

Local structure and occurrence of Kr in solar primordial materials

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Introduction

Noble gases are widely used as traces for studying the Earth's mantle activity and evolution of planets because of their inert character and the existence of radiogenic isotopes. Solar primordial noble gases were greatly enriched in a sticky fine material that floated on the water during freeze-thaw disaggregation of the Allende meteorite though the noble gas abundances in meteorite are extremely low (ppt level)[1]. The very small fraction is poorly defined and the host phase of meteoritic noble gases is not known well. It is necessary to obtain information about host phase, occupying site and bonding state of noble gas. In this study, XAFS spectroscopy has been applied to natural samples in order to directly investigate the local structure around Kr in solid.

Experimental

Kr bearing activated carbon, graphite, silica gel, quartz, plagioclase, olivine, pyroxene, zeolite, NaF and S were synthesized under pressure and temperature. Kr contents and thermal behaviour of Kr degas were determined using a mass spectrometer. XAFS experiments were carried out at the station on PF BL-12C. X-ray absorption spectra near Kr K-edge (14.3 keV) were measured in transmission mode and in fluorescence mode using Lytle-type or 19-elements SSD detectors. X-ray beam was monochromatized using Si(111) reflection. Kr in activated carbon, graphite, silica gel, quartz, plagioclase, olivine, pyroxene, zeolite, NaF and S were measured as reference materials. Kr gas and solid were also measured.

Results and Discussion

We have succeeded in measure the XAFS spectra for noble gases in the very small fraction in which solar primordial noble gases were concentrated. Figures 1 and 2 show XAFS and XANES spectra near Kr K-edge for the Kr concentrated fine material of Allende meteorite. EXAFS oscillations were observed in all samples, except for Kr gas. Figure 3 shows Fourier transform of the Kr K-edge EXAFS for the Kr concentrated fine material of Allende meteorite. Two states of existence of Kr in the meteorite can be recognized, according to the comparison with standard materials. It seems that Kr in meteorite was estimated to be rich in a site of carbon fine powder.

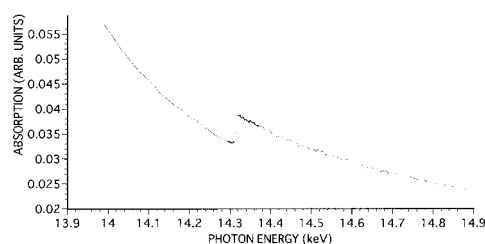


Fig.1. XAFS spectra near Kr K-edge for the Kr concentrated fine material of Allende meteorite.

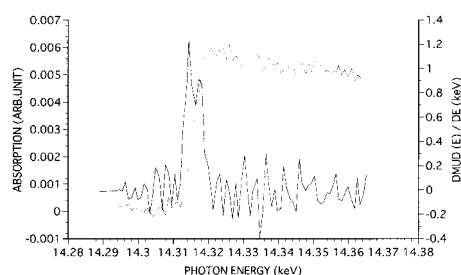


Fig.2. XANES spectra near Kr K-edge for the Kr concentrated fine material of Allende meteorite.

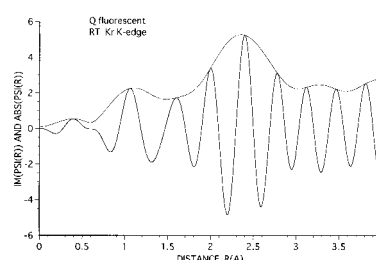


Fig.3. Fourier transforms of the Kr K-edge EXAFS for the Kr concentrated fine material of Allende meteorite. No phase shift corrections are made

References

[1] J.Matsuda et al., *Meteo. Planet. Sci.* 34, 129-136 (1999).

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