Temperature dependence of FMR spectra of γ-Fe_2O_3 agglomerates in an organic matrix

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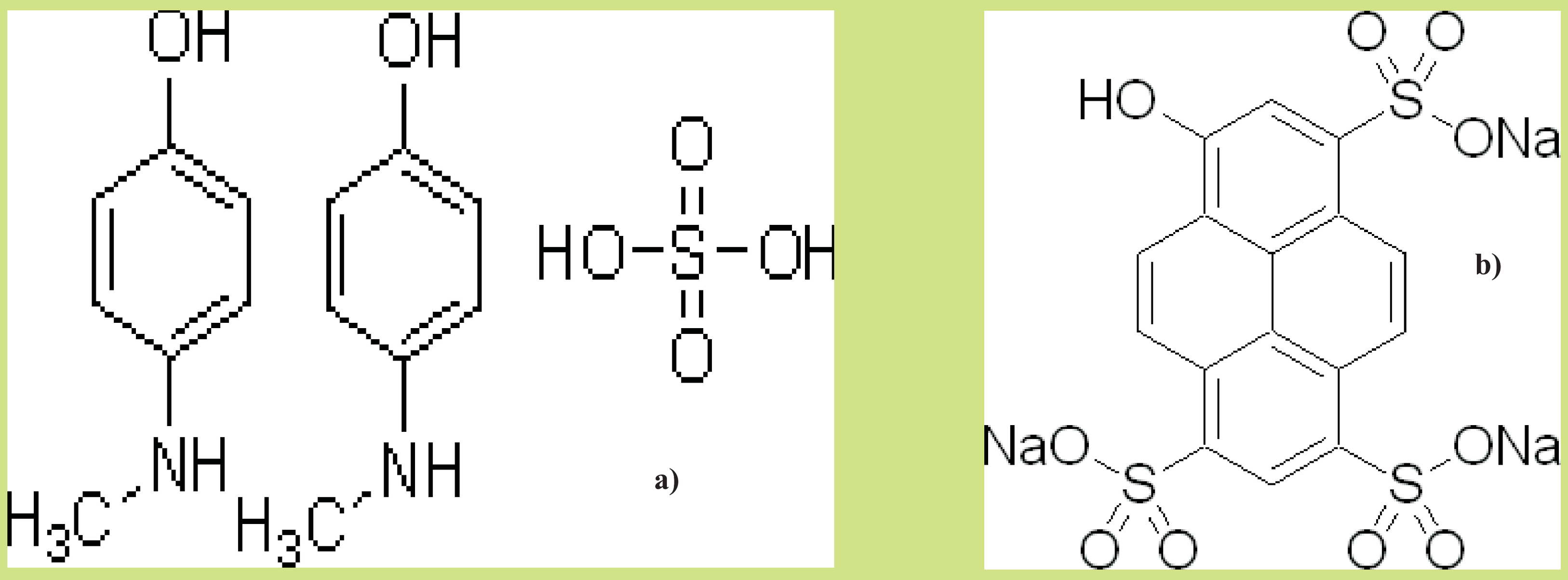
Two samples containing an extended free radical network derived from the condensation of cyanuric chloride with p-phenylenediamine and containing a small amount of magnetic agglomerates have been prepared. Both samples have produced asymmetric, very intense ferromagnetic (FMR) spectra (Fig.1a and b). The temperature dependence of FMR lines was measured in the 80–290 K temperature range. FMR spectra were fitted by two Lorentzian functions (Fig. 1c and d). The following values of the resonance fields and linewidths for the component lines have been obtained: H_r(I)=3354(1) Gs (g_{eff}(I)=2.017(1)), H_r(II)=2918(1) Gs (g_{eff}(II)=2.315(1)) with linewidths ΔH_{pp}(I)=815(2) Gs, ΔH_{pp}(II)=573(2) Gs for sample 1, and H_r(I)=3124(1) Gs (g_{eff}=2.170(1)), H_r(II)=2768(1) Gs (g_{eff}(II)=2.436(1)) with linewidths ΔH_{pp}(I)=573(2) Gs, ΔH_{pp}(II)=630(2) Gs for sample 2. Ultra low concentration of magnetic agglomerates in similar matrices has shown very different behavior. In both samples the resonance lines shift to lower magnetic fields, the linewidths increase, and the amplitudes decrease with decreasing temperature (Fig. 2 and 3). Low concentrations of magnetic nanoparticles in nanocomposite matrices behave in a similar way, while the average position of the resonance lines essentially change at room temperature. The following values of resonance fields temperature gradients were measured: $\Delta H_r/\Delta T$(I)~0.26(3) Gs/K, $\Delta H_r/\Delta T$(I)~0.92(3) Gs/K, for sample 1, and $\Delta H_r/\Delta T$(II)~1.31(3) Gs/K Gs/K, $\Delta H_r/\Delta T$(II)~3.34(3) Gs/K, for sample 2. The magnetic iron oxide clusters could produce an internal magnetic field which could be associated with the reorientation processes of the spin system. The magnetic anisotropy as well as the reorientation processes strongly depend on the concentration of the magnetic centers.



The p- methylaminophenol sulfate (a) and the 8-Hydroxy-1,3,6-pyrenetrisulfonic acid,trisodium salt (b)

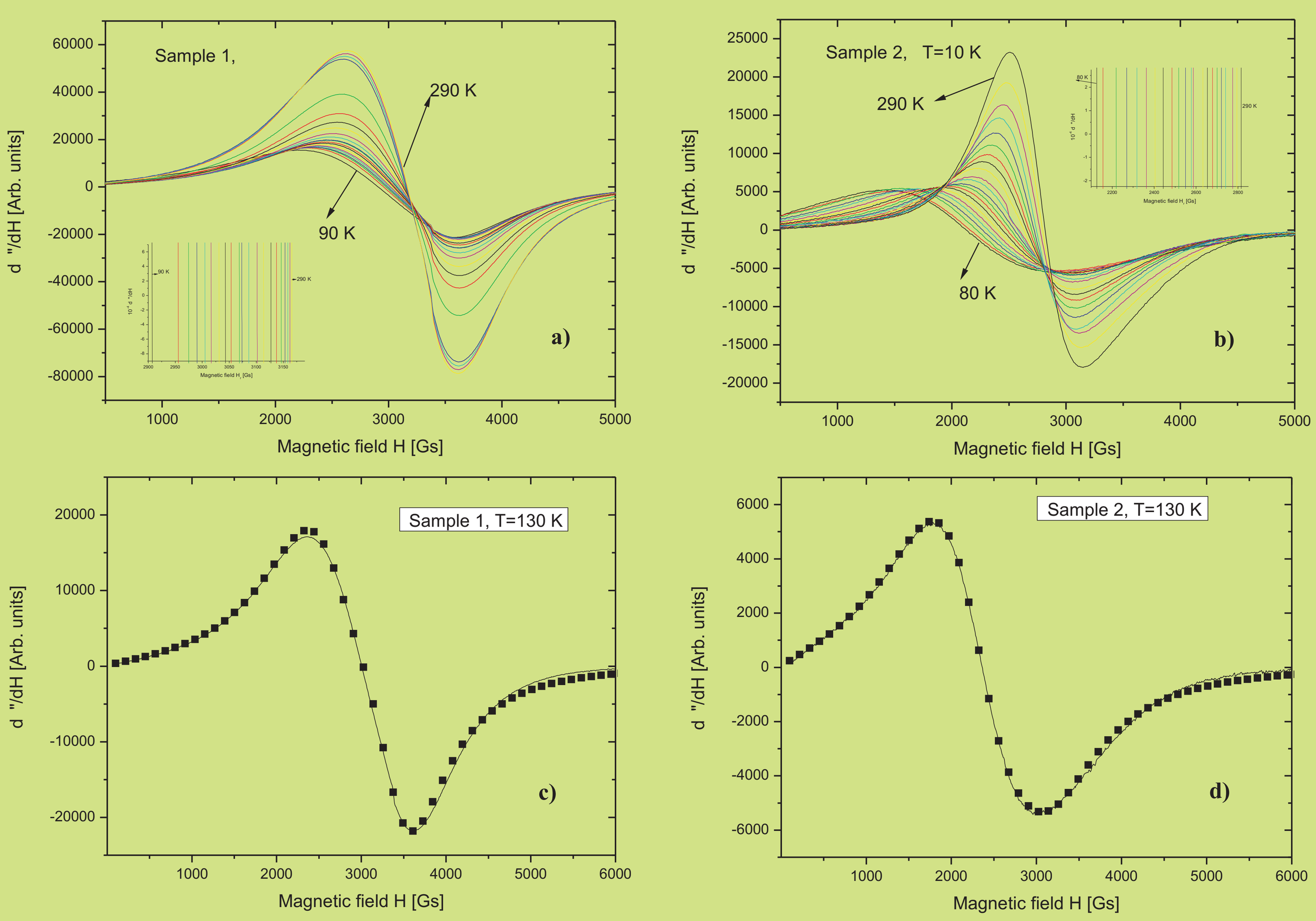


Fig.1. FMR spectra for sample 1 (a), sample 2 (b) and fitted spectra at 130 K for sample 1 (c), and for sample 2 (d).

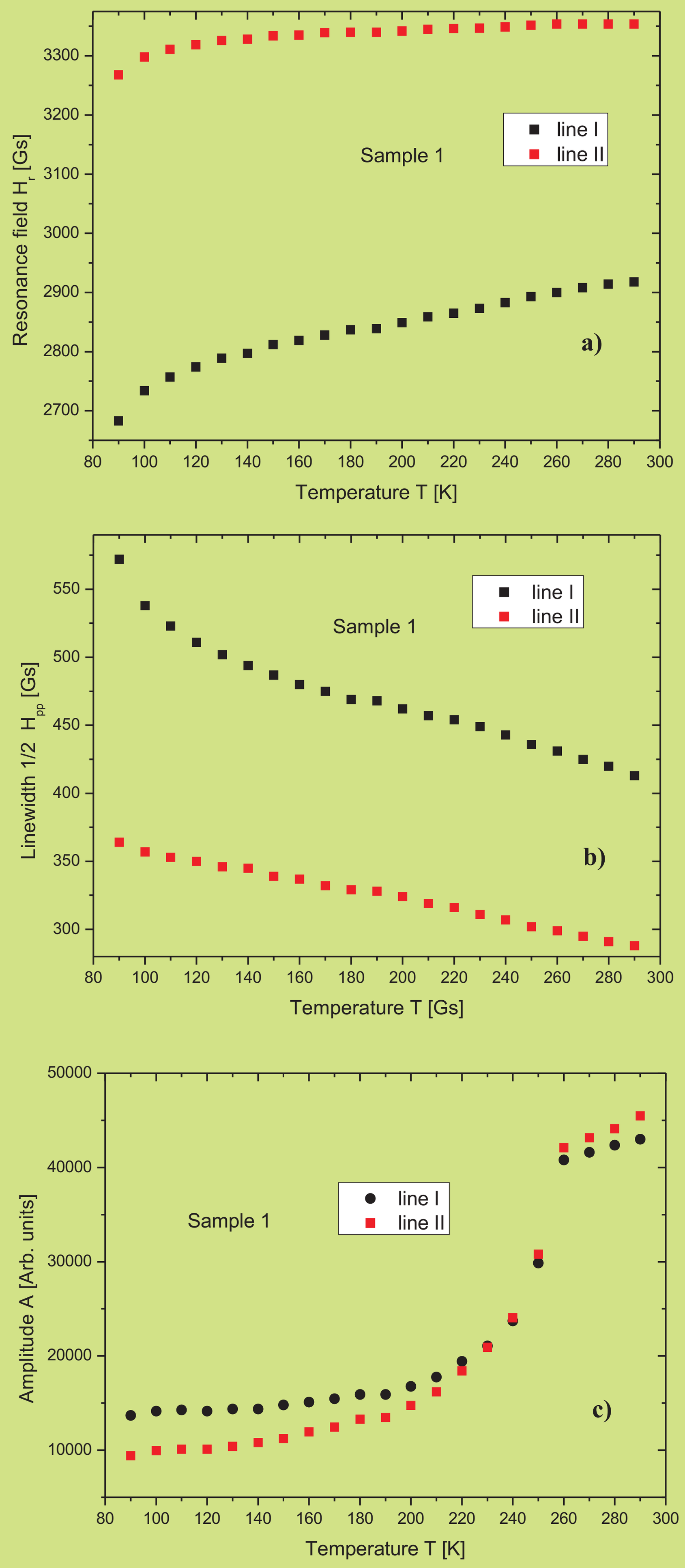


Fig. 2. Temperature dependence of the component resonance fields (a), linewidths (b) and amplitudes (c) for sample 1.

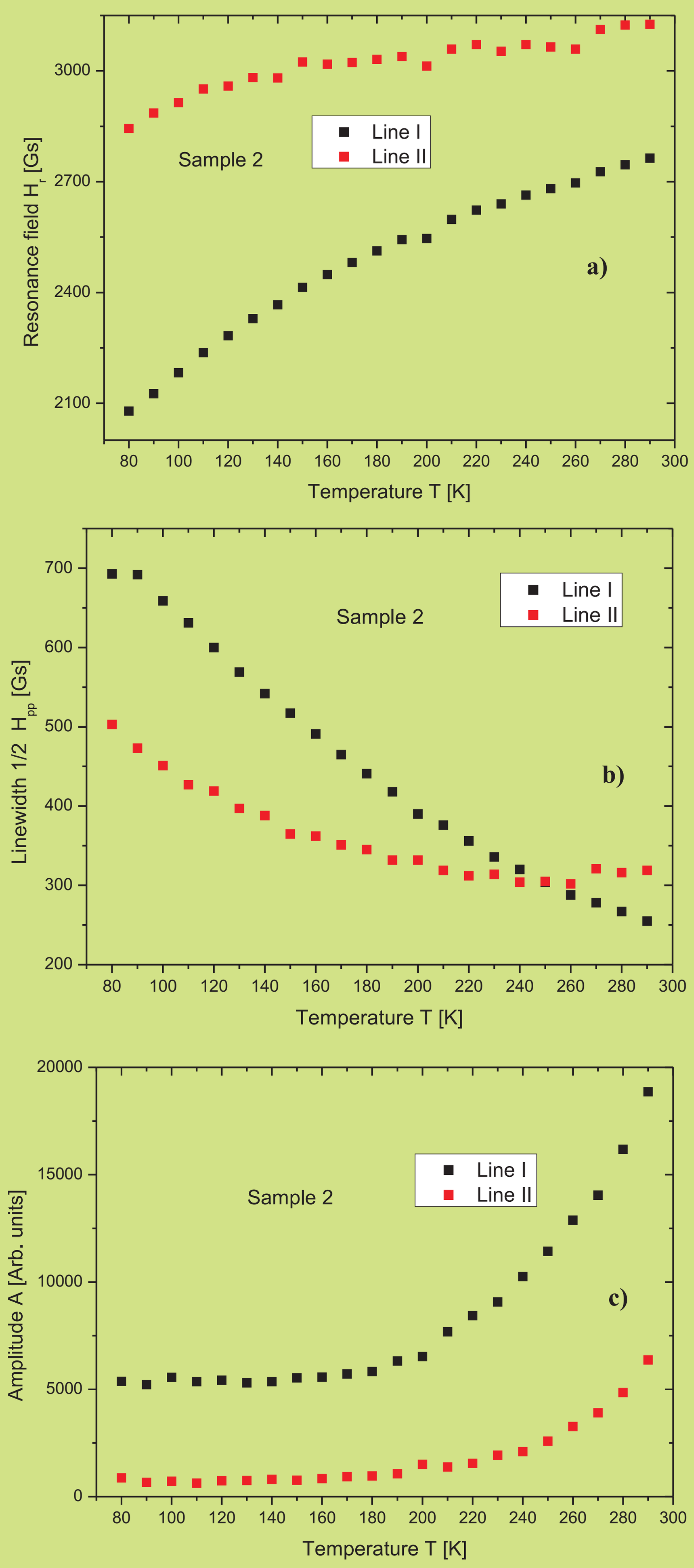


Fig. 3. Temperature dependence of the component resonance fields (a), linewidths (b) and amplitudes (c) for sample 2.

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