TABLE I. Hall coefficient A_H, spontaneous Hall resistivity ρ_{SH}, and resistivity ρ of some Ni alloys.

Composition atomic %	$-A_H\times10^{13}$ (Ω cm gauss^{-1}) 20°K	77°K	290°K	$-\rho_{SH}\times10^{8}$ (Ω cm) 20°K	77°K	290°K	$\rho\times10^{6}$ (Ω cm) 20°K	77°K	290°K
Ni (carbonyl)	5.0	3.6	12.6	0.00	0.12	1.48	0.059	0.69	6.8
Ni (commercial)	5.8	5.2	6.0	0.16	0.17	3.9	0.40	0.86	7.2
Ni (cold worked)	5.1	5.1	11	0.03	0.03	2.7	0.32	0.84	7.1
Ni (annealed)	4.0	4.2	13.3	0.10	0.11	2.2	0.12		6.9
Ni 91 Cu 19	24	21	11.5	3.7	4.2	13.4	8.3	9.3	18.5
Ni 82 Cu 18	25	23	13.5	7.2	8.1	15.8	15.5	16.7	28.8
Ni 92.5 Fe 2.5 Cu 5	20.5	17	14.5	2.3	2.6	9.0	6.3	7.1	15.0
Ni 85 Fe 5 Cu 10	24	21	21	2.4	2.9	7.6			20.2
Ni 90 Co 10	12	11	22.5	0.4	0.6	5.4	2.2		11.8
Ni 80 Co 20	21	20	19	0.22	0.12	0.55	3.2		12.0
Ni 70 Co 30	29	28	13	0.32	−0.25	−1.9	3.9	4.0	11.4
Ni 89.5 Fe 10.5	4	4.5	17	1.3	1.1	1.5	3.8	4.5	13.1
Ni 84 Fe 16	23.5	22	17	−0.40	−0.65	−0.90	4.6	5.2	14.4
Ni 92 Al 8	18	18	10	11.5	13	22.5	12.4	13.1	24.8
Ni 94 Si 6	7	10	11	8.7	9.1	18.3	9.5	10.1	18.0
Ni 97 Sn 3	8.5	9	20	9.0	9.1	16.1	10.8		17.2

The mean internal field is equal to **B**, but fields alternating with distance are superposed. These fields and also the effect (b) cannot give a finite ρ_{SH} in a periodic lattice (pure metal at $T=0$°K); this may be seen as follows. Apart from the effect due to **B**, both (a) and (b) give rise to a perturbing potential[1] having the same periodicity as the lattice which is unable to change the k vector of the Bloch wave function within one band; i.e., no effective force results. The relevant integrals in reference 3 are, in fact, all zero.

The force **f**, exerted on a dipole $\boldsymbol{\mu}$, due to (c), had been based[4,1] upon the equation $\mathbf{f}=(\boldsymbol{\mu}\cdot\nabla)\mathbf{H}$, giving $f_y=\mu_z\partial H_y/\partial z$. This formula applies only to a dumbbell dipole, whereas for a dipole generated by a circular current $\mathbf{f}=\nabla(\boldsymbol{\mu}\cdot\mathbf{H})$, giving $f_y=\mu_z\partial H_z/\partial y$. The latter model applies to electron spin and is implicitly used when stating that the mean internal field is equal to **B**. In strips, as normally used for Hall measurements, $\partial H_z/\partial y$ is negligible.

Thus, for a perfectly periodic lattice these theories do not predict a finite spontaneous Hall voltage.

---

[1] E. M. Pugh and N. Rostoker, Revs. Modern Phys. **25**, 151 (1953).

[2] J. Smit, Physica **17**, 612 (1951).

[3] A. G. Samolovich and B. L. Konkov, J. Exp. Theoret. Phys. (U.S.S.R.) **20**, 783 (1950).

[4] V. Rudnitsky, J. Exptl. Theoret. Phys. (U.S.S.R.) **9**, 262 (1939).

Dielectric Properties of Some Double Tartrates*

F. JONA AND R. PEPINSKY
X-Ray and Crystal Analysis Laboratory, Department of Physics, Pennsylvania State College, State College, Pennsylvania

(Received October 30, 1953)

IN his excellent discussion of the dielectric anomalies of Rochelle Salt, Mueller[1] states that "the isomorphous Tl−Na[2] and Rb−Na salts also are ferroelectric, but the NH_4−Na-tartrate, although it is also an isomorph, has normal dielectric properties." Cady,[3] on the other hand, states that "pure crystals of $NH_4NaC_4H_4O_6\cdot4H_2O$, $RbNaC_4H_4O_6\cdot4H_2O$ or $TlNaC_4H_4O_6\cdot4H_2O$ have quite normal dielectric behavior." Both authors quote Kourtschatov's extremely interesting observations on $Na(NH_4, K)$-$C_4H_4O_6\cdot4H_2O$ mixed crystals.[4] That investigator found that for molar concentrations of NH_4 greater than 20 percent, with the NH_4 ions substituted for K in Rochelle Salt, the mixed crystals show a single Curie point below −70°C.

We have re-examined the dielectric constants ϵ_a, ϵ_b, and ϵ_c (along the a, the b, and the c axis, respectively) in $NaRbC_4H_4O_6\cdot4H_2O$, over the temperature range from 4.2°K to 333°K, with a field of 10 v/cm and a frequency of 10 kc/sec. No dielectric anomaly appears in this temperature range. Table I gives values on the gently rising curves for 4.2°K, 88°K, 298°K, and 333°K. At about 333°K the crystal dehydrates rapidly, and losses and dielectric constants increase strongly.

Mueller's statement concerning the Na−Rb salt is thus not confirmed.

The dielectric behavior of the $NaNH_4$ double salt has also been re-examined. Although no *peak* appears along anyof the three axes, down to 4.2°K, confirming Mason's[5] prediction for ϵ_b, an anomaly does appear at 109°K. The dielectric constants ϵ_a, ϵ_b, and ϵ_c are 8.4, 9.3, and 9.6, respectively, at room temperature. At 110°K these values have dropped very gradually to 7.5, 8.3, and 8.6, respectively. But between this temperature and 105°K a sudden and reproducible drop of about 17 percent appears in all three values, as shown in Fig. 1. This suggests a rotational transition. The behavior is not affected by a dc biasing field of 10 kv/cm superimposed on the ac field of 10 v/cm.

TABLE I. Dielectric constants for $NaRbC_4H_4O_6\cdot4H_2O$.

	4.2°K	88°K	298°K	333°K
ϵ_a	6.8	7.3	9.7	11.2
ϵ_b	5.8	6.0	7.6	8.4
ϵ_c	5.3	5.6	8.3	13.7

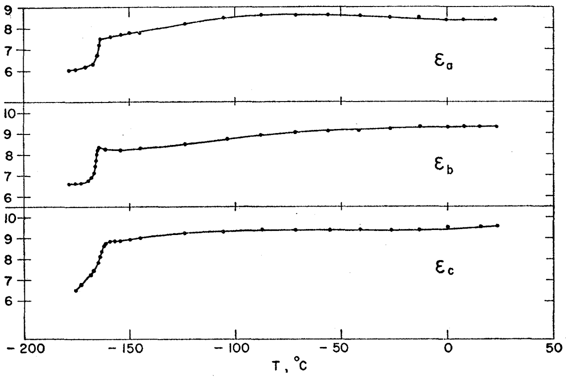

FIG. 1. Dielectric constants of $NaNH_4C_4H_4O_6\cdot4H_2O$ *vs* T.

The dielectric anomaly in the $NaNH_4$ salt was discovered in a re-examination of Kourtschatov's results for mixed $NaNH_4$ and NaK salts. The complete phase diagram, explored dielectrically and thermally, will be reported shortly. An x-ray study of the mixed salts is also in progress.

---

* Research supported by Air Research and Development Command.

[1] H. Mueller, Ann. N. Y. Acad. Sci. **40**, 321 (1940). See p. 322.

[2] Mueller actually writes "Ta −Na," but this is obviously a typographical error.

[3] W. G. Cady, *Piezoelectricity* (McGraw-Hill Book Company, Inc., New York, 1946), p. 654.

[4] I. V. Kourtschatov, *Le Champ Moleculaire dans les Dielectriques* (Hermann et Cie, Paris, 1936).

[5] W. P. Mason, *Piezoelectric Crystals and their Applications to Ultrasonics* (D. van Nostrand Company, Inc., New York, 1950), p. 223.