

Image Processing Determination for the Critical Density and Temperature of Carbon Dioxide

Kazuya Yamamoto, Yohei Koyanagi and Haruki Sato^{C, S}
Science and Technology, Keio University, Kohoku-ku, Yokohama, Japan

A method for the determination of critical temperature and density by use of digital data-processing of observed digital images around the meniscus of sample fluid near the critical point is proposed. Personal error in the judgment of the phase-boundary disappearance and critical opalescence can be drastically reduced by judgment of digital images. The reliability of digital judgment was confirmed using an improved apparatus and the determination of critical temperature and density of carbon dioxide. Those of carbon dioxide have been precisely measured by other researchers. We measured twice on the critical temperature and density of carbon dioxide to confirm the reproducibility. The sample purity of carbon dioxide is 99.999 mol %. The critical temperature of 304.131 K and density of 465.7 kg/m³ were determined in the first time. And the critical temperature of 304.131 K and density of 466.3 kg/m³ were determined in the second time. The expanded uncertainty ($k=2$) of the critical temperature is 0.012 K for both times. The expanded uncertainty ($k=2$) of the critical density is 1.9 kg/m³ or 1.6 kg/m³ for the first and second times, respectively.