Simultaneous Determination of Thermodynamic and Transport Properties from Speed-of-Sound Measurements in Gaseous Hydrofluorocarbons

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The recent results from an analytical study based on speed-of-sound measurements in gaseous hydrofluorocarbons by using a spherical resonator will be reported. Second and third virial coefficients can be accurately derived from precise speed-of-sound measurements by means of determining the parameters of an intermolecular potential model The square-well and Stockmayer potential models three parameters were applied for this purpose with an aid of a new additional temperature parameter introduced by one of our group members, Kojima (2001). While the speed-of-sound measurements in gaseous phase were obtained in a narrow range from 277 K to 343 K and pressures between 10 kPa and 600 kPa, the virial equation having the second and third virial coefficients derived only from our speed-of-sound measurements can reproduce the best pρT measurements within ± 0.05 % in a wide range from 263 K to 393 K and between 0 to nearly the saturation pressure in the case of R125. The heat capacity values of the gaseous hydrofluorocarbons including that for the saturated vapor would be correctly calculated from the virial equation, while the heat capacity values derived from existing Helmholtz equations of state have large discrepancies such as more than 5 % each other in the gaseous phase. Using the same parameters of the intermolecular potential model, the viscosity was also derived and compared with existing reliable experimental data. As the preliminary results of this study, the viscosity data for R125 and R143a measured by Takahashi et al. (1998) were represented within 15 % by the prediction using the intermolecular potential model based on our speed-of-sound measurements.