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Review Report
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on the abstract of the dissertation of Ashraf M. Semaida "Features of the formation of a high-coercivity nanocomposites based on strontium hexaferrite $SrFe_{12}O_{19}$ and a rapidly quenched alloy of the Nd-Fe-B system obtained by high-energy ball milling", presented for the degree of Candidate of Physical and Mathematical Sciences in the specialty 01.03.08 - "Physics of Condensed Matter"

If 10-15 years ago, hard magnetic materials (MTM) were primarily used in magnetic recording and information storage systems, as radio-absorbing coatings, etc., at present, one of the most promising areas of their application is permanent magnets. Due to their high energy characteristics, simplicity of production methods, and the possibility of controlling their behavior using an external magnetic field, MTMs are considered as promising materials for household appliances, they are widely used in instrumentation, including for scientific research, space, computer and robotics, biomedicine and medical technology, energy, including "green", electrical, electronic, automotive, aviation and many other products. It is clear that for all these applications it is important to have a good understanding of the regularities of the formation of the phase-structural state of MTMs, as well as the influence of their sizes, morphology, and crystal structure on their magnetic properties. It is the solution of these problems that the Author has put in the basis of his dissertation work.

Among the results I want to note the most interesting, from my point of view:

- It is shown that the use of high-energy ball milling of $(1-x)(SrCO_3 + 6Fe_2O_3) + x$Co powders, where $x = 0.1$, 0.2 and 0.3, and subsequent high-temperature annealing, instead of complex chemical methods of synthesis, makes it possible to obtain two-phase nanocomposites based on $SrFe_{12}O_{19}$ with strong exchange coupling between the crystallites of the formed magnetically hard and soft phases.

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- A technique for micromagnetic modeling in subgrain scale on polycrystalline models of exchange-coupled two-phase magnets. In particular, the comparison of the magnetic characteristics of the synthesized exchange-coupled nanocomposites $SrFe_{12}O_{19}/Fe_3O_4$ with the characteristics obtained using the theoretically developed model shows a satisfactory agreement. It was shown that for nanocomposites $SrFe_{12}O_{19}/Fe_3O_4$ maximum value $(BH)_{max}$ = 10.8 kJ/m^3 can be obtained when the grain sizes hard magnetic ($SrFe_{12}O_{19}$) and magnetically soft (Fe_3O_4) phases are about 10 nm, and the volume fraction of the magnetically soft phase V_s = 30 %.
- Using the law of approximation to saturation, the values of specific saturation magnetization σ_s of the Nd-substituted phase of hexaferrite $Sr_{1-x}Nd_xFe_{12}O_{19}$ ($0 \le x \le 0.5$) are determined, and the corresponding values of the effective anisotropy constant, magnetic anisotropy field and shape anisotropy fields.
- As a result of a comparative analysis of X-ray diffraction spectra of nanostructured powders of strontium hexaferrite $Sr_{1-x}Nd_xFe_{12}O_{19}$, where $0 \le x \le 0.5$, by the Scherer method, the Williamson-Hall method, the Halder-Wagner method and the method of size-strain plots, it is shown that the Halder-Wagner and the size-strain plots allow one to obtain more accurate data on the sizes of nanocrystallites, which makes it possible to recommend these methods for the analysis of X-ray diffraction spectra of nanostructured powders.

By reading the abstract of the dissertation, it can be seen that the work was done at a high professional level, the provisions and conclusions submitted for defense are reliably substantiated, and the main results of the dissertation were published in a timely manner. As a remark, I would like to see in the abstract a more detailed physical substantiation of the relationship between the particle size and the magnetic properties of samples. Perhaps this issue is discussed in more detail in the text of the dissertation. In general, the thesis of Ashraf M. Semaida, in terms of relevance and volume of the results obtained, as well as in terms of scientific novelty and practical significance, satisfies all the requirements the "Regulations on the procedure for awarding an academic degree at NUST MISiS" P 70.05-19, for dissertations for the degree of Candidate of Physical and Mathematical Sciences, and its author, Ashraf M. Semaida, deserves to be awarded the degree of Candidate of Physical and Mathematical Sciences in the specialty 01.03.08 - Condensed Matter Physics.

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