Dynamics of Spin Glass in NiFe$_2$O$_4$ Nanoparticle

Y. YING, T. W. EOM, J. M. KIM, Y. P. LEE, Hanyang University, Korea, J. H. KANG, Kookmin University, Korea — The dynamic magnetic properties of spin glass in NiFe$_2$O$_4$ nanoparticles have been investigated. The strong irreversibility in the zero-field-cooled and the field-cooled temperature-dependent magnetizations implies the spin glass. The real part of the ac susceptibility $\chi'(T)$ curve shows a pronounced peak. With increasing frequency, the peak ($T_f$) shifts to a higher temperature, which is a characteristic of spin glass. The frequency-dependent $T_f$ data is fitted by a critical power law: $\tau = \tau_0 (T_f/T_g - 1)^{-z\nu}$. The spin-glass transition temperature $T_g$ is 290 K. The microscopic flipping time $\tau_0$ of the fluctuating spins and the critical parameter $z\nu$ are obtained to be $10^{-10}$ s and 8.3 respectively. They are both within the ranges typical for spin glasses ($10^{-10} - 10^{-12}$s for $\tau_0$ and 5 - 10 for $z\nu$), confirming the nature of spin glass. The excellent fit by the Vogel-Fulcher model, revealing the existence of the inter-particle interaction, exhibits that spin glass rather than superparamagnetism exists in NiFe$_2$O$_4$ nanoparticles.

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