Practically Accurate Virial Coefficients for Binary-Mixture Refrigerants Determined from Density Measurements near Saturation and Stockmayer Potential Model

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For providing reliable thermodynamic properties of gases, our group has consistently and carefully assessed the virial coefficients especially to represent reliable specific heats near saturation. We have already revealed that the determination of virial coefficients using reliable gas-density data near saturation and Stockmayer potential-model with a temperature correction parameter is effective to satisfy the requirement in the case of pure working fluids. A method of the determination of the virial coefficients is reported in another paper for the cases of twelve pure fluids.
Reliable thermodynamic properties for binary mixture working fluids in the gaseous phase, virial coefficients for pure fluids with the cross-term or mixed virial coefficient B_{12} are needed. We will propose a method for determining those virial coefficients from density measurements near saturation and Stockmayer intermolecular potential model, which is the same method applied for pure fluids as introduced in another paper. We applied the method for determining the cross-term virial coefficients of the binary-mixture systems of R32/125, R125/143a, and propane/isobutane. Although only about 20 density data including the data near saturation were measured for respective binary-mixtures of R32/125 and R125/143a, the predicted derived properties from the determined parameters of Stockmayer-potential model based on our measurements can reliably reproduce other measurements of density or sound speed in the gaseous phase by 0.20 % or 0.15 %, respectively. Regarding the binary-mixture of propane/isobutane, we measured 154 $p\rho Tx$-properties including many data near saturation at molar compositions of propane being 0.25, 0.50, and 0.80 in the range of temperatures from 303 to 323 K and of pressures up to 980 kPa. The parameters of Stockmayer potential-model with a temperature-correction parameter were determined and the cross-term virial coefficient was derived. In the case of the binary mixture of propane/isobutane system, no reliable experimental data in the gaseous phase are available, so the prediction of thermodynamic properties from those parameters will be calculated in the gaseous phase and the results will be discussed by comparing with existing reliable equations of state for this system.