

Temperature Control on the VELOCE System

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VELOCE CRYO

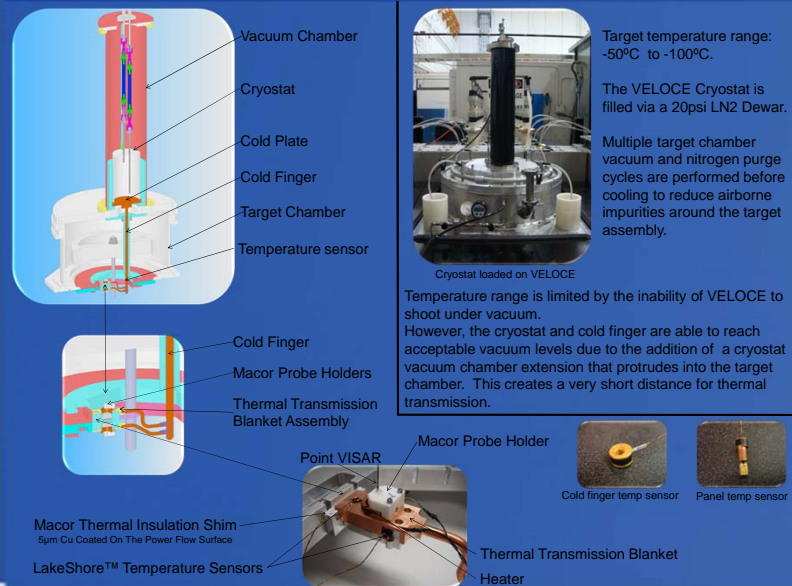
The Sandia pulsed-power generator VELOCE has been used extensively to perform shockless compression experiments on materials. The option of controlling the initial sample temperature greatly expands the range of states accessible via the nearly-isentropic loading capability provided by VELOCE. We have established this option by developing pre-heating and pre-cooling (cryogenic) systems for VELOCE. This poster illustrates the designs and capabilities of the pre-heating and cooling systems for equation-of-state studies.

VELOCE PRE-HEAT

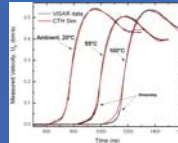
COMPONENTS OF THE CRYO SYSTEM

MOTIVATION

COMPONENTS OF THE PRE-HEAT SYSTEM



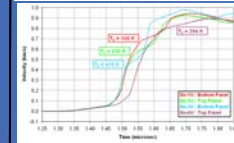
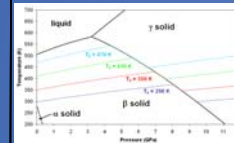
- Shockless compression experiments allow for the exploration of regions of phase space inaccessible to traditional shock compression experiments.
- Temperature conditioning (pre-heating/pre-cooling) further expands the region of phase space that we can examine.
- From these experiments, we can better define a material's phase space behavior, examine the kinetics of phase transitions, and determine temperature effects on the constitutive properties of materials.



Baer, et al., "Temperature dependent equations of state for HMX-based composites," SCCM 2011.

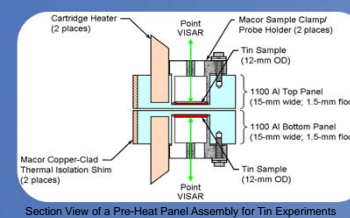


Pre-Heated VELOCE Panel

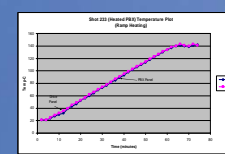


Wise, et al., "Measurement of the temperature dependence of the β - γ transition pressure in tin using dynamic isentropic compression," SCCM 2009.

- A system for preheating test specimens prior to shock or isentropic loading was developed at Sandia's Dynamic Integrated Compression Experimental (DICE) Facility.
- A dual-output, proportional-integral-derivative (PID) controller using feedback from thermocouples regulated power supplied independently to resistive heaters so as to achieve the desired temperature(s) at selected position(s) within the test assembly.
- Thermal isolation features validated by finite element heat-transfer analyses afforded temperature uniformity across samples mounted in electrode panels for the VELOCE pulsed electromagnetic driver.



Standard VELOCE panel



Ramp-Heating History for PBX (one hour+ to shot temperature)



Pre-Heat control chassis



VELOCE 3Mamp, 450ns ICE Driver 30-200kbar



3" Smooth Bore Light Gas Gun
Velocities to 400 m/s

VISAR, LINE ORVIS, X-RAY DIFFRACTION Diagnostics

