic nanoparticles, which are still being explored, makes the range of their possible applications grow. The best recognized nanosystems are based on pure and doped magnetite [1]. The most important condition for the use of nanoparticles in medicine is the fact that they must be non-toxic and biocompatible. It was discovered that in order to improve their applicability, it is possible to cover nanoparticles with functionalizing substances, e.g. frequently used chitosan [2]. An example of the use of such nanoparticles in medicine is an alternative oncology therapy - magnetic fluid hyperthermia (MFH). MFH therapy requires a high heat capacity of biocompatible nanoparticles. In this respect, gallium ferrites are an interesting class of bioactive materials. Two series of nanoparticles were obtained using the Massart method: $Ga_xFe_{3-x}O_4$ pure and coated with chitosan ($x =< 0; 1.5 >$) [3]. The nanoparticles were studied by small-angle neutron scattering (SANS) and small-angle X-ray scattering (SAXS). The data obtained from the SANS measurements were described by the Guinier-Porod function. SAXS studies have shown that the nanoparticles are mass fractals. An important parameter from the point of view of MFH is SAR (Specific Absorption Rate). SAR was measured for ferrifluids of various concentrations and configurations of alternating magnetic field parameters (frequency and magnetic field strength). The heating time was 700 s. Systems for $x =< 0.53; 0.66 >$, regardless of whether they were coated by chitosan or not, gave similar results. The most promising was the system with $x = 0.73$ without chitosan at the lowest concentration of 2.8 mg/mL ($f = 532\ kHz$, $H = 15.2\ kA/m$), giving SAR = $(83.4 \pm 2.2)\ W/g$.

References:

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