Dielektrinės viendimensinio ledo savybes HHTP -4H_2O kristalituose

Dielectric Properties of one dimensional ice in HHTP-4H_2O crystallites

Sergejus Balčiūnas[1], Anna Peterson[2], Maksim Ivanov[1], Jasper Adamson[2], Jūras Banys[1]
[1]Faculty of Physics, Vilnius University, Sauletekio 3, LT-10257 Vilnius, Lithuania
[2]National Institute of Chemical Physics & Biophysics, Akadeemia tee 23, 12618 Tallinn
sergejus.balciunas @ff.vu.lt

The idea that water molecules can be translated in to a polar form of ice was introduced in early 1933 in a paper written by J. D. Bernal and R. H. Fowler [1]. To obtain polar ice there are several successful techniques based on surface layer deposition and dimensionally reduction in confined phases like in water filled carbon nanotubes. In those systems the alignment of polar ice is difficult and in practice we need a bulk dipolar alignment. Therefore the new approach is to exploit alignment of polar ice in crystalline voids.

In this poster presentation dielectric properties of 2,3,6,7,10,11 hexahydroxytriphenyle tetrahydrate cold pressed ceramics will be presented. The measurements of dielectric permittivity was performed using HP 4284A precision LCR meter and P(E) curves were obtained using AixACCT TFAnalyzer 2000 E system. The dielectric spectra show an anomaly at 256 K temperature (Fig. 1). Furthermore it can be noted that temperature dependence curves slightly follows Curie Weiss law which is typical for improper ferroelectrics. The frequency dependence spectra show 4 relaxation processes A, B, C and D (Fig. 2.) The first relaxation at the lowest frequency range (A) is due to polarization between two contacts and has no particular interest for us. From Cole - Cole approximations we have extracted relaxation times for the second and third process (B and C) and fitted using Arrhenius law [2]:

$$\tau = \tau_0 e^{E_A/k_B T}$$

here, E_A – activation energy, k_B – Boltzmann constant, τ_0 – attempt time. For both relaxation processes activation energy in the margin of errors is the same and is equal to 300meV. Regarding the last relaxation (D),

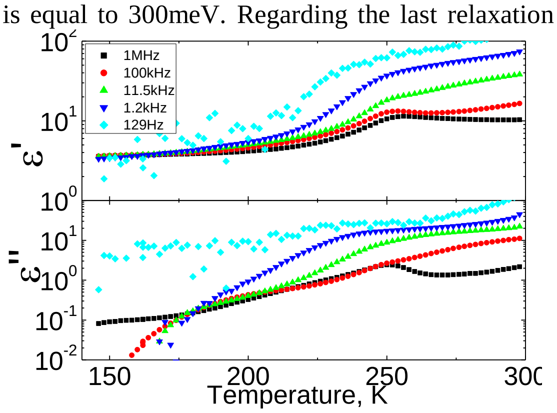

Fig. 1. Temperature dependence of the real (a) and imaginary (b) parts of dielectric permittivity for HHPT cold pressed pellets.

it is only visible at low temperature when relaxation time decreases below gigahertz range and we can see a tail at few hundred kilohertz. It's known that water molecules can give a relaxation in 0.1-1 THz range. In some cases this frequency can be lowered if water molecules are in confine spaces or in form of thin films. For P(E) measurements up to 60 kV/cm field was applied. No hysteresis loops were observed below phase transition.

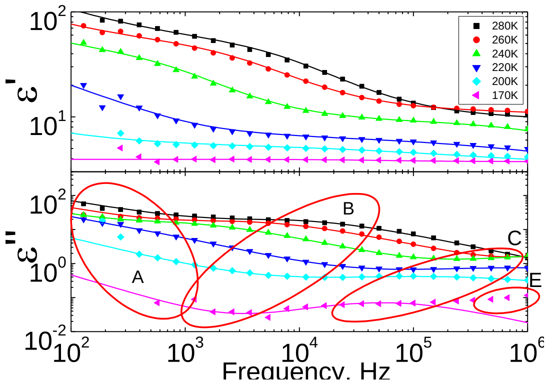

Fig.2. Frequency dependence of the real (a) and imaginary (b) parts of dielectric permittivity for HHPT cold pressed pellets. Regions mark as A, B, C and D refers to relaxations accordingly: contacts, grain boundary, twin boundary, water molecules or from HHTP grains.

Key words: Dilectric permmitivity, HHTP, temperature dependance, phase transitions.

Literature

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