

## Temperature dependence and line width of ESR signal from chromium(III)

Product used : Electron Spin Resonance (ESR)

### ■ ESR signal of chromium(III)

Chromium (III) oxide has been used for cement, rubber, roofing materials, ceramics, etc. Recently, an unique characteristic has utilized in the development of memories. At room temperature, chromium (III) oxide does not exhibit an ESR signal. However, an ESR signal becomes noticeable around  $g = 1.98$  when the temperature reaches  $200^{\circ}\text{C}$  (refer to Figure 1). Chromium (III) oxide behaves as an antiferromagnet at room temperature, and physical properties undergo a phase transition to a paramagnetic state at elevated temperatures. The temperature at which this phenomenon occurs is the phase transition temperature  $T_N$  (Néel temperature).

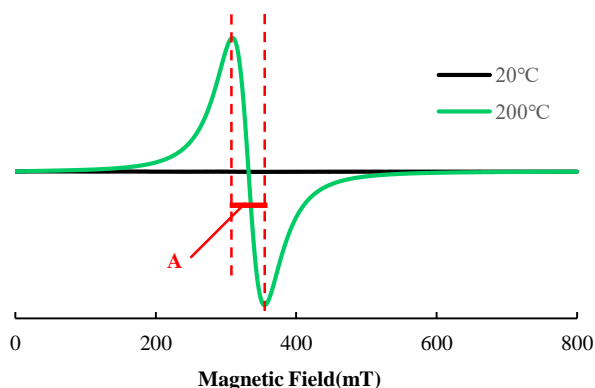


Figure 1. ESR signal of chromium (III)

### ■ Temperature dependence of ESR signal

ESR measurements were conducted within the temperature range of  $33$  to  $200^{\circ}\text{C}$ , facilitated by a variable temperature controller (ES-13060DVT5). Figure 2(A) shows that the vertical axis represents the integral value of the ESR signal, while the horizontal axis represents temperature. The integral value exhibited a progressive increase as the temperature advanced from the phase transition point, denoted as  $T_N$  (approximately  $34^{\circ}\text{C}$ ). The value reached its zenith at around  $40^{\circ}\text{C}$ . The maximum paramagnetic susceptibility is attained at approximately  $40^{\circ}\text{C}$ . Figure 2(B) shows the vertical axis now depicts the linewidth of the ESR signal (A in Figure 1), while the horizontal axis corresponds to temperature. The ESR signals were measured within the range of  $34$ - $35^{\circ}\text{C}$ , in increments of  $0.1^{\circ}\text{C}$ . Consequently, the linewidth of the signal exhibited continuous variations at these temperatures. Upon surpassing  $40^{\circ}\text{C}$ , linewidth of the ESR signal became at an average of  $46 \pm 1$  mT, and thereafter, no substantial alterations in linewidth were noted with changing temperature. This phenomenon has been reported to be observed in the vicinity of the phase transition temperature,  $T_N$ [1].

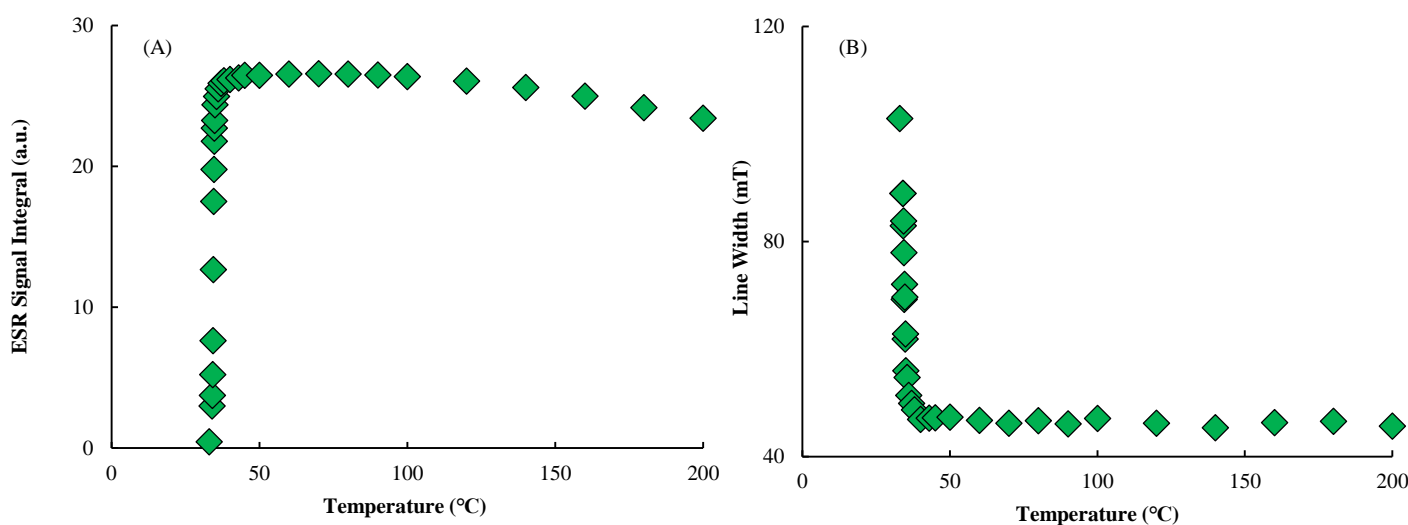


Figure 2. Temperature dependence of integral value and line width of ESR signal of chromium(III)

#### Reference

[1] V.G.ANUFRIEV (1977) : EPR of  $\text{Cr}_2\text{O}_3$  in the phase transition region, Physics Letters A, Vol.64, 1, 139-140.

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