Physical and chemical changes of hydrogen peroxide under high pressures

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Motivations and Objectives

- H$_2$O$_2$ is a strong oxidizer and even explosive, and is often used as IED
- Stability and behavior of H$_2$O$_2$ and water mixtures are not known
- Shock-induced detonation of concentrated H$_2$O$_2$ has been observed at ~13-15 GPa
- Behaviors of highly concentrated H$_2$O$_2$ are not known under static high pressures

Mitigating chemical and shock threats of H$_2$O$_2$ requires understanding of the stability of H$_2$O$_2$-H$_2$O mixtures at relevant thermal conditions

Experimental Approach

Under Static High Pressure at WSU
- Diamond anvil cell
- Confocal micro-Raman
- Synchrotron x-rays

Under Dynamic High Pressure at LANL
- H$_2$O$_2$ target with stress gauge
- Loading H$_2$O$_2$
- 2-Stage gas gun

Chemical Decomposition of Compressed H$_2$O$_2$

- O$_2$ from H$_2$O$_2$ decomposition
- EOS comparison of H$_2$O$_2$, H$_2$O, O$_2$

Detonation in Shocked H$_2$O$_2$

- Decomposition across the melting at 2.5 GPa
- Decomposition of H$_2$O$_2$ is driven by densification and melting

Behaviors of Binary Mixtures: H$_2$O + H$_2$O$_2$

- Phase transition occurs at lower pressure for diluted samples.
- Oxygen clathrates are observed at low concentrated mixtures.

The presence of water stabilizes the H$_2$O$_2$ mixtures by forming stronger hydrogen bonds

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