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The figure shows the amplitudes of two TSC maxima for one crystal as a function of the amplitude of the applied alternating voltage. In the absence of a transverse field two maxima were found at  $-250$  and  $-230^\circ\text{C}$  (there were no other maxima right up to  $+50^\circ\text{C}$ ), which correspond to the level depths of  $\approx 0.04$  and  $0.075$  eV, respectively. A strong dependence of the TSC maxima on the amplitude of the applied voltage was observed. The value of  $I_m$  (the maximum stimulated current) at  $600$  V ( $\Delta t = 100$  msec) was reduced by a factor of about 100 in the case of the  $0.04$ -eV level. This change is considerably greater than the change of the TSC current reported by Böer and Kümmel [4].

Since a large change of  $I_m$  was also observed at relatively low voltages ( $200$  V), which correspond to fields of  $(2 - 5) \cdot 10^4$  V/cm in the crystal, it was assumed that the hole levels were not ionized. A dependence of the TSC maxima on the wavelength of light and on the field on it was also observed. A study of the dependence  $I_m(\Delta t)$  indicated that considerable emptying of levels occurred during a time interval of the order of several hundreds of milliseconds.

The results obtained indicate that it is in principle possible to determine both the mechanism of the action

of the field on the levels (tunnel effect from the levels to a band, impact ionization) and the quantitative characteristics of this mechanism. For this purpose it is necessary to study the dependence  $I_m(V)$  and  $I_m(\Delta t)$  together with the kinetics of photoconductivity at low temperatures, and to determine (from the TSC curves in the absence of a field) the trapping level parameters.

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X-ray

## POLYMORPHIC TRANSFORMATION OF NaCl

V. V. Evdokimova and L. F. Vereshchagin

Institute of High Pressure Physics, Academy of Sciences, USSR, Moscow  
Translated from Fizika Tverdogo Tela, Vol. 4, No. 7,  
pp. 1965-1966, July, 1962  
Original article submitted March 19, 1962

Up to now polymorphic transformations under the effect of pressure have been observed in the case of potassium and rubidium halides. An x-ray analysis of RbI was made by Jacobs [1], that of RbCl by Vereshchagin and Kabalkina [2], and that of KI by Jamieson [3]. In all cases it was shown that the phase which has the NaCl type structure under normal conditions acquires the CsCl type structure under the effect of high pressure.

We have observed an analogous transformation in the case of NaCl under a pressure of about  $1.8 \cdot 10^4$  kg/cm<sup>2</sup>. X-ray photographs (see figure) obtained by the method described earlier [4] show eight clearly visible lines be-

longing to the new phase. Indexing showed that the high-pressure phase of NaCl has a CsCl type structure with a lattice constant of  $a_0 = 3.39 \pm 0.06$  Å at atmospheric pressure (see table).

The density of the new phase is  $\rho_0 = 2.535$  g/cm<sup>3</sup>; the jump in the specific volume occurring as the result of the transformation is  $\Delta V = 14.2\%$ .

If we follow Gol'dshmidt's conclusion [5] that the transformation is accompanied by a change in the coordination number from 6 to 8, which leads to a 3% increase in the distance between the different kinds of atoms, we can calculate the lattice constant of the new

July 1962

a  
b  
c

One of the x-ray photographs. a) Before the application of pressure; one can see the spots due to beryllium; b) under a pressure of 18,900 kg/cm<sup>2</sup>; the third line belongs to the new phase (110); c) after relief of pressure.

## Results of Indexing

<i>I</i>	$\theta$	$\sin^2 \theta$	<i>d</i>	<i>hkl</i>	<i>a</i> , Å
Medium	8°28'	0.0217	2.42	110	3.42
Weak	12 23	0.0460	1.66	200	3.32
	13 26	0.0540	1.53	210	3.42
	14 12	0.0602	1.45	211	3.55
	17 34	0.0911	1.18	220	3.34
	19 02	0.1062	1.09	300 221	3.27
Very very weak	20 30	0.1226	1.02	311	3.38
Very weak	21 24	0.1331	0.98	222	3.39

$$a = 3.39 \pm 0.06 \text{ \AA}$$

NaCl phase;  $a = 3.35 \text{ \AA}$ . This value is in good agreement with that found experimentally. The high-pressure phase of NaCl is usually preserved after the removal of pressure, which indicates an exceptional laxness of the transition. This assumption is confirmed by the fact that no more than 5% of the substance undergoes transformation during 10-20 hours (photographing time). It is also possible that deformations due to slip, occurring as the consequence of the method used, play an important role in the transformation.

All these considerations explain why Bridgman [6] did not observe any transformation in NaCl up to  $10^5 \text{ kg/cm}^2$ .

These results concerning the phase transformation in NaCl are preliminary; more detailed results will be published later.

To conclude, we would like to note that the phase transformation observed in NaCl under pressure is an additional example of the transformation of ionic crystals with face-centered cubic structures into body-centered structures, as in the case of rubidium and potassium halides.

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