

CHEMICAL THERMODYNAMICS OF CARBOSILANE DENDRIMERS

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Abstract

Dendrimers are highly-branched cascade polymers with nanosized regular structure which have been received by regular synthesis and related to a new class of polymer materials called «macromolecular nanoobjects». Current technologies are impossible without thermodynamic and thermophysical calculations of optimization and search for effective paths of processes with the implication of new materials. It seems that the problem of precision thermodynamic values accumulation for compounds of this class and receiving of most common virtually important dependences as «thermodynamic property - composition» is quite actual. The studied samples of carbosilane dendrimers (more than 18 compounds) were synthesized and described in terms of composition and structure at N.S. Enikolopov Institute of Synthetic Polymer Materials, Russian Academy of Science, in the scientific group of academician A.M. Muzafarov. The composition and structure of the samples were confirmed by elemental analysis and methods of ¹NMR spectroscopy and IR spectroscopy. In the present work the temperature dependences of the heat capacity of carbosilane dendrimers from the third to the ninth generation with different terminal functional groups have been determined in over the range from 6 to (350-650) K by the methods of precision adiabatic vacuum and differential scanning calorimetry; thermodynamic characteristics of devitrification and glassy state, phase transitions and anomalies and high-temperature «nanosized effect» (transition). The standard thermodynamic functions, namely, heat capacity, enthalpy, entropy, and Gibbs energy were calculated for different physical states studied dendrimers in over the range from 0 to (350-650) K. It was found repeating conditional unit at the limit for all dendrimers under study for the calculation purpose of thermodynamic properties per mol of this unit and detection most common dependences on composition and structure of dendrimers for all dendrimers under study. Analysis of obtained results complex was allowed to make some significant regularities for this class of compounds. Thus the comparison of glass transition values for observable carbosilane dendrimers is capable to consider the structure and chemical nature of outer layer as determinative factor T_g meaning.

Keywords: Dendrimers, adiabatic calorimetry, heat capacity, high-temperature “nanosized effect”

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