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"The influence of the terminal groups of dendritic polymers to their behaviors in solution and at the air-water interface as well as molecular layer structure formed on solid substrates."

Abstract

The aim of the present study was to investigate the effects of temperature and length of alkyl chains terminated to dendritic polymers, their physicochemical properties as well as mechanism of formation of Langmuir films at the air-water interface. A poly(propylene imine) dendrimer and a hyperbranched polyester were used. Terminal groups of these polymers have been substituted with alkyl chains of different length. Furthermore, structures of polymers were characterized with proton nuclear magnetic resonance (^1H NMR), gel permeation chromatography (GPC) and mass spectrometry (MS).

A Langmuir trough was used to study monolayers of modified dendritic polymers at the air-water interface. Pressure-area isotherms of Langmuir films were recorded in a wide temperature range of 280 to 319 K by two modes i.e., static and dynamic in conjunction with surface pressure, Kelvin potential, Brewster angle microscopic, and relaxation measurements. Monolayers were transferred onto silicon and gold substrates using the Langmuir-Blodgett (LB) technique. Thereafter, studies of these samples were conducted with X-ray reflectivity (XRR), atomic force microscopy (AFM), and polarization modulation-infrared reflection-adsorption spectroscopy (PM-IRRAS).

Additionally, dendritic polymers in solutions were studied. A combination of pulsed field gradient nuclear magnetic resonance (PFG-NMR) and dynamic light scattering (DLS) was applied to determine the diffusion coefficient of the dendrimer in a deuterated methanol at zero concentration. Then, the hydrodynamic radius, the second virial coefficient and the interpenetration function were calculated.

Moreover, phase behavior of the hyperbranched polyester modified with alkyl chains in primary, secondary or tertiary alcohols and in hydrocarbons have been examined. The study of the phase equilibria was conducted with two methods, namely, the synthetic, as a function of temperature, and in a new apparatus built at the Institute of Physical Chemistry PAS, as a function of temperature and pressure. Moreover, the pure hyperbranched polymer was analyzed with several techniques including small angle X-ray diffraction (SAXS), scanning electron microscopy (SEM) and differential scanning calorimetry (DSC), the latter being used to investigate the melting point temperature and heat of phase transition.