SOME INFRA RED OPTICAL PROPERTIES OF $GeSe_2$

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Germanium selenide is a semiconducting compound crystallises with an orthorhombic structure (Space group D_{2h}^{13}) having 24 molecules per elementary cell and the following lattice parameters: a=6,953 Å, b=12,22 Å, c=23,036 Å [1]. Recently it has been shown that $GeSe_2$ can also crystallise in another type of orthorhombic structure with parameters: a=7,037 Å, b=11,826 Å and c=16,821 Å, with only 16 atoms per unit cell [2]. The space group has not been determined yet for this unit cell. $GeSe_2$ is a rather anisotropic compound concerning its physical properties. The atomic intralayer forces in $GeSe_2$ are mainly covalent [3]. There are only a few papers about the optical properties of $GeSe_2$, and these concern the energy gap [4,5] which was obtained from transmission measurements using both nonpolarized and polarized light. Samples, which were used for transmission measurements in the far infra red were made by pressing powdered $GeSe_2$ and polyethylene together [6]. A "wide absorption edge", at about 38,5 μm was observed and also a sharp very intensive absorption at the wafelength of about 80 μm.

In this work far infra red reflectivity measurements have been done and made using Kramers-Krönig integration. Reflectivity measurements have been performed on a Beckmann FS 720 Fourier spectrometer for freshly cleaved single crystals of $GeSe_2$ which were made by the Bridgemann technique [7] in the laboratories of the Institute of Physics.

The reflectivity results for light polarized with $\vec{K} \parallel \vec{a}$, $\vec{K} \parallel \vec{b}$ and $\vec{K} \parallel \vec{c}$ at 300 K in the frequency range bet-

ween 40 and 400 cm^{-1} are given in figure 1. These diagrams were analysed by Kramers-Krönig techniques and results of this analysis are displayed in figure 2, 3 and 4 eg the diagrams of the real (ε') and imaginary (ε'') components of the dielectric constants are given as a function of the wave number.

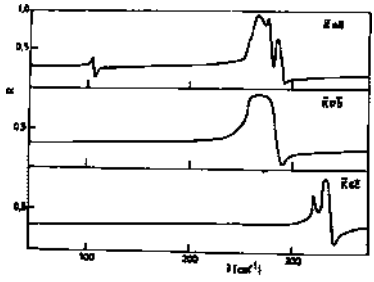

Fig.1

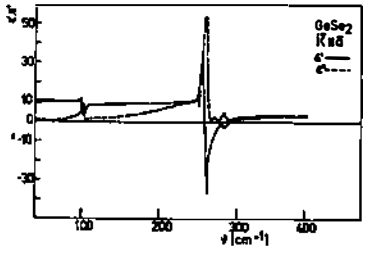

Fig.2

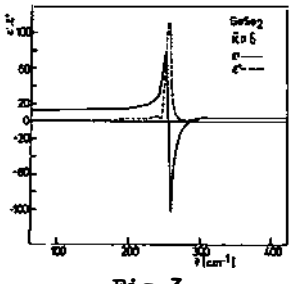

Fig.3

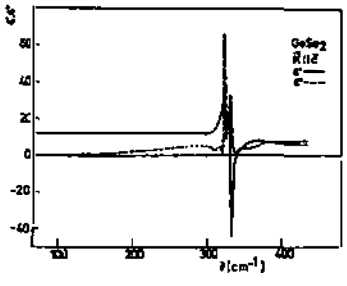

Fig.4

For the polarization $\vec{K} \perp \vec{a}$ 4 oscilators were observed, one at about 100 cm^{-1} and three in the range between 250 and 300 cm^{-1}. It is not impossible that some more oscillators exist in the range between 65 and 125 cm^{-1} but we could not detect them because of the high level of noise which affected our measurements. For the $\vec{K} \perp \vec{b}$ polarization only one oscillator was observed in the range between 250 and 290 cm^{-1}, whereas for the $\vec{K} \perp \vec{c}$ polarization another two resonances were observed in the range between 320 and 330 cm^{-1}.

The optical parameters obtained using Kramers-Krönig

TABLE I.

	$\vec{K} \parallel \vec{a}$	$\vec{K} \parallel \vec{b}$	$\vec{K} \parallel \vec{c}$
TO_1	103,7	256	322
LO_1	106	288	324,6
TO_2	260		329,5
LO_2	272		339
TO_3	272		
LO_3	279		
TO_4	282		
LO_4	289		

analysis are given in table I. The preliminary Raman spectra experimental measurement [8] are in good agreement with this infra red data and show existance of a rather large number of Raman active modes. This is what one would expect for $GeSe_2$ wich has many atoms per unit cell, and therefore probably a rather complicated pattern of lattice vibrations. The results obtained in this work couldn't be compared with the literature data because, as far as we know, there have been no data published yet for $GeSe_2$ concerning this problem.

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