

phys. stat. sol. 34, 95 (1969)

Subject classification: 6 and 20.1; 12; 13.4; 22.5.2

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## Uniaxial Stress Effects on Parity-Forbidden Transitions in NaCl:Cu<sup>+</sup> and KCl:Ag<sup>+</sup>

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The temperature dependence of the stress-induced dichroism in the UV absorption bands of NaCl:Cu<sup>+</sup> and KCl:Ag<sup>+</sup> is investigated. The experiments are explained by a frequency splitting of the IR active resonance mode and an off-centre displacement of the defect in the excited state. The value of the quadratic electron-lattice interaction is determined.

Die Temperaturabhängigkeit des durch axialen Druck verursachten Dichroismus in den UV-Banden von NaCl:Cu<sup>+</sup> und KCl:Ag<sup>+</sup> wird untersucht. Die Experimente lassen sich durch eine Frequenzaufspaltung der IR-aktiven Resonanzschwingung und durch eine „off-centre“-Verschiebung der Störstelle im angeregten Zustand erklären. Der Wert der quadratischen Elektron-Gitter-Wechselwirkung wird bestimmt.

### 1. Introduction

The UV absorption bands of Cu<sup>+</sup> and Ag<sup>+</sup> in alkali halides show a characteristic temperature dependence, which was carefully investigated by Fußgänger et al. [1, 2]. The defect ion replaces a cation on a normal lattice site with point symmetry O<sub>h</sub>. The electronic transitions have been interpreted as parity-forbidden electric dipole transitions  $(n-1)d^{10} \rightarrow (n-1)d^n s$  ( $n=4$  for Cu<sup>+</sup>,  $n=5$  for Ag<sup>+</sup>). Odd parity lattice modes destroy the inversion symmetry of the defect and the transitions become allowed by mixing of even and odd electronic states [3]. Observed deviations from the expected temperature dependence of the oscillator strength gave further information about the defect properties. In NaCl:Cu<sup>+</sup> a small "off-centre" displacement of the Cu<sup>+</sup> ion in the lattice cell and a thermal contraction of the cell at higher temperature has been proposed [1, 4]. In KCl:Ag<sup>+</sup> two phonon processes in the high-temperature range cause an additional increase of the oscillator strength proportional to the square of the temperature [2].

To investigate the interactions of the defect electrons with cubic distortions of the lattice, the UV absorption of NaCl:Cu<sup>+</sup> was measured under hydrostatic pressure at room temperature [4] using a method due to Driekamer [5]. Under a hydrostatic pressure of 1 kbar, the relative shift of the peak energy  $\Delta E/E$  was found to be  $1.5 \times 10^{-3}$  and a small decrease of the oscillator strength was observed [4]. In the present work we report on the effects of uniaxial stress (interactions with noncubic distortions of  $T_3^+$ - and  $T_5^+$ -symmetry) on the UV bands of NaCl:Cu<sup>+</sup> and KCl:Ag<sup>+</sup> at different temperatures.

### 2. Measurements

We measured the difference in the absorption constant K for light polarized parallel and perpendicular to the stress axis by a rotating polarizer using a lock-in technique [6, 7]. The size of the samples was about  $7 \times 5 \times 1$  mm<sup>3</sup>. To avoid

n Flußlinie und Versetzung

$\nu = 4$			
$1/\sqrt{2}$	1	2	5
$< 0.1$			
0,19	0,15	0,10	0,1
0,44	0,39	0,27	0,15
0,38	0,34	0,23	0,13
0,57	0,45	0,31	0,18
$< 0,1$			

or. Fiz. 20, 1064 (1950).

und Eigenspannungen, 1. Auflage,

436 (1950).

rbereitung.

9 (1967).

ater. Sci. 12, 183 (1964).

e (Suppl.) 27, C3-51 (1966).

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