Influence of Sr2+ Doping, Temperature and Frequency on Dielectric Constant, Dielectric Loss Factor and AC Conductivity of Ammonium Zinc Chloride Crystal

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Abstract:

Ammonium zinc chloride (AZC) crystals doped with different strontium concentrations have been grown by the slow evaporation technique. Detailed temperature (300-450 K) and frequency (400-105 Hz) study of the dielectric constant ($\varepsilon$), loss factor ($\tan\delta$) and the ac conductivity ($\sigma_{ac}$) of the grown crystals has been carried out. Along the polar b-axis, $\varepsilon$ increased gradually with increasing temperature showing clear peaks at the phase transitions. Thermal recycling decreased $\varepsilon$, inhibited the peak height, decreased its broadening but without shifting the transition points. However, Sr2+-doping causes a shift of the transition temperature towards lower values and a decrease in the $\varepsilon$-peak broadening and height. Relation between $1/\varepsilon$ and $T$ in the vicinity of the commensurate (C) to incommensurate (IC) phase transition revealed the validity of an equation similar to the Curie-Weiss law. Doping with Sr2+ in different concentrations causes a systematic change in the equation constants. Soliton pinning increased in the presence of Sr2+ leading to residual discommensurations (DCs) in the C-phase. The dielectric constant decreased continually with increasing frequency for the undoped and Sr2+-doped samples. Doping with 0.144 wt% Sr2+ destroyed 25% of the C-phase, which means the possibility of having AZC crystal with reduced C-phase. $\sigma_{ac}$ increased with increasing frequency following a power law of the form $\sigma = \sigma_0 f^s$. Conduction by hopping was found to be dominant in all phases of AZC and after doping with Sr2+ in different concentrations. Mechanism for DC formation and annihilation was also discussed

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