Isotope effects on the ferroelectric phase transition temperature

Annette Bussmann-Holder and Naresh Dalal*
Max-Planck-Institut für Festkörperforschung, Heisenbergstr.1, D-70569 Stuttgart, Germany
*Department of Chemistry and NHMFL, Florida State University, Tallahassee, FL32306, USA

Isotope effects on the ferroelectric phase transition temperature have attracted little experimental and theoretical attention except for the KH_2PO_4 (KDP) family, where deuteration causes a nearly doubling of the transition temperature. High-precision NMR experiments on KDP crystals and its analogues have revealed that the ferroelectric phase transition observed in the KDP-family carries a pronounced displacive component [1], quite opposite to the general believe that this transition is a prototypical order-disorder driven transition. In consensus with former work the huge isotope effect on T_c upon deuteration has been confirmed and it was observed that also the deuterated compound shows clear evidence that a coexistence of order-disorder and displacive dynamics are present. Most interestingly oxygen isotope experiments have not been carried through to search for an isotope effect on T_c stemming from the oxygen. Especially the recent finding of oxygen isotope induced ferroelectricity in $SrTiO_3$ [2] could have lead to speculate that a pronounced enhancement of T_c should also be detected in KDP. Yet opposite to these assumptions recent new ^{18}O NMR measurements on KDP revealed that an isotope effect on T_c practically does not exist. This finding can be explained within a coupled pseudospin-electron-lattice interaction model [3], and supports strongly our previous findings of coexistence of order-disorder and displacive dynamics in hydrogen-bonded systems. In addition it is shown, why different results are obtained in the quantum paraelectric $SrTiO_3$, but should not be observable in the analoguous compound $KTaO_3$ [4].

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