RAMAN-HIGH PRESSURE STUDIES

Raman spectra of gases at high pressures have been obtained.[39-40] The first Raman spectra of micro quantities of solid using the diamond-anvil cell was reported in 1968.[41-42] The method complements the high pressure-infrared technique and allows a complete vibrational analysis of a molecule to be made at non-ambient pressures.

The instrumentation consisted of a Spectra-Physics Model 125 He-Ne laser (90 mW) with a Spex double monochromator at a slit width of 2 cm^{-1} resolution. Figure 10 shows the schematic diagram of 0° laser excitation. Figure 11 shows the actual apparatus used. Figure 12 shows the Raman spectra for HgI_2 at various pressures. The sample must be contained in a molybdenum steel gasket to build up the thickness of the sample. Best results were obtained for 0° radiation, although 180° radiation may also be used.

The Raman results are important, since the LO mode of crystals showing a first-order Raman spectrum are more intense in the Raman spectra, and thus are more easily studied. In addition, various infrared inactive or infrared weak vibrations may be studied with this technique.

LIMITATIONS OF TECHNIQUES

The above applications have been presented to attempt to illustrate the potential use of the high pressure technique for study of molecules in the low frequency range. The technique is new and much work remains to be done. Further, a better understanding is necessary as to what mechanisms are involved when a material is under pressure stress. More work with gaskets and with hydrostatic pressures is needed. Certainly precautions are necessary when using the average pressures obtained in the diamond anvil cell, and relating these to other pressure data. This is particularly dangerous in attempts to obtain quantitative data such as anharmonic contributions in ionic crystals. For qualitative work, the use of an average pressure appears quite satisfactory. The technique has warranted the attention it has received in the past two years. Although it may never realize all of its potentials ultimately, it has already demonstrated that it is a valuable tool for the chemist, physicist, spectroscopist, and solid-state scientist.

ACKNOWLEDGMENT

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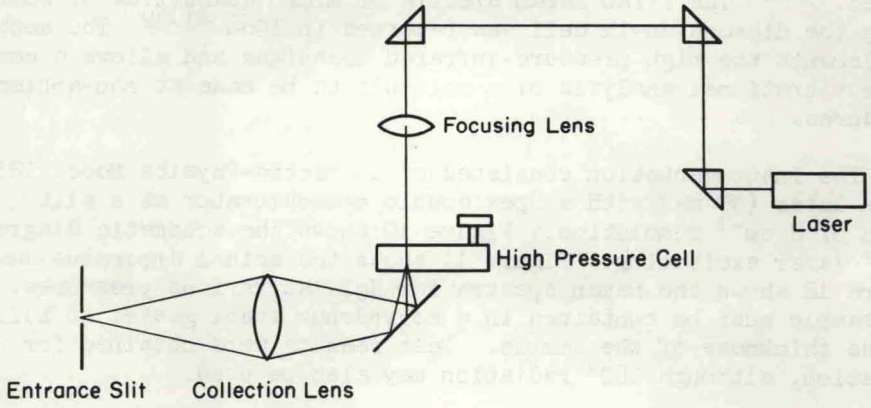

Fig. 10. Schematic Diagram for Laser Raman-High Pressure Experiment.

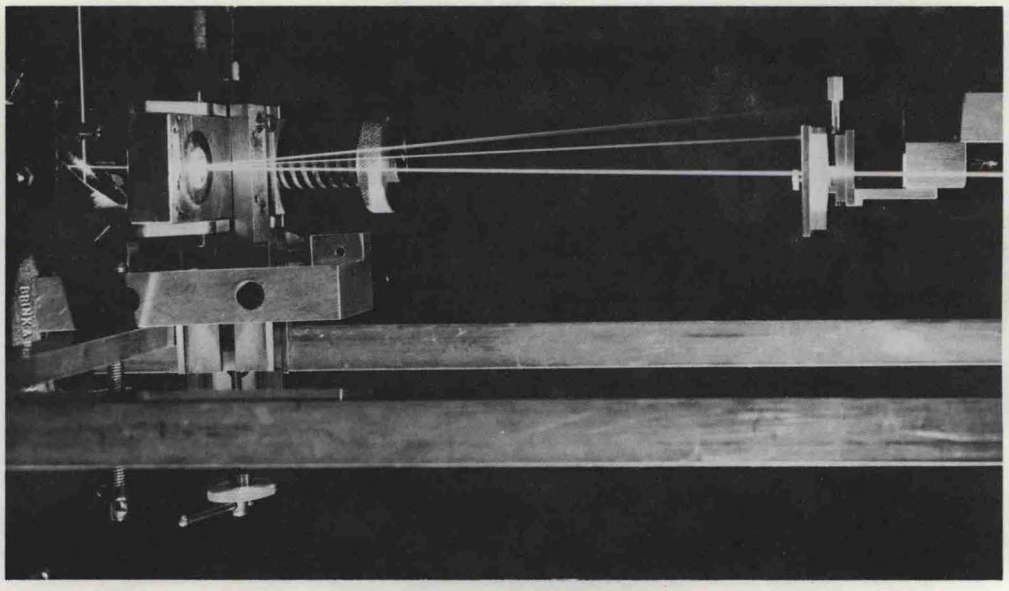

Fig. 11. Apparatus Used in Laser Raman-High Pressure Experiment.