X-Ray Diffraction of Ramp-Compressed Potassium

This work
Solid phases of potassium are observed at pressures up to 400 GPa

- Potassium (K), like other alkali metals, is predicted to transform into complex structures at extreme pressures.
- The melting temperature has been previously observed to increase sharply with pressure up to 22 GPa.
- *In-situ* x-ray diffraction on ramp-compressed K constrains the crystal structure and melting curve up to 400 GPa.
Collaborators


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Core electrons influence structures of alkali metals at high pressures

For Na, see D. Polsin’s talk at session UM9

Increasing Structural Complexity

The phase diagram of K is unknown above 112* GPa and 550 K**

K was ramp compressed to high pressures near the isentrope.
The x-ray diffraction pattern encodes information about the crystal structure.

- Compression changes d-spacing between lattice planes.
- Compression causes phase transformations, leading to different diffraction patterns.

\[ \lambda = 2d \sin \theta \]
The powder x-ray diffraction image plate (PXRDIP)* platform is deployed on OMEGA EP to record the diffraction patterns.

Cu XRS spectrum

Photon energy (keV)

0 1 2 3

J/keV/sr

Heα

Kα

Hα

X-ray source

Drive laser

Direct x-ray beam


**VISAR: Velocity interferometer system for any reflector.
Pressure in the K sample is inferred using velocimetry measurements

Shot 26478

Algorithm

Characteristics

$P = 240 \pm 5 \text{ GPa}$
Solid phases are observed at pressures up to 400 GPa, and not consistent with expected candidate structures.

\[ \lambda = 2d \sin \theta \]
Solid diffraction observations up to 400 GPa put a new constraint on the melting curve.
Solid phases of potassium are observed at pressures up to 400 GPa

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