**substance: NiO**
**property: transport properties in Li doped NiO**

Lithium enters NiO substitutionally, compensation being by the formation of $Ni^{3+}$ – $Li^{+}$ dipoles that are only slightly dissociated at 300 K. In addition some compensation by $V_0$ formation is found, with profound effects on semiconductor statistics [70A].

**Figures:** effect of lithiation on $T_N$: Fig. 3, on resistivity: Fig. 4 (change in activation energy closely following $T_N$), resistivity in the exhaustion region: Fig. 5, Seebeck coefficient: Fig. 6, and comparison with resistivity: Fig. 7. The activation energy of 0.3 eV observed is entirely due to the variation in free-hole concentration above 140 K. Below this temperature impurity conduction apparently dominates.

**Hall mobilities:** Figs. 1, 8; calculated from Seebeck coefficient: Figs. 2, 9. Sign inversion of $R_H$ occurs at $T_N$ as in pure NiO. Further data: [67K, 65K2, 64R]. It has been established that the activation energy for conduction falls with increasing Li content both above and below the break near $T_N$ (Fig. 10).

| | | | | |
|---|---|---|---|---|
| $\mu_H$ | 0.1...0.4 $cm^2$/V s | $T$ = 300 K | Li content: 0.005...0.088 at % Li | 70B |
| $\mu_{dr}$ | 0.5...5.0 $cm^2$/V s | | | |
| | 0.4 $cm^2$/V s | higher temperatures, exhaustion region | | |
| $\mu_H$ | exp (0.08[eV]/k$T$) | $T$ = 200...400 K | data support large-polaron model ($m^{**} \approx 6\ m_0$) [70B] | 70B, 67K |

## References:


64R Roilos, M., Nagels, P.: Solid State Commun. 2 (1964) 285.
65K1 Koide, S.: J. Phys. Soc. Jpn. 20 (1965) 123.
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66B Bosman, A. J., Crevecoeur, C.: Phys. Rev. 144 (1966) 763.
67A Austin, I. G., Springthorpe, A. J., Smith, B. A., Turner, C. E.: Proc. Phys. Soc. 90 (1967) 157.
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70A Adler, D., Feinleib, J.: Phys. Rev. B2 (1970) 3112.
70B Bosman, A. J., van Daal, H. J.: Adv. Phys. 19 (1970)1.
73N Notis, M. R., Spriggs, R. M., Hahn, W. C.: J. AppI. Phys. 44 (1973) 4165.

**Fig. 1.**

NiO:Li. Hall mobility for holes vs. reciprocal temperature for various single crystal samples doped with Li. at% Li: *1* (open circles: 0.032; triangles: 0.029), *2* 0.144, *3* 0.211, *4* 0.202, *5* 0.537 [67A].

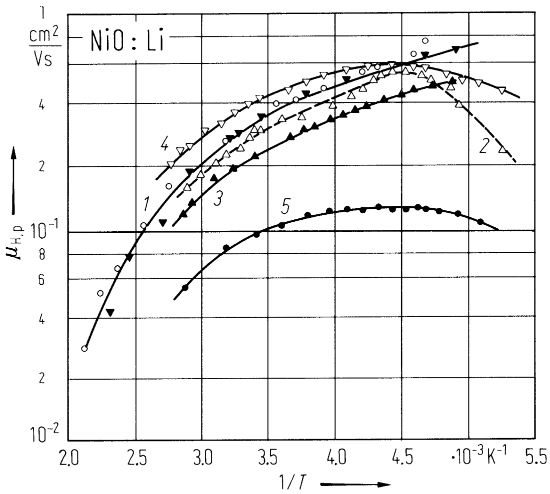

**Fig. 2.**

NiO:Li. Seebeck coefficient vs. (reciprocal) temperature for several pure and Li doped crystals. at% Li: *1* 0, *2* 0, *3* 0.032, *4* 0.202, *5* 0.211, *6* 0.537 [67A].

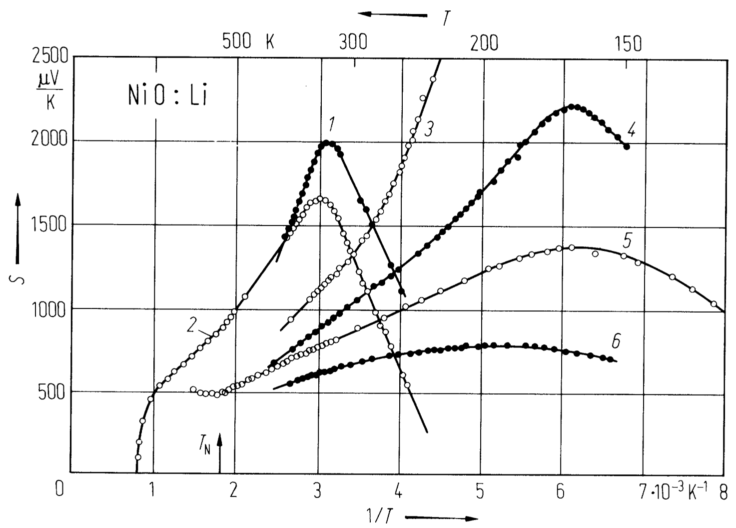

**Fig. 3.**

$Li_xNi_{1-x}O$. Néel temperature vs. Li concentration [73N].

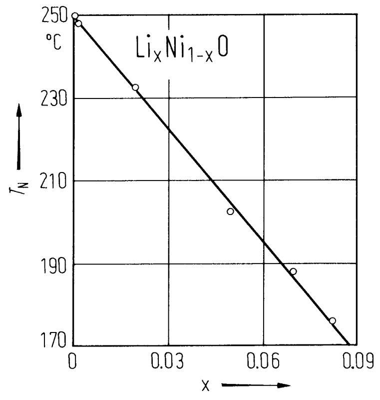

**Fig. 4.**

$Li_xNi_{1-x}O$. Resistivity (over $T$) vs. reciprocal temperature for different doping levels. The arrows indicate $T_N$ for each sample [73N].

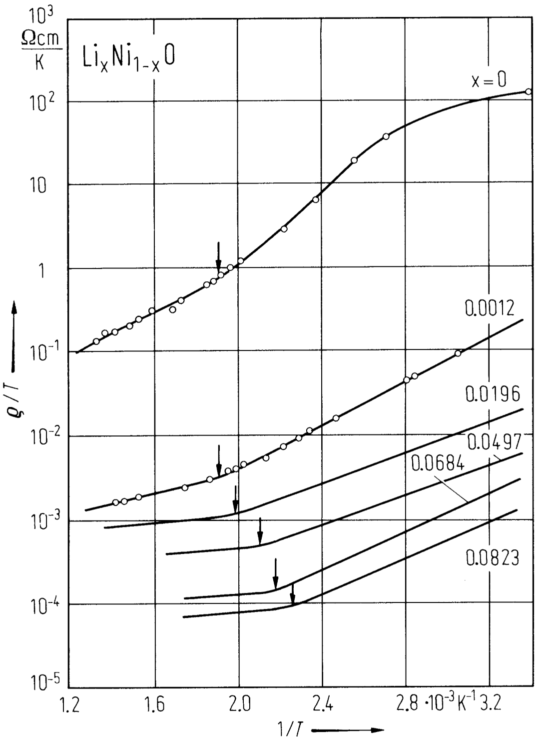

**Fig. 5.**

$Li_xNi_{1-x}O$. Resistivity vs. Li doping at $T$ = 1200 K for NiO, CoO and MnO. Deviation from the linear behaviour at low doping concentration are due to the pressure of cation vacancies [70B].

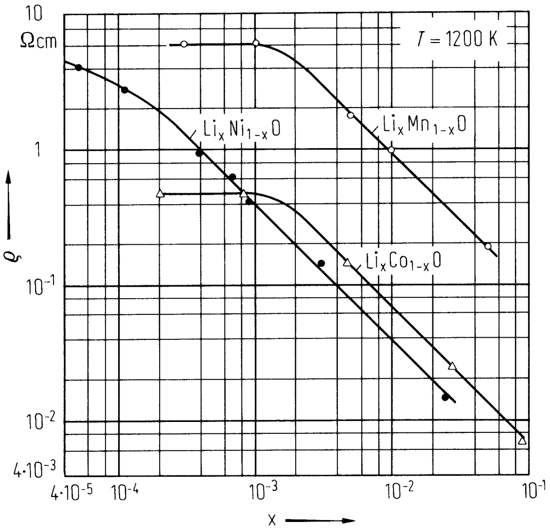

**Fig. 6.**

$Li_xNi_{1-x}O$. Seebeck coefficient vs. temperature for a sample containing $8.8\cdot10^{-2}$ at% Li. Note the change in both scales at 500 K [66B].

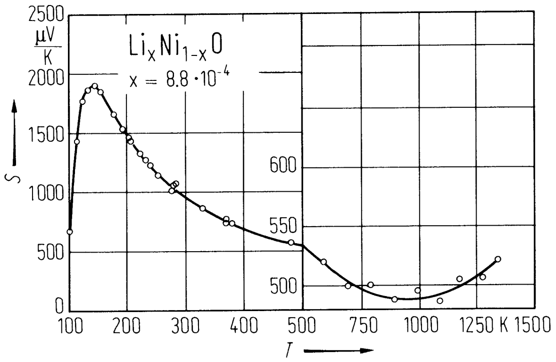

**Fig. 7.**

$Li_xNi_{1-x}O$. Resistivity and reduced Seebeck coefficient vs. reciprocal temperature for a sample containing $8.8 \cdot 10^{-2}$ at% Li [66B].

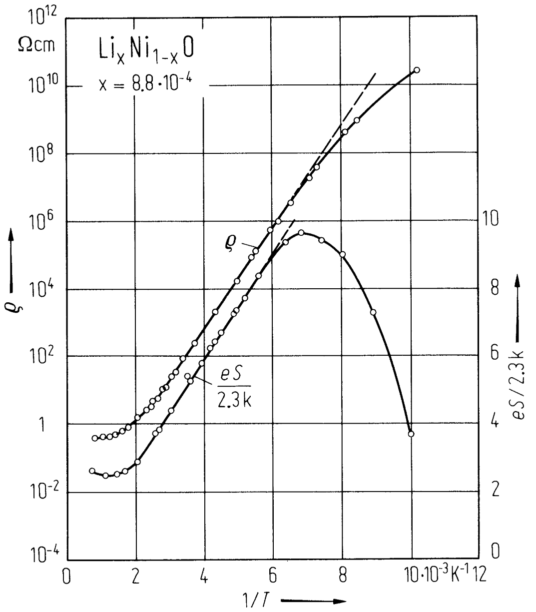

**Fig. 8.**

NiO:Li. Resistivity, Hall coefficient and Hall mobility vs. (reciprocal) temperature for p-type ceramic and non-deliberately-doped single crystal material. Values of $\rho$ for ceramic samples have been indicated by solid lines solely. With regard to the resistivity of single crystals at high temperatures the black circles and squares represent different values for a thin disk measured when cooling the sample slowly and rapidly, respectively. The broken line results from a rapid run performed on a thick bar [67D].

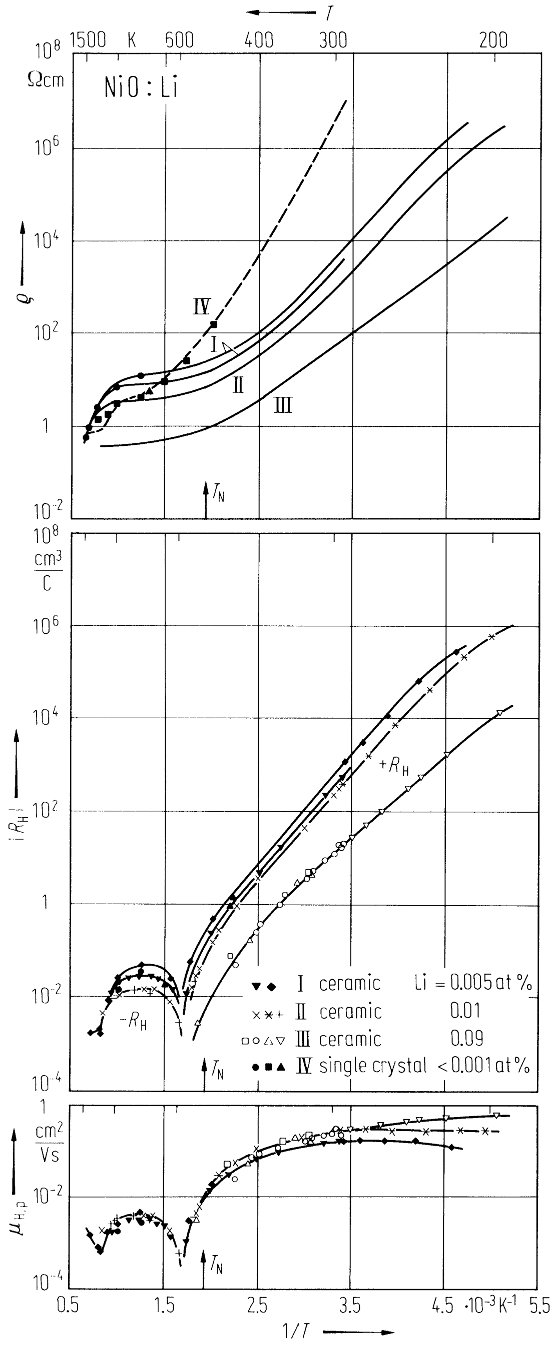

**Fig. 9.**

NiO:Li. Mobility *1*, *2* and Hall mobility *A*...*D* for holes vs. reciprocal temperature. *1*, *2* 0.088 at% Li doped, calculated $\sigma$ and *S* using different approximations. *A* Li doped crystals with 0.088...0.005 at%, *B* single crystal undoped and *C*, *D* single crystals 0.2 at% Li doped [66B].

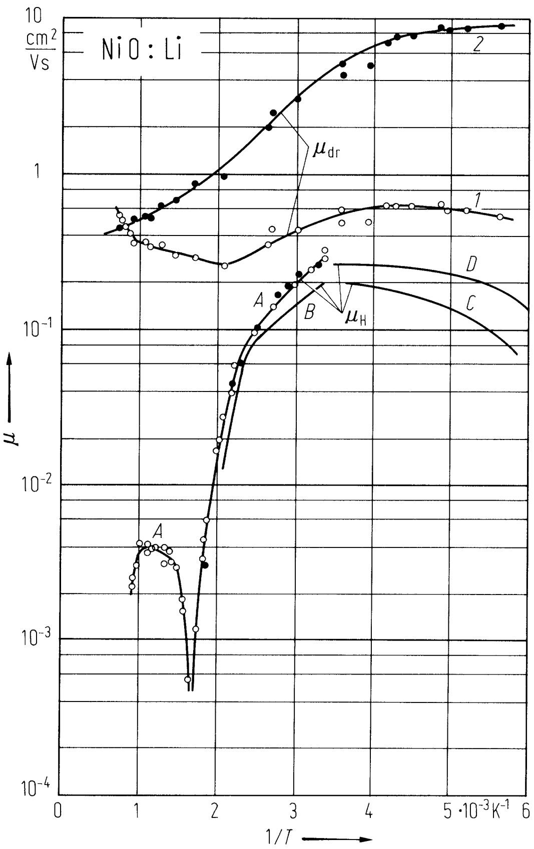

**Fig. 10.**

$Li_xNi_{1-x}O$. Activation energy vs. Li content for two specimens. Full circles: $E_{A1}$ for $T > T^*$, open circles: $E_{A2}$ for $T < T^*$ where $T^*$ is the temperature at which a break occurs in the log $\sigma$ vs. $1/T$ plot and $E_{A1}$ and $E_{A2}$ are the activation energies $T >$ and $< T^*$ [65K1].