Temperature dependence of magnetic anisotropy of nanocrystalline 0.90(Fe_2O_3)/0.10(ZnO) studied by FMR

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The nanocrystalline 0.90(Fe_2O_3)/0.10(ZnO) sample has been prepared by coprecipitation and calcination method. The phase composition of sample was determined by X-ray diffraction. It is dominated by Fe_2O_3 and ZnO phases and also a very small concentration of $ZnFe_2O_4$ phase was identified. The ferromagnetic resonance (FMR) investigation of 0.90(Fe_2O_3)/0.10(ZnO) nanopowder has been carried out in the temperature range from liquid helium to room temperature (Fig.1). The asymmetrical and very intense magnetic resonance line was recorded at all temperatures.

A significant shift of the FMR spectra towards low magnetic fields with decreasing temperature was observed. A very good fitting by two Lorentzian functions has been achieved which suggests the existence of a strong anisotropic magnetic interaction. The decomposition of the FMR spectrum of 0.90(Fe_2O_3)/0.10(ZnO) registered at 90 K on two components is shown in Fig. 2. Temperature dependence of the resonance fields (left panel), linewidths (middle panel) and FMR signal amplitudes (right panel) for two component lines of the 0.90(Fe_2O_3)/0.10(ZnO) sample is presented in Fig. 3. Certain similarities can be observed in temperature dependence of the FMR parameters registered previously for 0.95(Fe_2O_3)/0.05(ZnO) sample but the measured values are essentially different. The temperature shift of resonance field $\Delta H_r/\Delta T$, the broadening of the resonance line as well as FMR signal amplitude change more strongly with temperature in comparison to 0.95(Fe_2O_3)/0.05(ZnO) nanopowder. The following values of $\Delta H_r/\Delta T$ gradient were obtained for 0.90(Fe_2O_3)/0.10(ZnO) sample : 16.7(1) Gs/K and 20.7(1) Gs/K for temperature above 60 K (for 0.95(Fe_2O_3)/0.05(ZnO) it was 3.7(1) Gs/K and 8.3(1) Gs/K [1]) while below 40 K the values were 41.5(1) Gs/K and 56.0 (1) Gs/K (in contrast to 40.5 Gs/K and 49.6 Gs/K for 0.95(Fe_2O_3)/0.05(ZnO)). Thus the reorientation processes are more intense in 0.90(Fe_2O_3)/0.10(ZnO) sample, especially at high temperature.

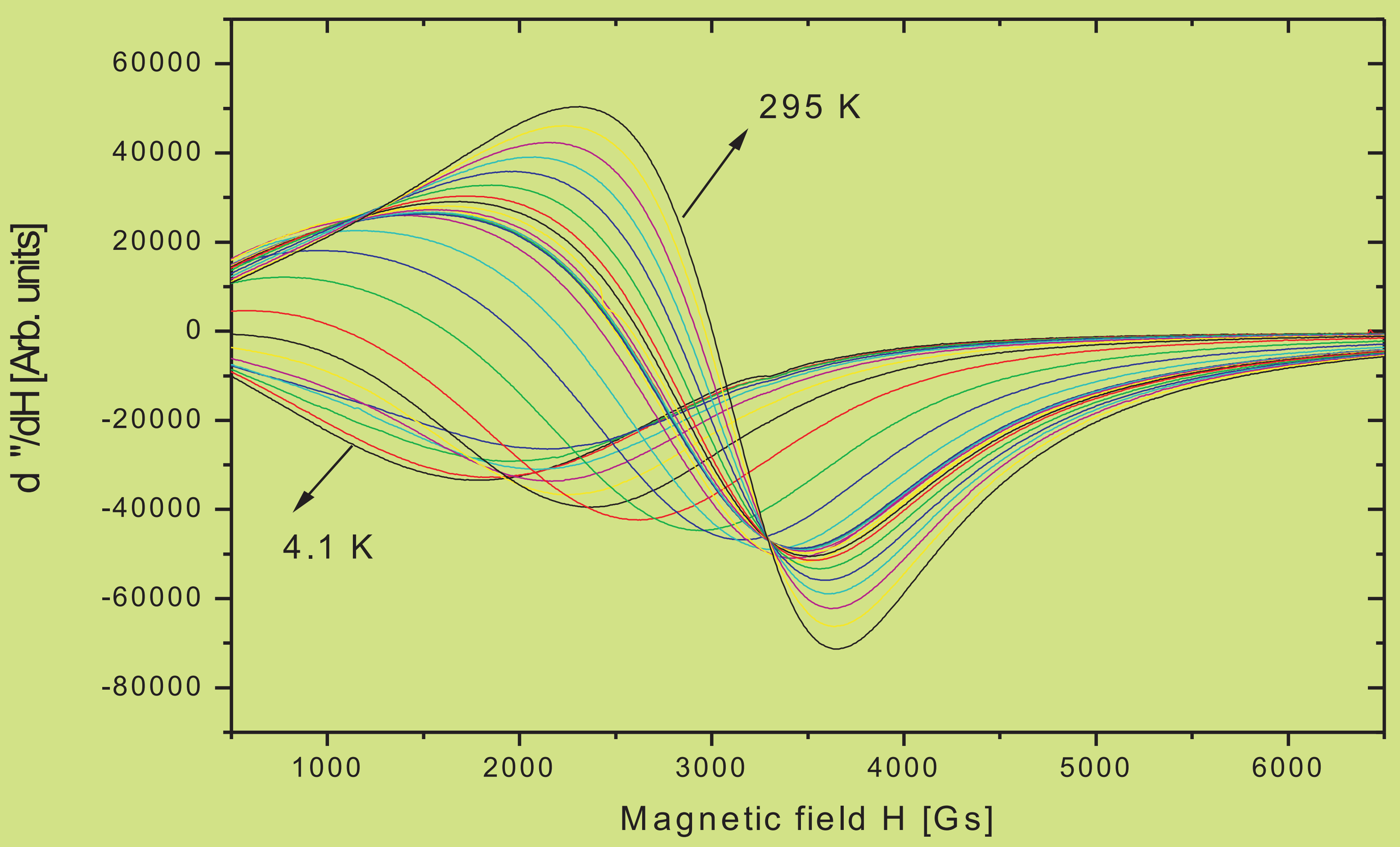

Fig. 1. Registered FMR spectra of 0.90(Fe_2O_3)/0.10(ZnO) at different temperatures.

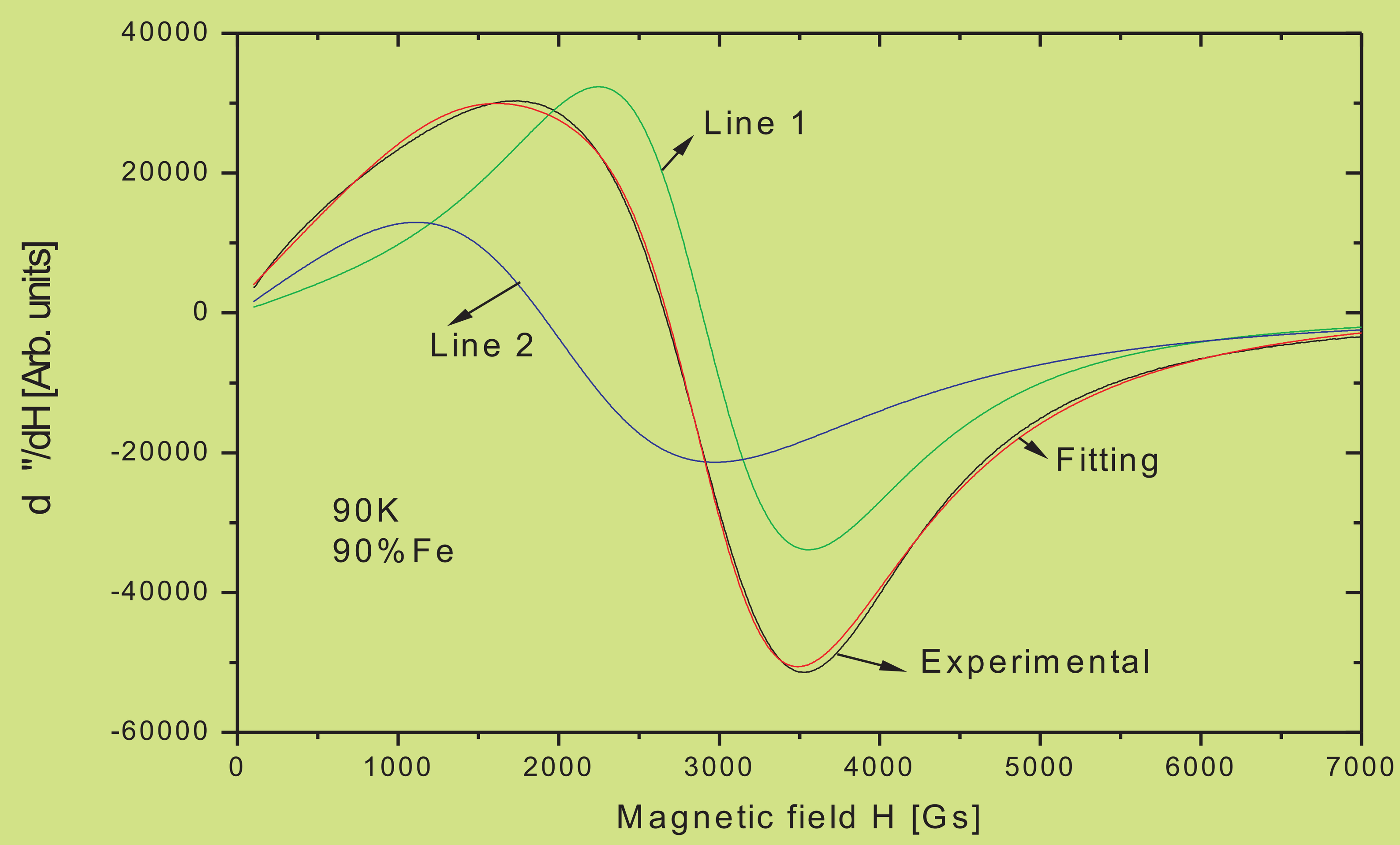

Fig. 2. Decomposition of the FMR spectrum of 0.90(Fe_2O_3)/0.10(ZnO) registered at 90 K.

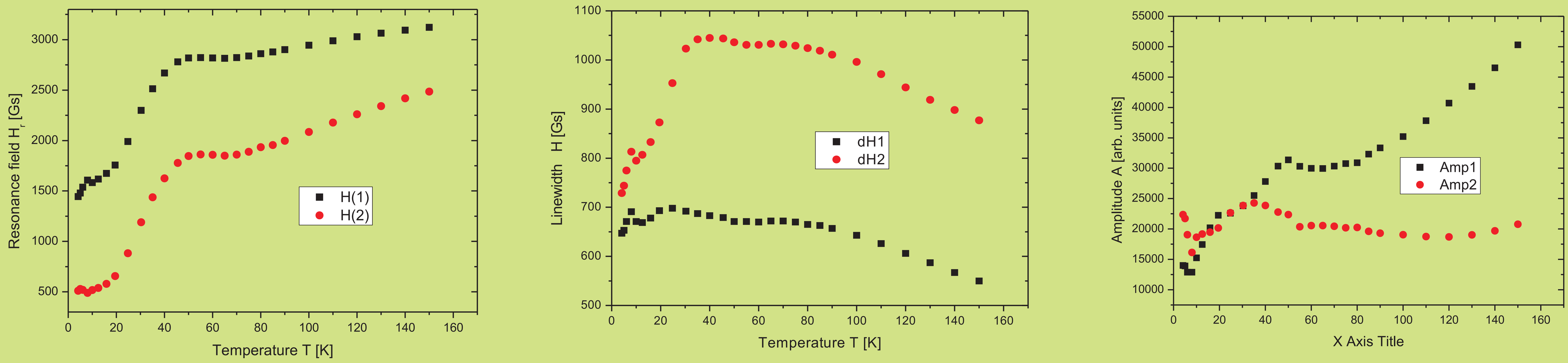

Fig. 3. Temperature dependence of the resonance fields (left panel), linewidths (middle panel) and FMR signal amplitudes (right panel) for two component lines of 0.90(Fe_2O_3)/0.10(ZnO) sample.

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