Phase Transitions and Water Dynamics of $[Mn(H_2O)_6](ClO_4)_2$ Studied by Differential Scanning Calorimetry and Neutron Scattering Methods

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DSC measurements performed at 95 - 290 K have shown that $[Mn(H_2O)_6](ClO_4)_2$ possesses, besides a high-temperature phase, existing above 323 K, four low-temperature solid phases. The inelastic incoherent neutron scattering (IINS) spectra and neutron powder diffraction (NPD) patterns registered at 20 - 290 K have supported the DSC results and provided evidence that the investigated substance possesses even more than five solid phases. The IINS spectra have shown that in the room-temperature phase, water molecules perform fast stochastic reorientation at the picosecond scale. The orientational disorder characteristic for the room-temperature phase can be easily overcooled and frozen. Even by relatively slow cooling at ca. 40 K/hour a metastable, orientational (protonic) glass phase is formed below ca. 160 K. Below ca. 100 K, a structural phase transition was observed by the NPD, however the IINS spectra indicate existence of the pure ordered low-temperature phase only after annealing the sample for a few hours at 100 K. On heating, a structural phase transition takes place at ca. 120 K, and at ca. 225 K water molecules begin fast reorientation.

Key words: Hexaaquamanganese(II) chlorate(VII); Phase Transitions; DSC; Neutron Scattering.