Specific Heat and Electrical Resistivity of Pure and Doped Lithium-Ammonium Sulphate Single Crystals

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Abstract:

The temperature dependence of the specific heat $C_p$ and the electrical resistivity $\rho$ of pure lithium-ammonium sulphate (LAS) single crystals along the three principal crystallographic directions is investigated in the 300-500 K temperature range. The transition energy $\Delta Q$ and the number of both elementary (No) and thermally excited (Ne) dipoles are calculated. It appears that only a small fraction of the total number of dipoles is capable of being thermally excited in the ferroelectric phase. The correlation between the $C_p$ data and the spontaneous polarization $P_s$ is verified. The J-E characteristics indicate the possibility of space charge effects at low measuring fields. Anomalous behaviours before and at the transition point is observed. Thermal annealing is found to be necessary for reproducible results. The temperature dependence of $\rho$ along the polar axis yields the values $\Delta E = 0.54$ and $1.48$ eV and $\Delta E = 1.95$ eV for the energy activating the charge transport mechanisms in the ferro- and the paraelectric phases, respectively. A pre-transition phenomenon is observed while measuring both $C_p$ and $\rho$ along the a- and the b-axes. The mechanism of electrical conduction in the measuring range is discussed. Along the polar axis $C_p$ of LAS crystals doped with either $Cu^{2+}$, $Co^{2+}$, $Ni^{2+}$ or $Mn^{2+}$ is measured in the same temperature range. Above $T_c$, the temperature range through which log $C_p$ is linearly proportional to $(T - T_c)$ is wider than that predicted theoretically. The transition energy, the fraction $Ne/No$ and $P_s$ are also calculated for doped crystals

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