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VIBRATIONAL STUDIES OF SOLID INORGANIC AND COORDINATION COMPLEXES AT HIGH PRESSURES *

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A. INTRODUCTION

The earliest high-pressure studies were made by Amagat [1], but the important and fundamental studies on high pressure were conducted by Bridgman [2—16] who has been called the father of high-pressure chemistry. Bridgman

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was able to attain pressures to 10^5 atm. His work still finds extensive use today, and his compressibility data as a function of pressure for common liquids was a classical achievement.

There are several books and reviews [3,17—26] on high pressure, some of which cover the history of high pressure comprehensively. It is not intended in this review article to dwell on the history of high pressure to any large degree for fear of being redundant with already published material.

The general effects of pressure on matter have been discussed by Sinn [26].

It is the aim of this review to discuss the effects of pressure to 150 kbar on the vibrational transitions occurring in solid materials such as inorganic compounds and coordination complexes. The magnitudes of these effects are measured by IR and Raman scattering methods. The review restricts itself chiefly with the versatile diamond anvil cell. Electronic transitions have been discussed by Drickamer and Frank [27].

(i) Units of pressure

A brief discussion on the units of pressure is necessary at this point. The international standard (SI) unit of pressure is the Pascal or Newton per square meter. The interrelationships between various units in use today and the SI units are given as follows

$1 \text{ bar} = 10^5 \text{ N m}^{-2} \text{ (or Pascal)} = 10^6 \text{ dyne cm}^{-2} = 0.9869 \text{ atm} = 1.0197 \text{ kg cm}^{-2}$

$1 \text{ atm} = 1.01325 \times 10^6 \text{ dyne cm}^{-2}$

We will use kbar in this discussion, which corresponds to 10^3 bar, and at extremely high pressures, Mbar, where 1 Mbar = 10^3 kbar.

To provide the newcomer with an idea of the magnitude of some of these pressure values, Table 1 has been compiled.

TABLE 1

Naturally occurring pressures [26]

Pressure (kbar)	Site of occurrence
1	Deepest part of ocean — Marianas trench
10	Crust—mantle interface — Mohorovicic discontinuity
1.37×10^3	Mantle—core interface — Wichert-Gutenburg discontinuity
3.64×10^3	Center of earth
1×10^8	Center of sun
10^{10}—10^{14}	White dwarf star
10^{17}—10^{21}	Neutron stars