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Electron Spin Resonance Study of $\alpha$-Cr$_2$O$_3$ and Cr$_2$O$_3$·$n$H$_2$O Quasi-Spherical Nanoparticles

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ABSTRACT

The quasi-spherical nanoparticles of hydrated Cr$_2$O$_3$·$n$H$_2$O, and crystalline $\alpha$-Cr$_2$O$_3$, have been synthesized by reduction of the first row (3d) transition metal complex of K$_2$Cr$_2$O$_7$. The temperature dependence of electron spin resonance (ESR) spectrum was studied in terms of g-factor, line width and intensity. ESR of both Cr$_2$O$_3$·$n$H$_2$O and $\alpha$-Cr$_2$O$_3$ has been studied at X-band (9.61 GHz) in the temperature range of 292–420K. An anomalous thermal hysteresis was observed in the ESR intensity and linewidth ($\Delta H_{pp}$ of Cr$_2$O$_3$·$n$H$_2$O. This study shows that there could be a dominant water loss/gain during the heating-cooling cycles which is influencing the thermal relaxation time of Cr$_2$O$_3$·$n$H$_2$O. A similar hysteresis was observed in the differential scanning calorimetry (DSC) data which correlates well with that of ESR indicating possible surface dehydration/rehydration of Cr$_2$O$_3$·$n$H$_2$O nanoparticles during the heating–cooling cycles of ESR measurements.