Universal behavior of the heat transport properties of molecular glassy crystals

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A comparative analysis of experimental data on the thermal conductivity has been made for two types of molecular glassy crystals: orientational glasses (ethanol, freon112, cyanocyclohexane, cyclohexanol) and clathrate gas hydrates ($CH_4(5.75H_2O)$, $Xe6.2(H_2O)$ and $THF(16H_2O)$) in the temperature region from 2 K to the glass transition temperature Tg. The temperature dependence of the thermal conductivity $\kappa(T)$ of these substances is similar to that of amorphous atomic solids. The temperature dependence of the thermal conductivity is well described by a sum of two contributions: $\kappa(T) = \kappa_I(T) + \kappa_{II}(T)$, where $\kappa_I(T)$ accounts for the heat transport by long living acoustic excitations and $\kappa_{II}(T)$ is for the heat transfer by delocalized vibrational excitations (diffusons). It is shown that the contribution of $\kappa_I(T)$ is well described by the universal curve in the soft potential model and $\kappa_{II}(T)$ corresponds to short wavelength acoustic phonons with the minimum allowed value of the phonon relaxation time $\tau_{min}(\omega) = \pi/\omega$ according to Cahill-Pohl model.