the pressure, the sample density and dipole moment increase, resulting in an increase of the permittivity.

The dotted line in Fig. 6 represents the permittivity obtained by Davis' X-ray diffraction method with the correction made with consideration of the sample deformation. Davis pointed out that the phase V of $CaCO_3$ is characterized by the same calcite-type hexagonal pseudo cells as in the X-ray diffraction pattern for the phase III of KNO_3, because the phase diagram of $CaCO_3$ is similar to that of KNO_3. He also concluded that the phase II of $CaCO_3$ has the same structure as the phase III of KNO_3 [16]. It is also confirmed that the phase III of KNO_3 is ferroelectric [1].

We have measured the field vs. flux density relation for the phase II of $CaCO_3$ at room temperature. However, no hysteresis loops appeared and no spontaneous polarization was observed. Further, the permittivity does not exhibit peaks at the transition pressure. Therefore, it is concluded that $CaCO_3$ is not ferroelectric in the phase II, and is different from KNO_3 in the phase III.

As seen in Fig. 6, the loss tangent exhibits a peak at 8 kbar in the phase II under room temperature. The permittivity also varies slightly near this peak. This variation may be due to new phase transition.

Marks □ in Fig. 4 represent the pressure dependence of $\log_e \sigma$ which is obtained from ε_{rc} where the effect of abnormal peaks of loss tangent on ε_{re} is not considered. As seen in this figure, $\log_e \sigma$ of $CaCO_3$ in the phases I and II decreases linearly with the pressure according to Eq. (1). The activation energy per unit pressure is 9.0×10^{-4} eV/kbar at low pressure (below 8 kbar) in the phase I, 8.5×10^{-4} eV/kbar at high pressure (above 8 kbar) and 30×10^{-4} eV/kbar in the phase II.

At room temperature under normal pressure, electrical conduction in $CaCO_3$ takes place in extrinsic region. Its activation energy is 0.11 eV [20] and increases further with an increase of the pressure.

4. Conclusions

According to the previous studies, the permittivity of solid materials decreases with an increase of the pressure because of the reduction of the polarization coefficient due to limited ionic motion. However, our experimental results indicate that the permittivity of $CaCO_3$ in the phase I increases with the pressure.

The logarithmic dielectric conductivity at low frequencies decreases linearly with an increase of the temperature. This phenomenon is related to the diffusion (or generation) of lattice defects and can be explained as an increase of activation energy with the pressure.

The pressure dependence of the conductivity dE/dp decreases gradually with the pressure. The values of dE/dp of KNO_2, $NaNO_3$ and $CaCO_3$ are almost identical to those of KCl and KBr [21].

APPENDIX

Figure A1(a) [10], (b) [10] and (c) [18] show the temperature-pressure phase diagrams of KNO_2, $NaNO_2$ and $CaCO_3$ which were obtained by Rapoport. These figures also include our test results marked by —··— or O.

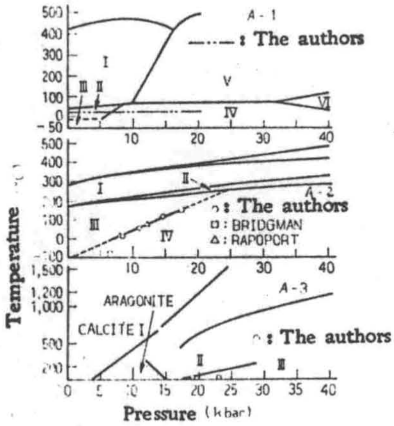

Fig. A1. Temperature-pressure phase diagrams for KNO_2 (A-1), $NaNO_3$ (A-2) and $CaCO_3$ (A-3) (after Rapoport).

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