

Infra-red Spectrum and Germanium Co-ordination in some High-pressure Meta-Germanates

THE occurrence of high-pressure transformations in *meta*-germanates, and their structural investigation by X-ray methods, have been reported recently by one of us (A. E. R.)¹. An infra-red investigation of some of these new phases has now been carried out as a further check of the structural changes induced by pressure.

A schematic diagram of the infra-red spectra is given in Fig. 1, which allows an easy comparison of the patterns given by the 'common' and high-pressure (HP) forms of MgGeO_3 , CaGeO_3 and CdGeO_3 .

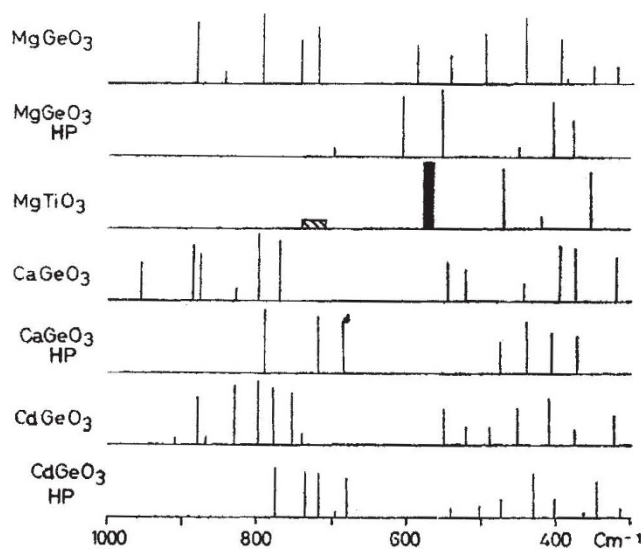


Fig. 1

For each of these substances, the most striking difference between the infra-red spectra of the common and high-pressure forms is the shift towards the low frequencies experienced by the bands related to the Ge-O stretching vibrations. This shift may be explained by 2 types of structural changes: either a change of co-ordination of germanium, or a change in the 'linking mode' of the GeO_4 tetrahedra.

(a) *Change of co-ordination of germanium.* The influence of the cation co-ordination number on the cation-oxygen vibrational frequencies has now been observed for a number of cations². The characteristic frequency range, which is 900–700 cm^{-1} for GeO_4 tetrahedra, falls down to 650 cm^{-1} and below for GeO_6 octahedra. This drop in frequency is well illustrated by the common and high-pressure form of MgGeO_3 (pyroxene and ilmenite structure respectively). The spectrum of MgTiO_3 (which also has the ilmenite structure) is given for the purpose of comparison: it should be pointed out that the GeO_4 and TiO_6 stretching frequencies are very similar (near 600–550 cm^{-1}) in these isomorphous compounds. This similarity in the stretching frequencies of Ge-O and Ti-O bonds has already been noticed for both tetrahedral (Ba_2GeO_4 and Ba_2TiO_4)³ and octahedral (LiCrGeO_4 and LiCrTiO_4)⁴ co-ordinations of germanium and titanium.

(b) *Change in the 'linking mode' of the GeO_4 tetrahedra.* The high-pressure forms of CaGeO_3 and CdGeO_3 exhibit strong bands in the 800–700 cm^{-1} region; this clearly proves that GeO_4 tetrahedra are still present in these structures. In such a case, the frequency shift is related to a transformation from a polygermanate (condensed GeO_4 tetrahedra) to an orthogermanate structure ('isolated' GeO_4 tetrahedra). This is in agreement with the X-ray powder diagrams of these high-pressure phases, which may be interpreted on the basis of a garnet structure⁵, the cation distribution on the different sites being Ca_3VIII

$[\text{CaGe}]^{\text{VI}}\text{Ge}_3^{\text{IV}}\text{O}_{12}$. No information is available about the infra-red frequencies of isolated GeO_6 octahedra; but, after a rough estimation, they should absorb near or below 500 cm^{-1} (ref. 2). The high-pressure phases of CaGeO_3 and CdGeO_3 exhibit a series of bands in this region, but there is actually no definite assignment of these bands, because 2 types of vibrational modes (namely, the bending frequency of GeO_4 tetrahedra, and the stretching frequency of GeO_6 octahedra) are represented in this spectral range. Further work is needed to settle this point.

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BIOPHYSICS

Some Physical Properties of Chick Interferon

DESPITE much intensive investigation on the properties of interferon produced in chick tissue, both the molecular weight and the iso-electric point of the active molecule continue to be a source of controversy. Thus Burke¹ reported a value of 63,000 for the molecular weight of interferon produced in the chorioallantoic membrane of fertile hens' eggs and suggested that the isoelectric point was between pH 4.5 and 5.0. Other investigators²⁻⁴, however, have described interferon purified from chick material as having a molecular weight ranging from 80,000 to 20–34,000. Recently, Rotem and Charlwood⁵ on the basis of the sedimentation rates of unrefined interferons in density gradients suggested that the molecular weight of chick interferon might be as low as 13,000–25,000. In further contrast to Burke's findings, interferon has been described by two groups of workers as being a basic protein^{3,6}.

In this communication, an account is given of the behaviour of chick interferon on columns of 'Sephadex G-100' and of the electrophoretic behaviour of interferon in starch gels.

The starting material for these investigations was obtained by inoculating 11-day-old fertile hens' eggs with influenza virus (B/England) and withdrawing the allantoic fluid after 48 h at 38.3°. After centrifugation (25 min at 53,620g) residual virus in the supernatant was inactivated by treatment at pH 2 overnight. After readjustment to pH 7.0, the starting fluid at a concentration of 1/50 gave 50 per cent reduction in plaque count⁷ compared with unprotected controls in a system in which monolayers of primary chick embryo cells were infected with Semliki Forest virus. Preliminary concentration of interferon was achieved by precipitation by means of ammonium sulphate at 0.73 saturation. After dissolving the precipitate in water and dialysing to remove ammonium sulphate, the volume of the interferon solution was made to one-fifth of that of the original allantoic fluid.

A column (90 × 5.4 cm) of 'Sephadex G-100' packed in phosphate buffer⁸ at pH 7.7, $\mu = 0.1$, was calibrated using a number of protein 'markers' of known molecular weight (bovine serum albumin, chymotrypsin and ribonuclease), thus establishing a relationship between retention volume and molecular weight.

The interferon solution concentrated as already described when fractionated on the column gave rise to seven distinct groups of compounds (Fig. 1). On assaying the