

# Geodynamics Seminar

## 第339回ジオダイナミクスセミナー

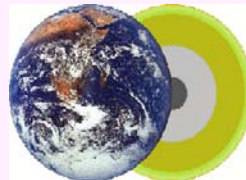
### Equations of state of Fe-Ni alloy

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主催: 愛媛大学地球深部ダイナミクス研究センター

日時: 10/19(金) 午後 4時30分～

場所: 総合研究棟 4F 会議室



#### Abstract

Equations of state of Fe and Fe-Ni alloy are fundamentally important to understand the Earth's inner core. The equation of state of pure iron was reported by several researchers using diamond anvil cell (Mao et al., 1990; Dubrovinsky et al., 2000; Dewaele et al., 2006), but there is a few percent difference in volume at the inner core condition between these studies. Moreover, the compression study of Fe-Ni alloy at multimegabar range was only reported by Mao et al. (1990) which is a cold compression study. Here I report the equations of state of Fe and  $\text{Fe}_{0.9}\text{Ni}_{0.1}$  alloy up to 283 GPa and 276 GPa with the laser annealing technique, and discuss about the effect of nickel on the density. We used a symmetric-type diamond anvil cell with the diamond anvils of culet size of 40, 130 and 300  $\mu\text{m}$  for high pressure generation. Fe (99.9% pure) and  $\text{Fe}_{0.9}\text{Ni}_{0.1}$  reagent (99.99% pure) were used as the starting materials. The sample was sandwiched between layers of sodium chloride and loaded into a sample hole that had been drilled in a precompressed tungsten gasket. The unit cell volume of the sample was determined by the synchrotron X-ray diffraction experiment at the SPring-8 BL10XU beamline, Japan. The experimental pressure was determined by the 3rd order Birch-Murnaghan equation of state (B-M EoS) of NaCl-B2 phase as reported by Sakai et al. (2011). The sample was annealed by a double-sided laser heating method using a fiber laser at the BL10XU in order to minimize the deviatoric stress in the sample. Fe and  $\text{Fe}_{0.9}\text{Ni}_{0.1}$  were compressed to a pressure of 283 GPa and 276 GPa at ambient temperature, respectively. The data sets were fitted using the 3rd order B-M EoS. The density of iron at the inner core boundary pressure is estimated to be 13.95  $\text{g/cm}^3$ . Although this value is 1.7% smaller than that by Dubrovinsky et al. (2000), this difference decrease to 0.2% if we consider the effect of the difference of pressure scale. Our result is also consistent with the result of Dewaele et al. (2006) within 0.4%. On the other hand, the density of  $\text{Fe}_{0.9}\text{Ni}_{0.1}$  is  $1.8 \pm 1.3\%$  denser than that of pure iron at the inner core condition. This result shows that the nickel has a small but clear effect on the density, and it is about two times larger than that expected from Mao et al. (1990).

詳細は当センターホームページ: <http://www.ehime-u.ac.jp/~grc/>をご覧ください

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