TEMPERATURE DEPENDENCE OF DICHROISM IN MAGNETIC FLUIDS

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Abstract

The temperature dependence of dichroism, $\Delta A$, in Fe$_3$O$_4$ magnetic fluids has been investigated in the temperature range $100 \leq T \leq 320$ K and in magnetic fields up to 3 kOe.

The results show that dichroism for a given concentration and for a given applied field is zero below a certain temperature (below the melting point of the liquid carrier) and then increases with temperature till it reaches a maximum at a temperature $T_m$. The value of $T_m$ is found to vary with concentration and applied field. For temperature $T > T_m$ the dichroism decreases with temperature in an Arhenius-type behavior.

Analysis of our results shows that the orientation of pre-existing clusters in the field direction and the field-induced chain formation are the main reasons for the large observed dichroism. Moreover, the non-linearity of the inverse dichroism versus temperature suggests the non-adherence of dichroism to the Curie-Weiss law. However, good straight lines are obtained for Log($\Delta A$) versus $1/T$ for temperature $T > T_m$ and for Log($\Delta A$) versus $1/(T-T_0)$ for $T < T_m$. The linearity in these plots indicates that dichroism follows a Vogel-Fulcher and an Arhenius type behaviors for $T < T_m$ and $T > T_m$, respectively. Because this behavior is similar to the behavior of the viscosity of magnetic fluids, it is suggested that dichroism is mainly controlled by the viscosity of the fluid.