

THERMODYNAMIC PROPERTIES OF CARBOSILANE DENDRIMER OF THE SIXTH GENERATION WITH PHENYLETHYL TERMINAL GROUPS

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Abstract

Dendrimers are nanosized, three-dimensional, highly-branched, monodispersed (in the ideal case) macromolecules of perfectly regular structure with a large number of peripheral functional groups. Together with the hyperbranched polymers they represent a new class of polymeric materials, referred to as macromolecular nanoobjects [1, 2]. The synthesis of dendrimers is realized by repeating subsequent of chemical reactions; this makes possible to effective control of molecular weight of dendrimers, topology and chemical character of their functional groups. Dendrimers combine the properties of macromolecules and individual particles; they have good solubility and low viscosity in solutions. The combination of structural perfection of dendrimers and possibilities of modification of their outer surface layers enable to control the properties of dendrimers over wide ranges and it is necessary for development up-to-date nanotechnologies [3]. The investigation of the standard thermodynamic properties of carbosilane dendrimers in a wide temperature range by precision calorimetry allows us to reveal and analyze practically important typical dependences “thermodynamic properties vs. composition”. One result of systematic studies was the discovery of a high-temperature “nanosized effect” (relaxation transition) for carbosilane dendrimers of higher generations [4]. In the present work the temperature dependence of heat capacity of carbosilane dendrimer of the sixth generation with phenylethyl terminal groups G-6(Ph)₂₅₆ was measured for the first time by methods of precision Adiabatic Vacuum Calorimetry (Block Calorimetric Thermophysical, BCT-3 with discrete heating) and of Differential Scanning Calorimetry (DSC 204 F1 Phoenix with -sensor, Netzsch-Gerätebau) in the temperature range from 6 to 580 K. The physical transformations were detected in the above temperature range; their standard thermodynamic characteristics were estimated and analyzed vs. their composition and structure. The standard thermodynamic functions were calculated per conditional mole of repeating unit in the range from 0 to 580 K. The standard entropy of formation of compound under study in the devitrified state was calculated at 298.15 K. The standard thermodynamic properties of dendrimer under study together with literature data for carbosilane dendrimers with different functional terminal groups were compared and discussed. For example, the thermodynamic characteristics of dendrimers G-6(Ph)₂₅₆ and G-7(Ph)(Bu)₃₈₄ [5] were analyzed and as results some conclusions were made.

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

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