

Phase Equilibrium and Density Measurement of Hydrogen and Carbon Dioxide Mixtures near the Supercritical Region at Pressures up to 12 MPa

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Thermodynamic properties of fluid mixtures containing hydrogen are of great importance in the coming hydrogen society. The transportation of hydrogen using natural gas pipelines is considered for instance, and the thermodynamic properties of hydrogen and hydrocarbons mixtures are required including the supercritical region. In addition, hydrogen is often used in reduction reaction, and characteristics of a variety of hydrogen mixtures are of much interest. Binary hydrogen systems with hydrocarbons and carbon dioxide show the divergence of the critical curves to a high pressure region, and the development of accurate equations of state representing the complicated behavior of the systems are desired. Hydrogen and carbon dioxide mixtures are easily in the supercritical state at moderate temperatures and pressures, and appropriate to be studied for understanding the complicated system having the critical curve divergence. Hence, an experimental apparatus available from -10 °C to 50 °C was developed to observe the phase equilibrium of hydrogen and carbon dioxide mixtures in this study, and the phase equilibrium has been observed near the supercritical region at pressures up to 12 MPa. Moreover, expansion vessels were installed to the apparatus, and the densities of the mixtures have been measured with the expansion method.