

DIELECTRIC CONSTANT OF SOME PHOSPHATE COMPOUNDS

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There are some real assumptions that the H_2PO_4^- group with morevalent metals forms the crystals which have the ferro or antiferroelectric properties. The synthesis and obtaining the monocrystal are most difficult in these investigations. Therefore, the final results are only obtained for $\text{Ba}(\text{H}_2\text{PO}_4)_2$.

The dielectric constant and the polarization in a function of temperature are measured. The experiments are performed with $\text{Ba}(\text{H}_2\text{PO}_4)_2$, $\text{Sn}(\text{H}_2\text{PO}_4)_2$, $\text{Al}(\text{H}_2\text{PO}_4)_3$, $\text{Pb}(\text{H}_2\text{PO}_4)_3$ and $\text{Fe}(\text{H}_2\text{PO}_4)_3$. For Ba we succeeded in obtaining the monocrystal, while the other substances are studied with polycrystal samples.

The measurements which were performed at dihydrophosphate compounds Al, Pb and Fe did not succeed, because these substances cannot be freed out of the solution from which they are synthesized so that the loss tangent was great and it increased with increasing temperature. These three substances are very hygroscopic what also made the experiment difficult. For Sn we can say that the dielectric anomaly is not seen at the polycrystal sample, while it is clearly expressed at the monocrystal of triclinic Ba. According to the structure made after these measurements (1), the anomaly is most pronounced along the one direction in the crystal when the crystal is cut below the angle of 109° with respect to the X-axis. The plane of dielectric anomaly is the YZ plane in which lies one of shorter

hydrogen bond of 2.50 Å. The temperature dependence of dielectric constant is given in Fig.1.

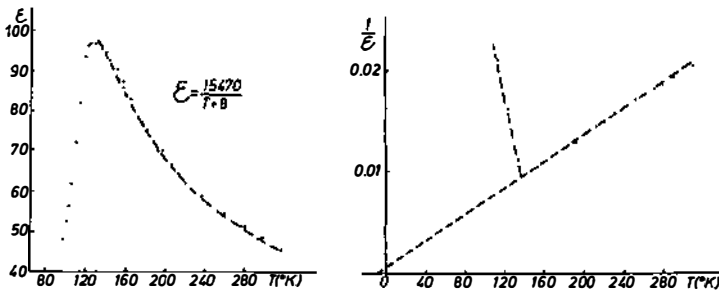


Fig.1

Fig.2

The circles represent the experimental values, while the broken line shows the agreement with the Curie-Weiss law and the negative value of critical temperature (2). If the same experimental curve is plotted in the diagram $1/\epsilon$, Fig.2, an interesting agreement of "negative absolute temperature" and the constant T_c in the Curie-Weiss law are shown.

On the basis of represented results it can be concluded that there is some analogy between KDP and $\text{Ba}(\text{H}_2\text{PO}_4)_2$. In KDP all hydrogen bonds contribute to the dielectric anomaly, while in Ba this contribution gives only 1 of possible 5. Therefore, it is naturally that this effect is slightly lower expressed. As the measurements of polarization showed that in Ba there was no the spontaneous polarization below T_c , it can be concluded that this substance can be existed only as the antiferroelectric.

References

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