

Measurements of *PVT* Properties for Tetrafluoro-Butenes by a Single-Sinker Magnetic Levitation Densimeter

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Accurate thermodynamic property data of refrigerant are important to estimate and to evaluate HVAC&R applications performance. In recent years, high temperature heat pump systems have received a lot of attention, because they can generate hot water by using waste heat. On the other hand, refrigerant need to have lower environmental impact and to work at higher temperature. In this study, a set of *PVT* properties data in gas-phase region for a couple of fluoro-buthenes are presented. Fluoro-buthene is one of the hydrofluoroolefin (HFO) refrigerant. The environmental impact of HFO refrigerant is extremely low and the critical temperature is higher than that for refrigerant applied to refrigeration or air-conditioning. The experimental *PVT* properties of fluoro-buthene have been measured by a magnetic levitation densimeter (MLD). MLD is one of the most accurate measurement technique to measure density under high-pressure and high-temperature conditions. Density is measured by MLD with Archimedes' principle. The measurement procedure of MLD is two steps. At first, the sinker in the measurement cell with sample has filled floated by a magnetic force. Second, buoyancy measured by balance. Density calculated by sinker density and buoyancy. The sinker is made by silicon single crystal and that is calibrated. In this study, the apparatus was newly developed and measured Tetrafluoro-butenes density. A densimeter cell is thermostated by an aluminum block and a thermal shield placed in an evacuated chamber. Temperature is measured by a standard PRT placed inside the aluminum block. Pressure is directly measured by a quartz pressure transducer. The measurement range of temperature is from 340 K to 400 K, pressure up to 5 MPa, respectively. The experimental uncertainties of the present measurements are estimated to be within 0.02 K in temperature, 0.7 kPa in pressure, respectively.