

FY2003 LDRD Annual Report Article

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Annual Report Information

Project Title:

Melting Studies of Simple Planetary Ices

Principal Investigator: Jae-Hyun Park

Responsible Directorate:

Primary Category of Work: Earth and Space Sciences

Secondary Category of Work: Physics

Type of Research: Basic

Tracking Code: 03-LW-020

Annual Report Authors: Jae-Hyun Park, Bruce Baer, Choong-shik Yoo

Annual Report Text

Project Description

This study proposes to deliver fundamental experimental data on the melt and phase diagrams of methane in an extended region of high pressures and temperatures. This study targets three major scientific areas: the constraint of planetary models for the outer-giant planets, discovery of exotic phases and insights for many-body intermolecular interactions of non-hard sphere and non-spherical molecules for which no reliable theory exists for these models as yet. In this study, we will adopt in situ at high pressures and temperatures by using both conventional and coherent anti-Stokes Raman spectroscopy applied to laser- or ohmic heated diamond-anvil cells. Structures of methane will be characterized by using intense, third-generation synchrotron x-ray diffraction.

Expected Results

By Raman spectroscopic studies, we demonstrated that the presence of N₂ or heat treatment on high pressure methane shifts the phase boundaries among its various high pressure phases. Our synchrotron X-ray diffraction studies indicate that the presence of impurities can alter the equation of state of a pure substance significantly. Laser heating of pure methane shows that carbon and hydrogen is favored over methane or any other high order carbon chains.

Mission Relevance

Methane is the simplest organic molecule in which carbon is tetrahedrally bonded. It is well known that methane is a major component of some of the Jovian planets. Recently it was discovered that methane-water clathrates are abundant near the floor of deep oceans and are potentially a useful natural gas source. Given their importance to terrestrial investigations and astronomic models, the study of methane's high pressure phases as well as those of methane hydrates are in the progress. Moreover, methane is simply used as fuel. Therefore, its melt, and phase data are fundamental to understanding energy resources such as carbon management and environmental quality for the management as well as detonation chemistry.

Authors:	Title:	Journal:	Vol:	Page:	UCRL#:	Pub Type:
Park J.-H., C. S. Yoo, V. Iota, H. Cynn, M.F. Nicol and T. LeBihan	Crystal Structure of Bent Carbon Dioxide; Precursor to Polymerization	PRB	68	014107	UCRL-JC-151312	Refereed publication
Iota V., J.-H. Park and C.S. Yoo	Phase Diagram of Nitrous Oxide: Analogy with Carbon Dioxide	PRB	in press		UCRL-JC-153092	Refereed publication
Park, J.-H., et al.	Crystal structures of bent CO ₂ and N ₂ O at high pressures	APS 2003 march meeting, Austin, TX, March3-7, 2003	N/A		150171-ABS	Conference/Meeting Abstract

Awards

Official ID:	First Name:	Last Name:	Award:	Sponsor:
park10	Jae-Hyun	Park	PAT directorate	

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