Modified flame pyrolysis method for magnetic nanoparticles synthesis

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The potential of magnetic nanoparticles has been recognized in recent years, and new commercial applications were clearly identified. Together with usage as catalysts, sensors, composites and others, they got broad usage at illness diagnostics and treatment, in particular, tumor hyperthermia, drug delivery, in MRT image contrast enhancement agents. In all these applications, it is important for the particles to not only be small, but also to be non-agglomerated. The latter is a quite complex task to solve for powder magnetic materials. So, there are special synthesis methods being developed for obtaining such nanoparticles. One of these is the flame pyrolysis method. Though it has many benefits, the processes of aggregation of particles are still occurring. To avoid this, precise control of burning temperature and spraying speed is required. Besides, many of properties of nanoparticles obtained by this method depend on size of the sprayed droplets. To avoid these problems, in this work we propose to use ready-made sols of the source components instead of solutions, as precursor in flame pyrolysis. In this case, crystallization center formation and solid phase germ growth stages take place not in flame. Size, shape and crystal structure of the particles in this case are mostly determined by the conditions of the corresponding sol synthesis. The flame pyrolysis stage allows the transformation of sols into powders minimizing the risk of agglomeration of the particles. Simultaneously, this provides thermal treatment of the material. Non-agglomerated spherical particles (d ~ 80 nm) of γ-Fe2O3 doped with Co (2.6 mol %) were obtained by this approach. This material has a structure of CoxFe2–xO4 solid solution and can be potentially used for magnetic hyperthermia of tumors.

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Formation of the EM-absorbing polimer films

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In this talk we analyse different approaches to the formation of composite thin-film materials with carbon nanopparticles as filler, and present-day technologies for the deposition of shielding coatings. The interest to the work is dictated by that polymer materials with nanocarbons embedded manifest unique properties on attenuation (reflection and absorption) of electromagnetic radiation without essential damage of physical chemical characteristics of polymer matrixes. Nano-dimensional fillers drastically differ from mcrostructured ones in mechanical and electric properties. Structure formation in nano-scale systems is dictated not only by the energy of intermollecular and inter-partical interaction but also the mobility of macromolecules. That should be taken into account under design of polymer compositions. To optimize the cost and thickness of shielding materials without the effectiveness loss, the multilayer polymer systems can be applied. Each polymer layer is formed by several compositions and can include its own set of nanoparticles differing in size, structure, shape, concentfration, etc. Multilayer systems are very promising from the point of view of tunability snd control of working characteristics.

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