

Generalized concentration dependence of self-diffusion coefficients in poly(allylcarbosilane) dendrimer solutions

Sagidullin A., Muzafarov A., Krykin M., Ozerin A., Skirda V., Ignat'eva G.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Self-diffusion of three high generations (the fifth, sixth, and seventh) of poly(allylcarbosilane) dendrimer in solutions with deuterated chloroform has been studied over a wide range of macromolecular concentrations (ϕ). Diffusivity has been measured by NMR with a pulsed gradient of the magnetic field. It is shown that concentration dependences of the dendrimer self-diffusion coefficients (D) can be reduced to the generalized concentration dependence. Over the range of volume concentrations from 0.01 up to 0.55, the curve of the generalized dependence of D for dendrimers coincides with the analogous dependence for globular protein in aqueous solutions. Analogous to the universal concentration dependence of D for linear polymers in solvent, the generalized concentration dependence of dendrimers tends to the asymptote $D'(\phi)/D_0 \propto \phi^0 = 1$ in the limit of extremely dilute solutions and to the asymptote $D(\phi)/D_0 \propto \phi^{-3}$ in the range of concentrated solutions $0.3 < \phi < 0.55$. Here, $D_0 = \lim_{\phi \rightarrow 0} D(\phi)$ and $D(\phi)$ are the self-diffusion coefficients of dendrimer in an extremely dilute solution and in a solution with macromolecular concentration ϕ , respectively. $D'(\phi) = D(\phi)/L(\phi)$, where $L(\phi)$ is a normalizing function, taking into account the change of the local mobility of dendritic branches as the macromolecular concentration increases; the $L(\phi)$ functions have been experimentally extracted from the concentration dependence of the longitudinal relaxation times for the dendrimers in solutions studied.

<http://dx.doi.org/10.1021/ma0213246>
