

ELECTRON SPIN RESONANCE IN X-IRRADIATED SODIUM SULPHATE

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SINGLE crystals of Na_2SO_4 were irradiated with X-rays from a copper target (30 KV, 15 mA) and Electron Spin Resonance Spectra of the induced magnetic centres were obtained with X-band spectrometer (Varian Model V 4500) mainly at room temperature. The crystals were rotated about three orthogonal crystallographic axes every five degrees. The single crystals were grown from aqueous solution by slow evaporation and repeated crystallisation. From X-ray diffraction measurements the orthorhombic unit of Na_2SO_4 is found to have the unit cell dimensions $a_0 = 5.85$, $b_0 = 12.29$ and $c_0 = 9.75$ Å with 8 molecules per unit cell agreeing with the previous work.¹ The crystals, on irradiation, slowly developed a beautiful purple coloration.

The observed E.S.R. spectra consist of several lines. Figure 1 shows some typical spectra.

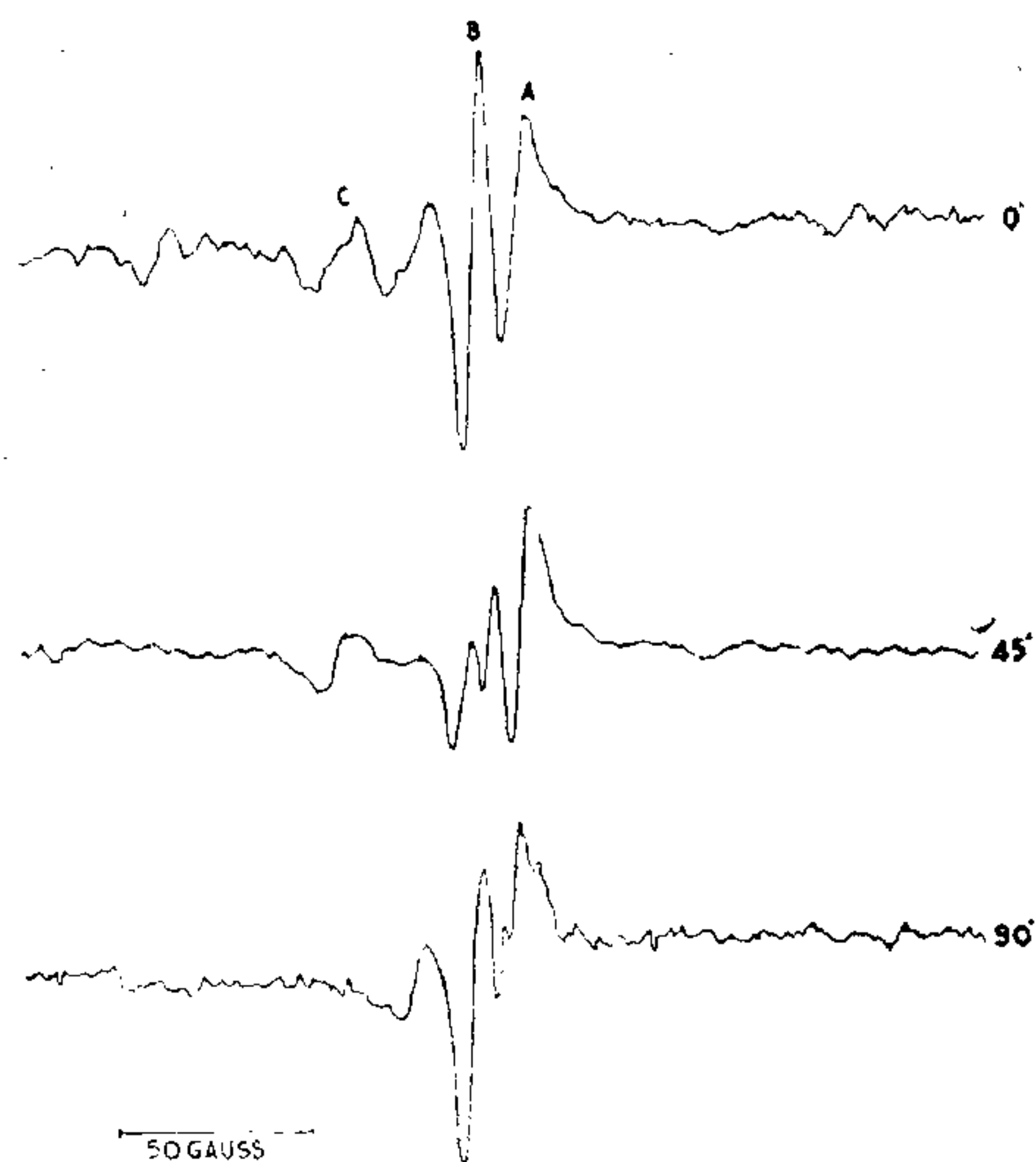


FIG. 1. Derivative of E.S.R. spectra of the irradiated single crystal of Na_2SO_4 . The magnetic field is rotated in the ac plane of the crystal and angles are measured from the a axis.

The centres are all found to be stable for days in the dark at room temperature.

Line A is almost isotropic with average g factor of 2.0045 and a width of about 10 Gauss.

This can be attributed to paramagnetic centre SO_3^- present in the crystal. Optical absorption measurements show that both SO_2^- and SO_3^- may be present in the X-irradiated crystal. Previous work^{2,3} on other sulphates reveal that SO_3^- is isotropic with g value 2.004 and SO_2^- has principal g values 2.0024, 2.0102 and 2.0057. It is possible that lines due to SO_2^- and SO_3^- may be overlapping thus giving rise to a broad spectrum. Further analysis on the fine structure and on the angular variation, which are in progress, may throw more light on this problem. E.S.R. spectra of X-irradiated powder of Na_2SO_4 were also measured and they also give lines with g value near 2.004.

Line C has g value near 2.03. This is similar to the resonance line observed in X-irradiated $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ by Golding and De Lisle³ which they have attributed to sulphur radical. Other work^{4,5} on the electron spin resonance of sulphur also reveal a similar resonance line.

Group B contains two to three lines in the central region of the E.S.R. spectra with g value varying from 2.004 to 2.03. The observed large anisotropy of g values suggests that these centres may contain some other ions associated with sulphur.

Other analogous sulphates are found to have SO_3^- and SO_4^- centres created by irradiation.⁶ Further analyses on sodium sulphate which are in progress will reveal more details about the centres present and their structure.

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