

Reliable Thermophysical Properties of Gases from Experimental Data and Intermolecular Potential Model

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Thermophysical properties, meaning both thermodynamic properties and transport properties, of saturated vapor or superheated gases in the region near saturation are extremely important in engineering calculations such as heat transfer in refrigeration heat exchangers, air-conditioning, and power-plant systems. In 2000, Narukawa *et al.*, one of the members in our group, pointed out that the behavior of specific heats near saturation derived from various internationally high-level equations of state differs from each other and the reason would be the incorrect third virial coefficients of those equations. The scarcity of data very close to saturation because of difficulties in measurements would be the most important reason. And it is also important to take intermolecular potential effect for forming clusters near saturation into consideration because the thermophysical properties would change somewhat in the vicinity of the saturation because of clustering molecules. We carefully studied the determination of reliable third virial coefficients of working fluids. We investigated the thermophysical properties of gases near saturation for twelve pure substances, HFC-32, HFC-125, HFC-134a, HFC-143a, HFC-152a, argon, nitrogen, CO₂, methane, ethane, propane, and isobutane. In this paper, the determination of reliable virial coefficients for pure fluids from accurate experimental data such as sound-speed in the dilute gas phase and/or density near saturation and an intermolecular potential model such as Stockmayer-potential model with one temperature correction parameter is carefully discussed.