Universality of NMR Results in LISICON Systems and Other Solid Lithium Conductors

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The temperature evolution of the ^{7}Li NMR spectra and relaxation rates in many investigated solid lithium conductors shows more or less the same behavior. These compounds are characterized by a disordered lithium sublattice with a surplus of cation sites in cavities and channels of the anionic network. At low temperature, the spectra consist of a central line and a distributed satellite base structure. Upon increasing temperature, both components narrow until a reduced constant width with a well resolved quadrupole structure is reached. The mean nuclear quadrupole coupling parameters reduce by either about 5 or by a factor of 15 in all the compounds. The spin-lattice relaxation rates $1/T_1$ are asymmetric as a function of reciprocal temperature and of quadrupolar origin. The activation energy of the main process of ionic motion may best be obtained from the temperature dependence of the dipolar spin-spin-relaxation rate $1/T_2$. The spectral densities of the relaxation dependences correspond to those for inhomogeneous motions; they may be described by modification of the BPP equation, a Cole-Davidson distribution or a Kohlrausch-Williams-Watts function. Within this study three LISICON systems, $Li_{4-3x}Ga_xGeO_4$, and two phosphates $Li_3M_2(PO_4)_3$ (M = Sc, In) were investigated or re-investigated which fit well into this scheme. Activation energies of 39 - 43 kJ/mol ($Li_{4-3x}Ga_xGeO_4$ with x = 0.06, 0.14, 0.24), 53 kJ/mol ($Li_3Sc_2(PO_4)_3$) and 75 kJ/mol ($Li_3In_2(PO_4)_3$) were obtained.

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