Nanocomposites and nanomaterials

Heat capacity of quasi-1D chains of Xe atoms adsorbed in outer grooves of carbon c-SWNT bundles: thermal vacancies effect

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The unique structure of bundles of single-wall carbon nanotubes closed at the ends (c-SWNT) makes possible to prepare low-dimensional systems (quasi-1D- and quasi-2D) formed by adsorbates. It is well known that long range order and two-phase co-existence are not possible in infinite 1D matter for T>0 K [1]. The processes of the formation, ordering and decay of the 1D chains with the limited length were studied by the computer simulation method in [2].

The heat capacity at the constant pressure C_P of 1D chains of Xe atoms physical adsorbed in the outer grooves of the c-SWNT bundles have been measured using an adiabatic calorimeter in the temperature range from 2 to 55 K. Experimental data have been matched with the theoretical values C_V [3]. Below 8 K the experimental and theoretical curves coincide. Above 8 K the deviation of $C_P(T)$ from $C_V(T)$ is observed. It was supposed that in the region of 8—30 K the difference $\Delta C(T) = C_P - C_V$ is mainly due to the contribution of the thermal expansion of the 1D chains. The sharp increase of the difference $\Delta C(T)$ above 30 K has been explained within the model of the formation of the single thermal vacancies in the 1D chains of the Xe adsorbate. The formation of vacancies leads to the decay of the long chains to the shorter ones (chain fragmentation). The enthalpy, entropy and concentration of thermal vacancies have been determined. The temperature ~ 28 K, at which the contribution of the processes of the decay of the dense chains into shorter chains to the hear capacity $\Delta C(T)$ become noticeable, is close to the theoretical value ~ 22 K [2].

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