Surface thermodynamic properties of sodium carboxymethyl cellulose by inverse gas chromatography

ABSTRACT

This study constitutes a new development of surface thermodynamic methods to determine the London dispersive surface free energy component γd s , the specific free energy of adsorption and the Lewis acid-base properties of polymers by using inverse gas chromatography (IGC) at infinite dilution. The net retention volumes Vn of n-alkanes and polar solvents adsorbed on a sodium carboxymethyl cellulose (Na-CMC) polymer surface were determined at four temperatures 313.15K, 323.15K, 333.15 and -343.15K by IGC technique The London dispersive surface free energy component of Na-CMC was determined by using Dorris-Gray and DorrisGray-Hamieh methods, Van der Waals, Redlich-Kwong, Kiselev, geometric, cylindrical, spherical and Hamieh models. The more accurate value of γd s of Na-CMC was obtained by Hamieh model taking into account the thermal effect on the surface areas of molecules: γd s(T)(mJ /m2) = − 0.630 T(K) + 229.01 showing a maximal temperature TMax = 91◦C that can be considered as a new characteristic of the Na-CMC polymer. Above TMax, there is no dispersive component of the surface energy of the polymer surface. The specific interactions of Na-CMC particles were determined by using the various molecular models, and the vapor pressure, the boiling point, the topological index and the deformation polarization IGC methods. The obtained results clearly showed a strong Lewis basicity of Na-CMC (about seven times more basic than acidic polymer surface). It was proved that the IGC methods and models do not give similar results. The thermal model gave the most accurate result of the Lewis acid-base properties of Na-CMC surface.