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FMR study of magnetic nanoparticles embedded in non-magnetic matrices

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Samples containing small amounts of magnetic nanoparticles (α-Fe/C, Fe_3C/C, γ-Fe_2O_3, Fe_3O_4 and Ni/C) embedded in various non-magnetic matrices, such as polymer, concrete or wax, have been studied by using the ferromagnetic resonance (FMR) method in the 4–300 K temperature range. Generally, an intense resonance line was recorded at all temperatures. All FMR parameters strongly depends on temperature, reflecting reliance on dynamic processes influenced by concentration of magnetic nanoparticles, agglomeration state, type of matrix characterized by its physical properties (presence of critical points) and the kind of used fine particles. The temperature gradient of the resonance field, ($\Delta H_r/\Delta T$), was introduced that is connected with reorientation processes of the correlated spin system. The value of this parameter usually increases over one order of magnitude in low temperatures range and straightforwardly shows matrix's phase transitions, e.g. to a spin glass state or other freezing processes present in the matrix. It is believed that after large statistics of experimental data is collected it could be a useful and simple method of characterization of different type of materials.