STRUCTURE OF KD$_2$PO$_4$ EMBEDDED INTO POROUS GLASS


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It is known that finite-size effect results in the drastic changes of the phase transition (PT) features, and these anomalies become especially significant if the characteristic size is comparable with correlation length of the order parameter critical fluctuation. The porous matrices give the unique possibility to study confined materials and their properties as a function of size and topology of pores.

Recent dielectric measurements of some ferroelectric materials confined in different porous matrices [1, 2] have shown unexpected growth of dielectric constant $\varepsilon$ above the temperature $T_c$ of ferroelectric PT for all materials and all matrices, but microscopic origin of observed anomalies was incomprehensible.

To clarify the situation we have attempted to study the temperature evolution of structure of high-deuterated KD$_2$PO$_4$ (DKDP) embedded into porous glass with pore sizes $70 \pm 3\,\text{Å}$ at temperatures $90\,\text{K} < T < 310\,\text{K}$ (below and above $T_c$) by neutron diffraction. The data treatment of obtained diffraction patterns shows that embedded DKDP forms a system of interconnected clusters with average size essentially exceeds the pore sizes. The structure of embedded DKDP does not change in investigated temperature region and corresponds to the space group $P2_1$. The lattice parameters $a$, $b$, and $c$ are practically temperature independent (Fig.1) and do not demonstrate any peculiarities in the vicinity of expected PT at $250\,\text{K}$. It is known that DKDP crystals may exist in two polymorths due to isotopic
effects, but monoclinic high-deuterated DKDP is stable at high temperatures. In air and at normal conditions it transforms into the tetragonal phase in a few days [3]. Our samples were prepared long before the experiment, were stored at normal conditions, and this stability of monoclinic phase is a surprising experimental fact. It is possible that this stability could be associated with anomalous properties of nanostructured DKDP and/or its interaction with porous matrix.

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