

論文 / 著書情報
Article / Book Information

題目(和文)	動的なエネルギー集中における超臨界二酸化炭素の相挙動
Title(English)	Phase behavior of supercritical carbon dioxide in dynamic energy focusing
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Outline of thesis

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In recent years, supercritical fluids have been widely used in the fields of chemical reactions and solvent extraction. In general, a large quantity of supercritical fluid is consumed under quasi-static conditions in a relatively large chemical plant. These technologies have been improving from an energy consumption point of view. However, regarding applications involving supercritical CO₂ with small volumes, it has not been well investigated. This thesis explores new methodologies to generate supercritical CO₂ by rapid compression and fast heating. Chapter 1 gives the background and the motivation of the thesis.

In chapter 2, a water hammer test apparatus was constructed in order to conduct experiments. It confirmed that the inner pressure of the CO₂ balloon became higher than the supercritical pressure (7.38 MPa) for 70 μ s. Parametric study was also conducted to obtain the longer duration of scCO₂ by the relationship between external pressure of the bubble and bubble's natural frequency which depends on the bubble's diameter. The longest duration of scCO₂ in the numerical simulations was 55 μ s, and it was much longer than that obtained in experiment in minimum energy (16 μ s).

In chapter 3, pico-to-nano-seconds order generation system of scCO₂ by excitation of gold nanoparticles in liquid CO₂ using femto-second laser was simulated. Created scCO₂ around the gold nanoparticle remains long time and to observe the reflex index changes due to the phase transition, new efficient method to obtain time dependent spectra in pump-probe measurement were proposed.

In chapter 4, the phase behavior of scCO₂ in a chamber was examined by heated from the top and the bottom of the chamber in milli-to-seconds order. The phase behavior indicated that the homogenization of liquid and vapor were strongly happened at the critical point, which can be used for creating scCO₂ efficiently.

Chapter 5 gives conclusions of thesis and future works.