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Both sodium cyanide (NaCN) and potassium cyanide (KCN) undergo two successive order–disorder phase transitions upon cooling below the room temperature. The first order-disorder transition in these solids is characterized by softening of the shear acoustic mode associated with the elastic constant C_{44}.[1] Recent Brillouin scattering of NaCN[2,3] and KCN[3] single crystals have confirmed this result. In Ref. 3 the elastic constants C_{11}, C_{12}, and C_{44} for the two cyanide crystals were determined as a function of temperature in the cubic disordered phase. For KCN our Brillouin scattering values for the elastic constants are in good agreement with the values obtained at 15 MHz from the ultrasonic technique by Haussuhl.[1] In the ultrasonic–hypersonic frequency range, there is negligible dispersion in the KCN crystal. Haussuhl has also published recently the elastic constants for NaCN using the ultrasonic technique.[4] While his C_{44} values for NaCN agree fairly well with our results, there is a significant discrepancy between his ultrasonic and our Brillouin scattering values for C_{11} and C_{12}. This discrepancy prompted us to repeat the Brillouin scattering measurement on NaCN.

We report in this communication the recent Brillouin scattering results on NaCN. In Ref. 3 the elastic constant C_{11} was determined by measuring the Brillouin spectra of the (100) longitudinal acoustic (LA) phonon using a 90° scattering geometry. In carrying out that experiment, NaCN crystal sample was prepared by cutting the crystal parallel to its (110) faces. Since NaCN crystals do not cleave naturally along the (110) direction, the cutting and subsequent polishing operation may introduce significant strain in the crystal. Furthermore, unless an x-ray diffractometer is used to monitor the cutting, there is a finite chance of making an error of few degrees in cutting the crystal. To circumvent these difficulties, we have in the present experiment determined the Brillouin frequency of the (100) LA phonon using the 180° scattering geometry. In this backscattering geometry, the incident light is directed perpendicular to the (100) face (which can be easily cleaved) and the scattered light is collected along $(\bar{1}00)$. While the 180° Brillouin scattering experiment is more difficult, the phonon frequency (which is proportional to $\sqrt{C_{11}}$) obtained using this geometry is believed to be of greater accuracy as one does not need to cut the crystal in this case.

Having determined the (100) longitudinal acoustic phonon frequency by the back scattering technique, we have determined the C_{11} values from the index of refraction and the density data given in Refs. 3 and 4. With the availability of C_{11} one can then determine C_{12} from the LA frequency previously measured, as reported in Ref. 3. The elastic constants C_{11} and C_{12} for NaCN determined by this technique are given in Table I, along with our earlier results. Haussuhl's values for C_{11} and C_{12} are also included in Table I for comparison. One notes that the present values of the elastic constants differ considerably from the earlier ones; furthermore, all the present values are between 1% and 3% higher than Hassuhl's ultrasonic ones, despite the similarity in the overall temperature dependence for the elastic constants. It is not known at present whether the 1%–3% difference is due to the frequency dispersion or to the uncertainty in the density and the index of refraction data of the NaCN crystal.

However, we believe that our previously reported C_{11} and C_{12} values for NaCN are probably in error for the reason that the C_{11} value, which was determined by using the 90° scattering geometry involved the use of a crystal cut along (110), showed a somewhat stronger temperature dependence than that determined by 180° scattering. This suggests that in the earlier measurements of C_{11} we were not observing the pure (100) longitudinal

TABLE I. Elastic constants of sodium cyanide (units C_{ij} in 10^{11} dyn cm^{-2}).

	Ref. 3			Present work			Ref. 4		
T(°C)	C_{11}	C_{12}	C_{44}	C_{11}	C_{12}	C_{44}	C_{11}	C_{12}	C_{44}
20	2.102	1.195	0.036	2.557	1.463	0.036	2.534	1.444	0.033
30	2.129		0.045	2.565	1.447	0.045	2.545	1.424	0.0415
40	2.155	1.123	0.054	2.576	1.430	0.054	2.554	1.406	0.0495
50	2.182		0.063	2.583	1.413	0.063	2.560	1.390	0.0575
60	2.208	1.047	0.071	2.586	1.398	0.071	2.565	1.375	0.066
70	2.243		0.080	2.599	1.371	0.080	2.569	1.361	0.074
80	2.275	0.930	0.088	2.600	1.360	0.088	2.571	1.347	0.082
90	2.301		0.096	2.601	1.345	0.096	2.572	1.333	0.0905
100	2.322	0.911	0.105	2.602	1.330	0.105	2.572	1.319	0.099

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phonon, due possibly to the error introduced in the cutting of the crystal. Apparently, an error of a few degrees and the strain introduced in cutting the NaCN crystal have a significant effect on the Brillouin frequency. Due to the fact that in Brillouin scattering C_{12} is not determined directly but through a combination of the quantity $C' = (C_{11} + C_{12} + 2C_{44})/2$, the temperature dependence of C_{11} also introduces a temperature dependence of C_{12}. The temperature dependences of C_{11} and C_{12} reported in Ref. 3 are thus exaggerated. Furthermore, the curve which shows the vanishing of $(C_{11} - C_{12})/2$ for NaCN as the second phase transition temperature is approached also appears to be fortuitous. In the light of the present result, it is unlikely that the second phase transition in NaCN is related to the vanishing of the shear modulus $(C_{11}-C_{12})/2$ as suggested in Ref. 3.

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