

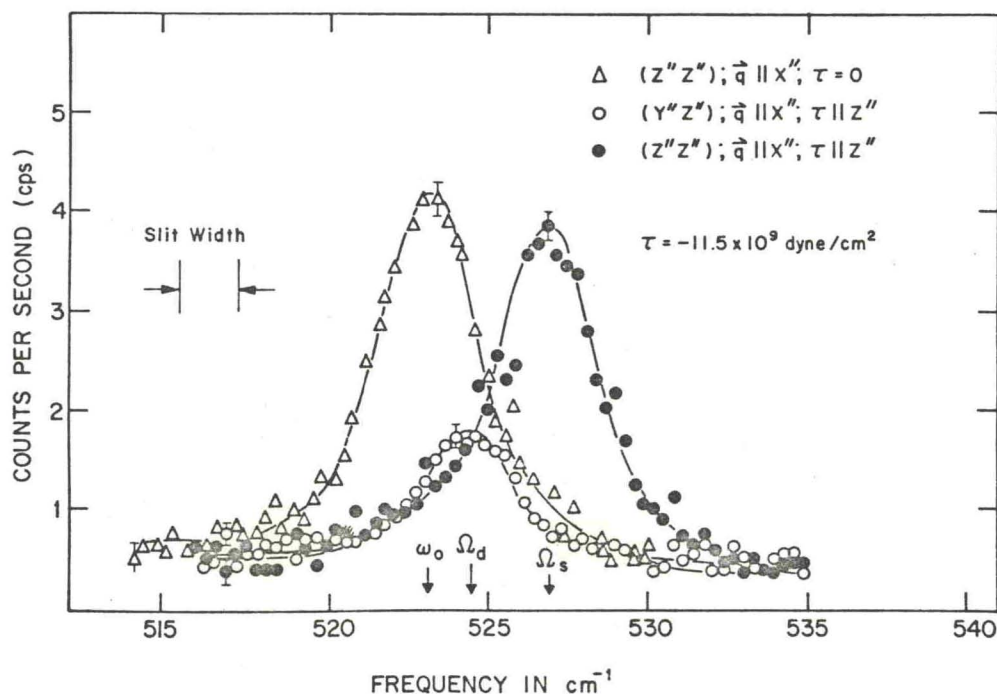


FIG. 1. The first order Raman spectrum of Si at 300°K with a uniaxial stress of -11.5×10^9 dynes/cm² applied along the [111] direction. The entries in the parentheses i.e. (z''z'') and (y''z''), designate the polarization direction of the incident and scattered radiation. In each case, the direction of the incident and scattered radiation is along x'' and -x'' respectively.

[111], $\Delta\Omega = \Omega_s - \Omega_d$ is positive. [In the case of the $x'y'z'$ orientation (negative uniaxial stress along [001]) the sign of $\Delta\Omega$ is found to be negative.] The intensities of the singlet and doublet peaks in Fig. 1 are uncorrected for small differences in the intensities of the incident beams for the two polarizations. When the appropriate corrections are made, the ratio of the singlet peak to doublet peak intensity is found to be 4 as expected from the first order selection rules. In recording the spectra the counting time per grating step for the doublet (400 sec) was chosen to be twice as long as that for the singlet (200 sec) in order to partially compensate for the unequal scattering intensities. [In the case of the $x'y'z'$ orientation, the singlet and doublet peaks are found to have the same intensities as expected.]

Curves of Ω_s , Ω_d and $\Omega_0 = \omega_0 + \Delta\Omega_h$ vs. uniaxial stress for the two orientations are shown in Fig. 2. From the slopes of the curves and the

values of the elastic compliance constants $s_{11} = 76.8$, $s_{12} = -21.4$ and $s_{44} = 126.0$ (in units of 10^{-14} cm²/dyne)⁸ we obtain using equations (3)–(6) the following values (within 20 per cent) for the coefficients p , q , and r (in units of 10^{29} sec⁻²): $p = -1.2$, $q = -1.8$ and $r = -0.63$. (The values for p and q are obtained directly from the data for the $\tau \parallel [001]$). The data for the two orientations yield values of -4.7 and -5.9 for the quantity $(p + 2q)$ which determines the shift in frequency with hydrostatic pressure, indicating a self-consistency of about 25 per cent. Our values for the coefficients agree in sign and are in reasonable agreement in magnitude with the theoretical values, $p = -0.4$, $q = -1.0$, $r = -1.5$, which Ganesan, Maradudin and Oitmaa² have obtained using a Morse potential and only taking nearest neighbor interaction into account.

The data also provide a value for the mode Gruneisen parameter of the $q \approx 0$ optical phonons¹ which is given by