

J. PHYS. SOC. JAPAN 35 (1973) 1562

**Effect of Hydrostatic Pressure on the
Curie Temperatures of Ferroelectric
 $\text{CH}_3\text{NH}_3\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (MASD)
and $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$**

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(Received August 15, 1973)

The effect of hydrostatic pressure on a ferroelectric phase transition has been known as a good indicator for the type of a given ferroelectric material; the pressure coefficient of the Curie temperature is negative for both ferroelectrics of displacive type and of hydrogen-bond type, while it is positive for those of order-disorder type.¹⁾ We have measured the effect of hydrostatic pressure on the ferroelectric Curie temperatures of two ferroelectrics containing hydrogens, $\text{CH}_3\text{NH}_3\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (MASD) (The Curie temperature at 1 atm $T_c^0 = -96^\circ\text{C}^{(2)}$) and $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$ ($T_c^0 = -94^\circ\text{C}^{(3)}$). The experimental procedures were described elsewhere,⁴⁾ and the Curie temperatures were determined from measurements of the dielectric constants at various hydrostatic pressures.

Figure 1 shows the pressure dependence of the Curie temperature of MASD. The Curie temperature T_c linearly increases with increasing hydrostatic pressure p up to about 7 kbar with a coefficient of $dT_c/dp = 2.5 \pm 0.1 \text{ deg kbar}^{-1}$. The result for $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$ is indicated in Fig. 2. In contrast to the case of MASD, the Curie temperature of $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$ decreases with increasing pressure, having

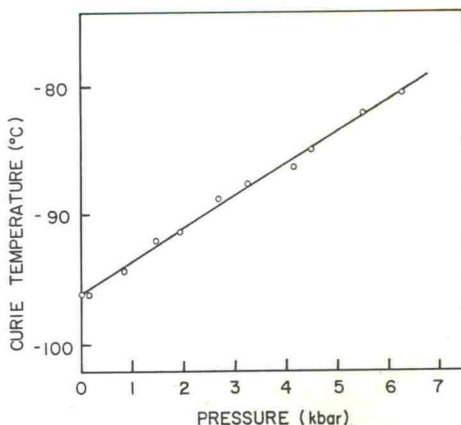


Fig. 1. Hydrostatic pressure dependence of the Curie temperature of $\text{CH}_3\text{NH}_3\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (MASD).

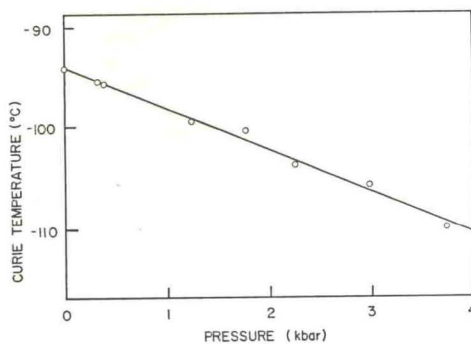


Fig. 2. Hydrostatic pressure dependence of the Curie temperature of $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$.

a rate of $dT_c/dp = -(4.1 \pm 0.2) \text{ deg kbar}^{-1}$.

The present results suggest that a proton collective motion in the hydrogen bonds may be less important for the ferroelectric process in MASD than for that in $\text{NaNH}_4\text{SeO}_4 \cdot 2\text{H}_2\text{O}$. In fact, deuteration of hydrogens in MASD does not alter the Curie temperature,⁵⁾ being consistent with the above suggestion.

References

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SEP 5 1974