Dielectric Behaviour of Gypsum Crystals and Possibility of their Zeolitic Dehydration

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(Received August. 28, 1952)

We have measured the anisotropy of the temperature and frequency dependences of the dielectric properties of gypsum single crystals. The crystals used were from Hanaoka, Akita Prefecture, Japan.(1)

The dielectric constants at room temperature are as follows: $\varepsilon_{\perp}=5.1$, $\varepsilon_{//}=10$, where $\varepsilon_{\perp}$ is the one perpendicular, and $\varepsilon_{//}$ the one parallel to the cleavage plane.

Temperature coefficients of the dielectric constants from 20° to about 90° C. show slightly positive signs in both directions. Above 90° up to 116°, they show slightly negative signs. Above 116°, the dielectric constant parallel to the cleavage plane at 5 kc rises slowly, and at 124° there is a maximum and then falls gradually, whereas there is no peak at 3 Mc. On the contrary, the dielectric constants perpendicular to the cleavage plane show no peaks at either frequencies. Above about 125°, the dielectric constants in both directions and both frequencies decrease gradually and tend to asymptotic values.

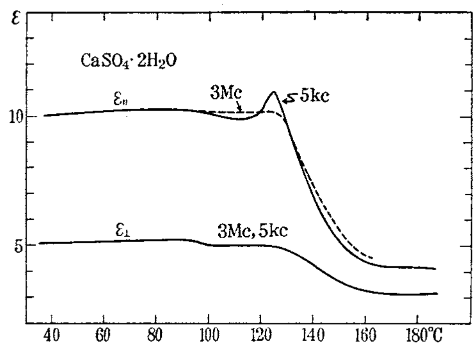
The dielectric loss has been measurable in only one case where a peak of dielectric constant appeared at about 124°.

In many hydrated crystals which we have studied up to this time, their dielectric constants and losses suddenly increase when their lattices collapse and dehydration occurs. These phenomena are due to the protonic conduction in adsorbed water layers of dehydrated crystals.(2)

In the case of gypsum, in spite of its dehydration, there was no remarkable rise of dielectric constants or losses except a low maximum at a low frequency mentioned above.

Then, it may be assumed that in gypsum, when this dihydrate changes to the hemihydrate by partial dehydration, the dehydrated water molecules form no adsorbed layers which are able to transfer protons on the surface.

The newly formed hemihydrate thus will contain water molecules in their crystal lattices as in typical zeolites, and the water molecules evaporate slowly with rising temperature.



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The low maximum of the dielectric constant parallel to the cleavage plane at 5 kc may be attributed to the temporary formation of dipole clusters caused by free water molecules in the loosened layer lattice. A phenomenon analogous to it has already been observed by the authors in the case of the dehydration of $K_2HgCl_4\cdot H_2O$ single crystals.(3)

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(1) The authors wish to thank Dr. Z. Harada and Mr. K. Sakurai for getting large single crystals.

(2) Details will be published elsewhere.

(3) Presented shortly to the 2nd Congress of International Union of Crystallography, 1951. Details will be published.