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Phase transition heat in MoRuB

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Introduction

- Production of glassy metal
  - » Fusion of alloy
  - » Rapid quenching
- Phase transition heat as a function of percentage of Boron in MoRuB
  - » Transition Temperature
  - » Differential Thermal Analyzer (DTA)

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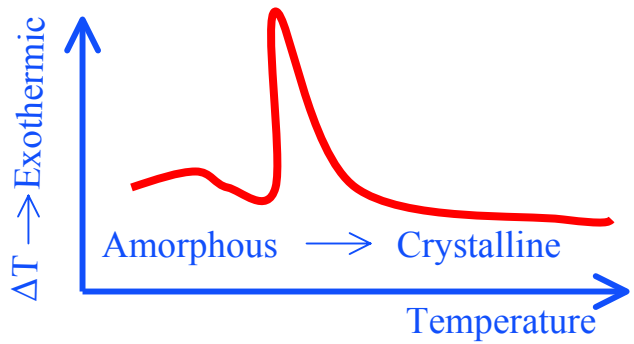
PRODUCTION

- $(Mo_{0.6}\,Ru_{0.4})_{1-x}\,B_x$



- Glassicity range from x=14 to x=24

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FUSING THE ALLOY

Mini-Arc Melter

Copper mould

RAPID COOLING AMORPHOUS STAGE

- Rapid quenching of MoRuB
  - » Employed cooling rates up to 10/6 K/sec
- Crystallization time
  - Hours for Fused Silica
  - Seconds for Glassy Metals

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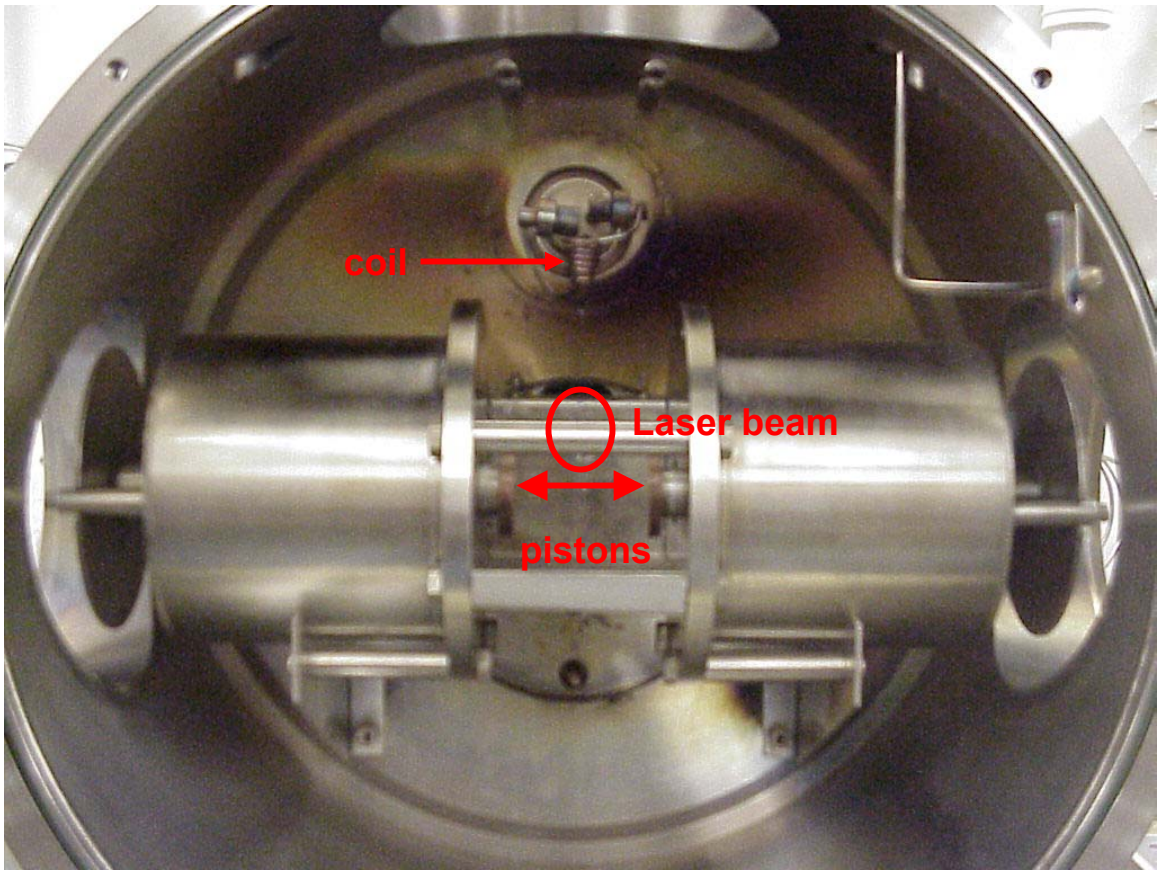
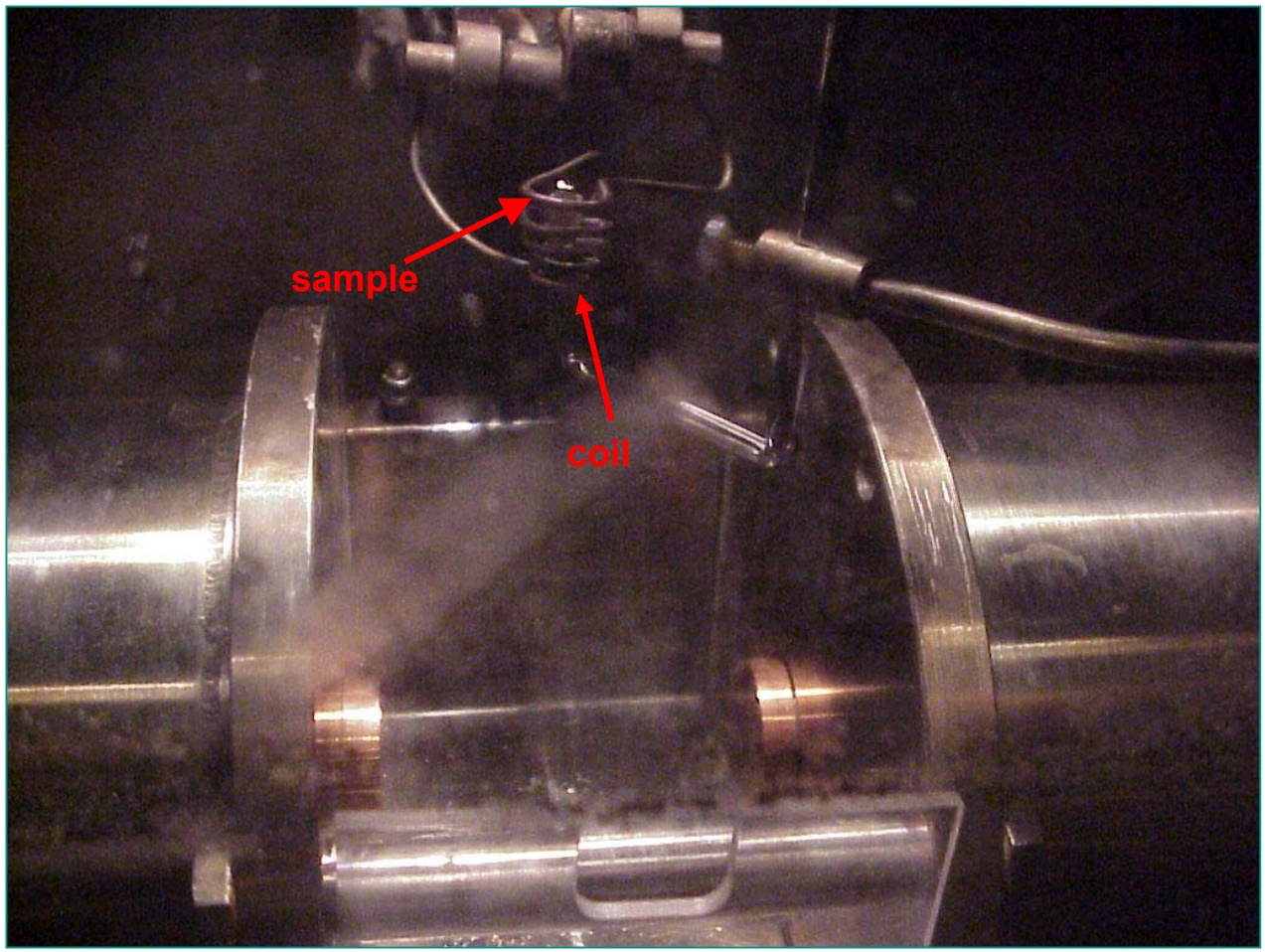
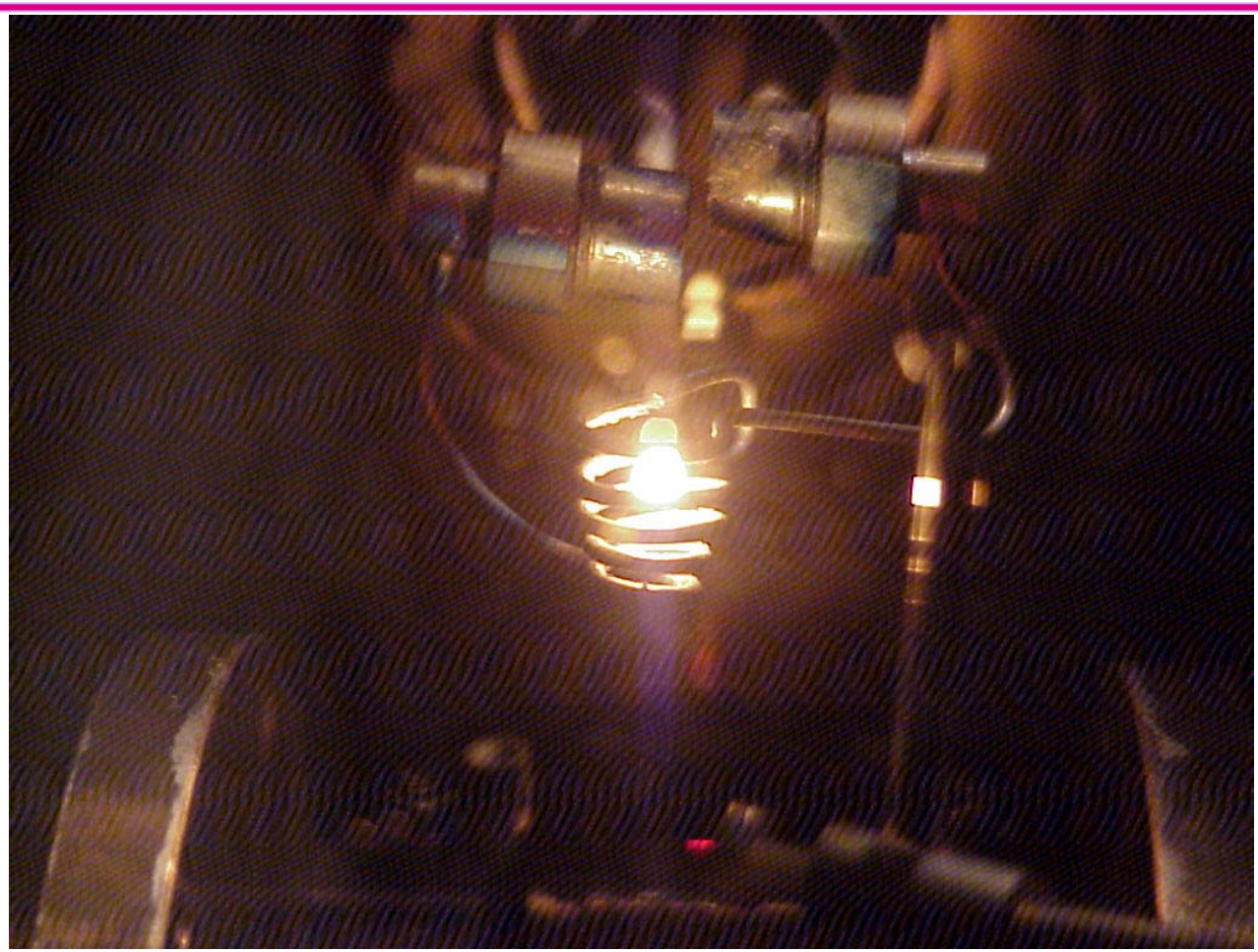
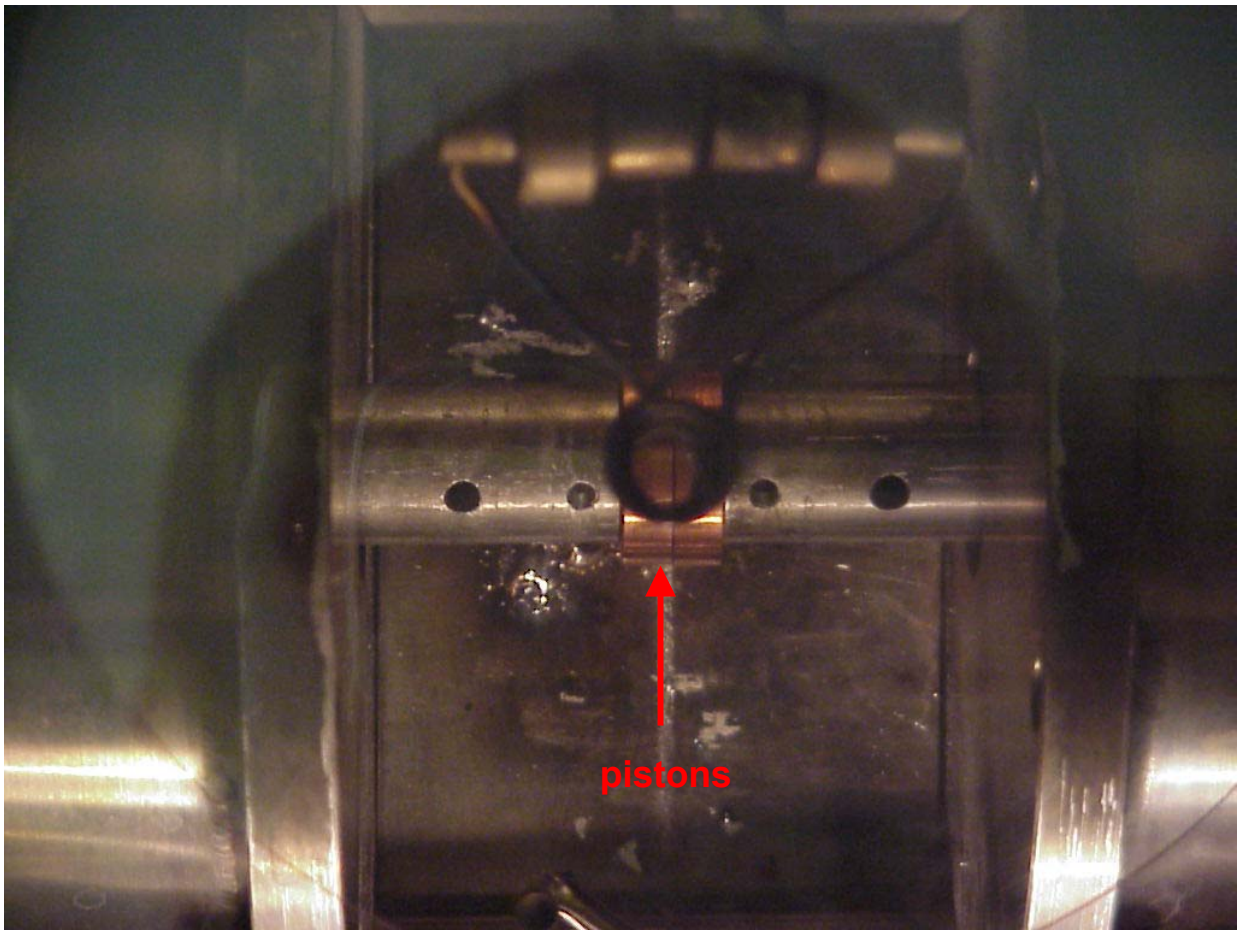
Ultra- rapid Quenching




sample
coil




pistons

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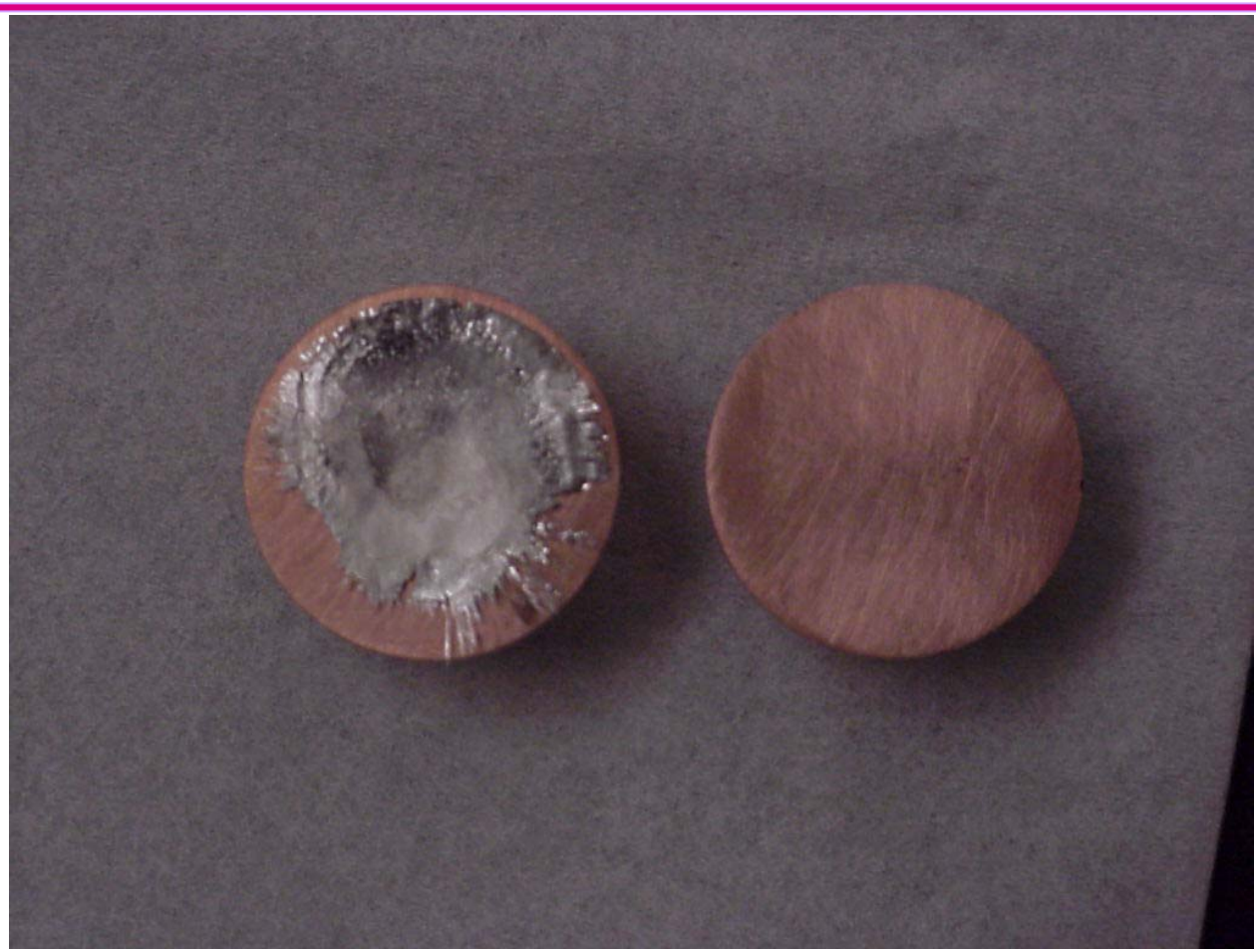

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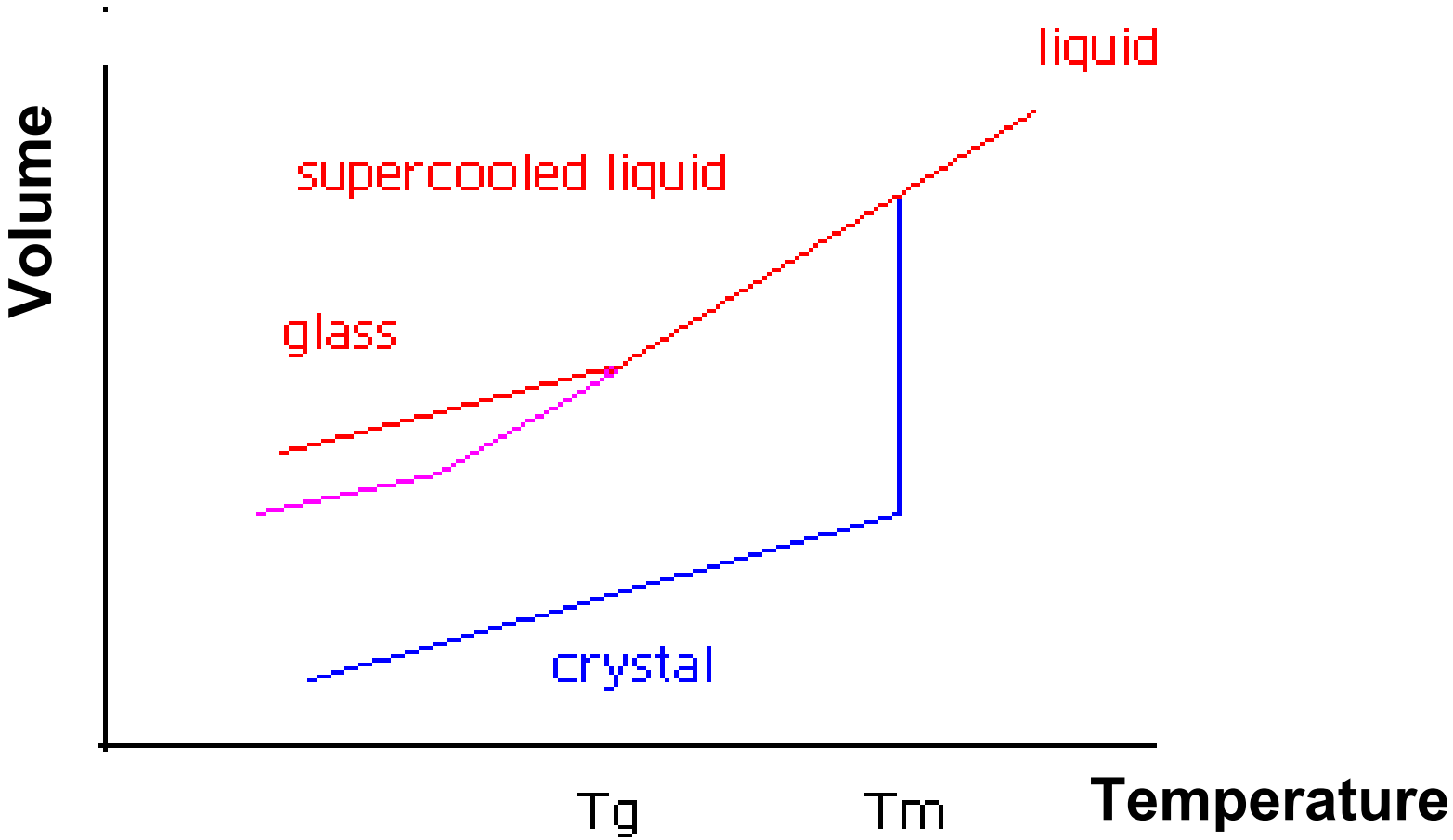
The Glass Transition Temperature

When a liquid is cooled one of two events may occur:

a. Crystallization at the melting point (Tm)

OR

b. Increasingly viscous ‘Supercooled’ liquid at temperature below Tm turns to glass


liquid
supercooled liquid
glass
crystal
Volume
Tg
Tm
Temperature

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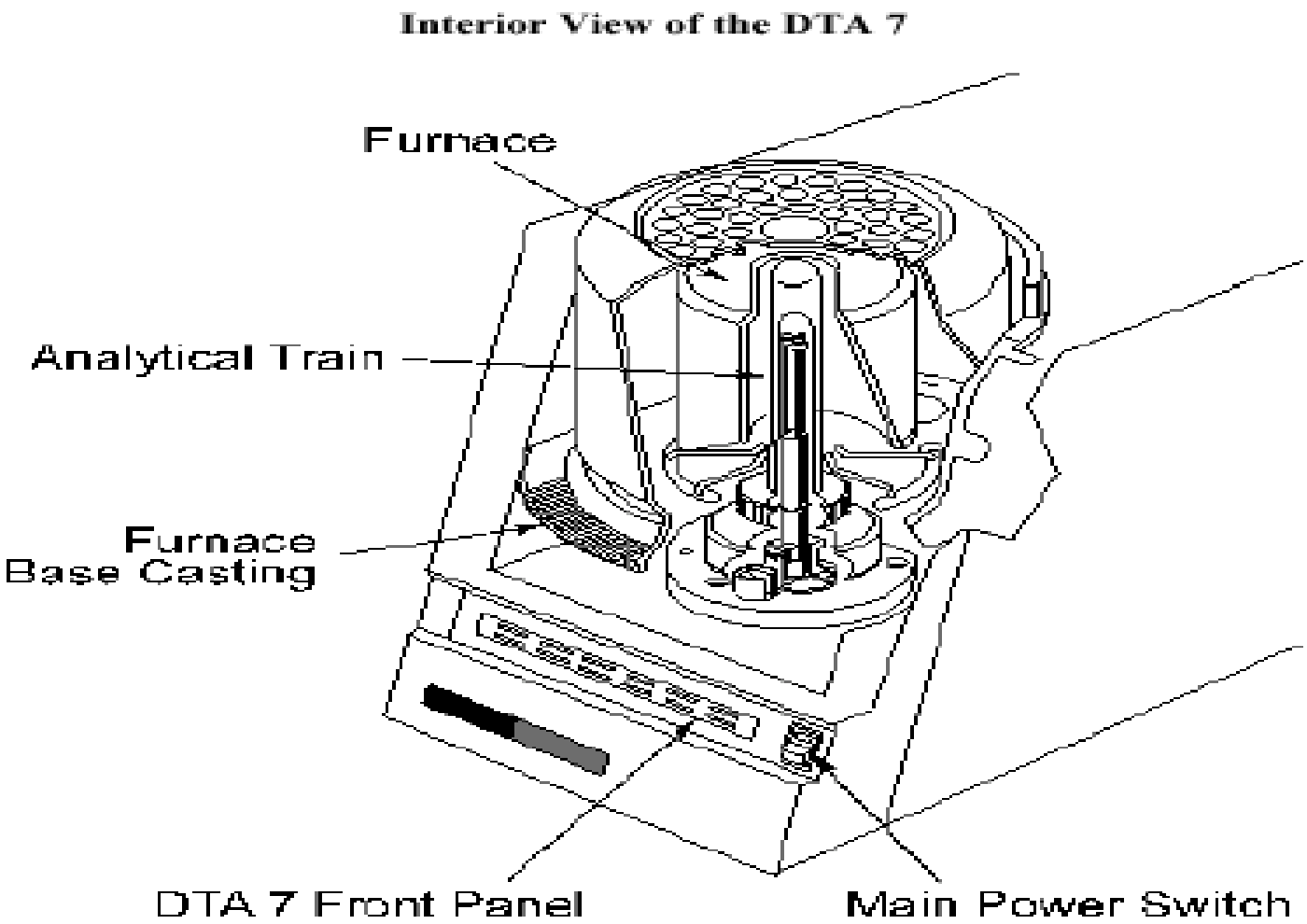
Differential Thermal Analyzer (DTA)



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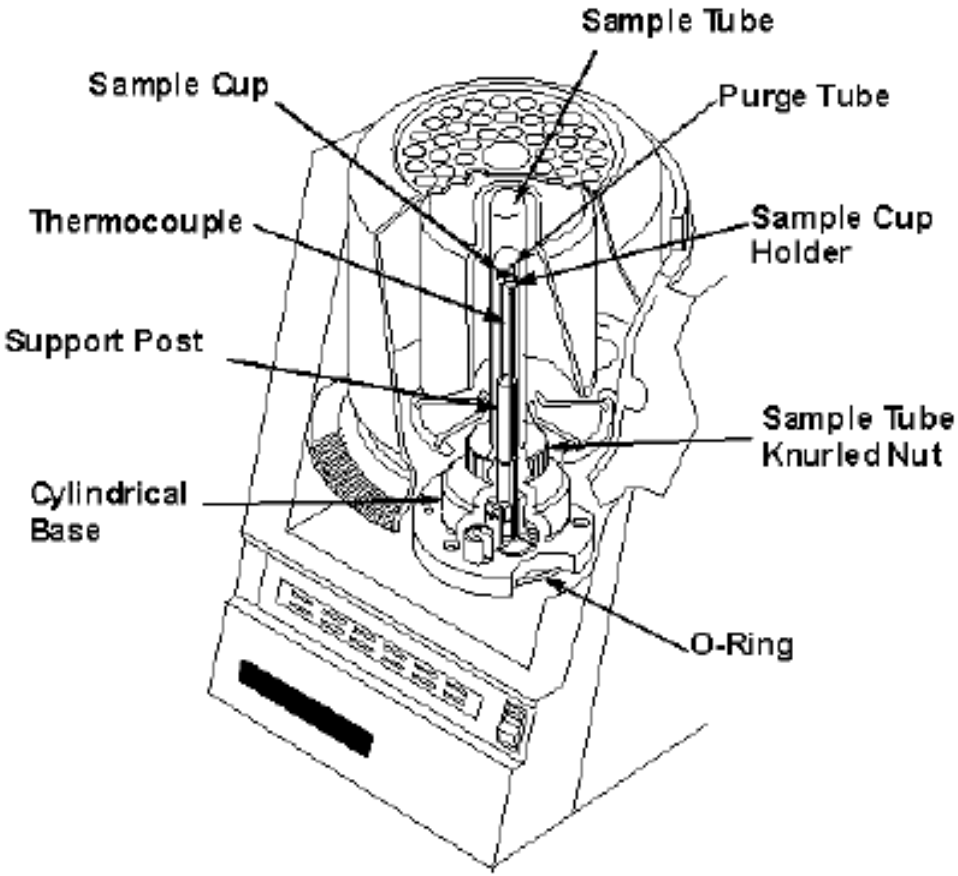
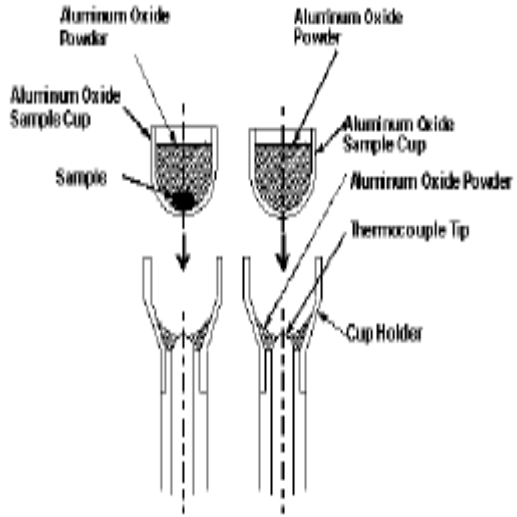
DTA SAMPLE AREA





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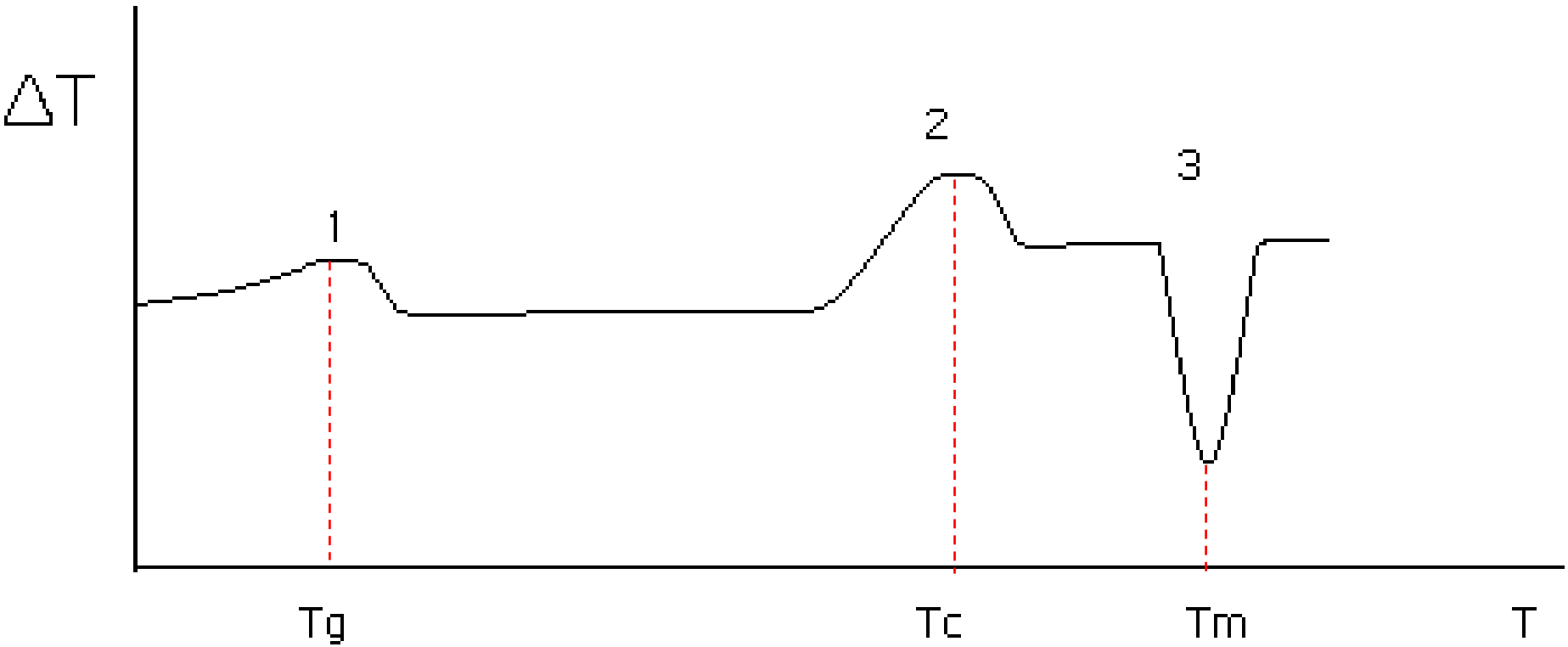
Differential Thermal Analyzer



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CALIBRATION

Three types of calibration:

. Temperature

. Heat Flow

. Furnace

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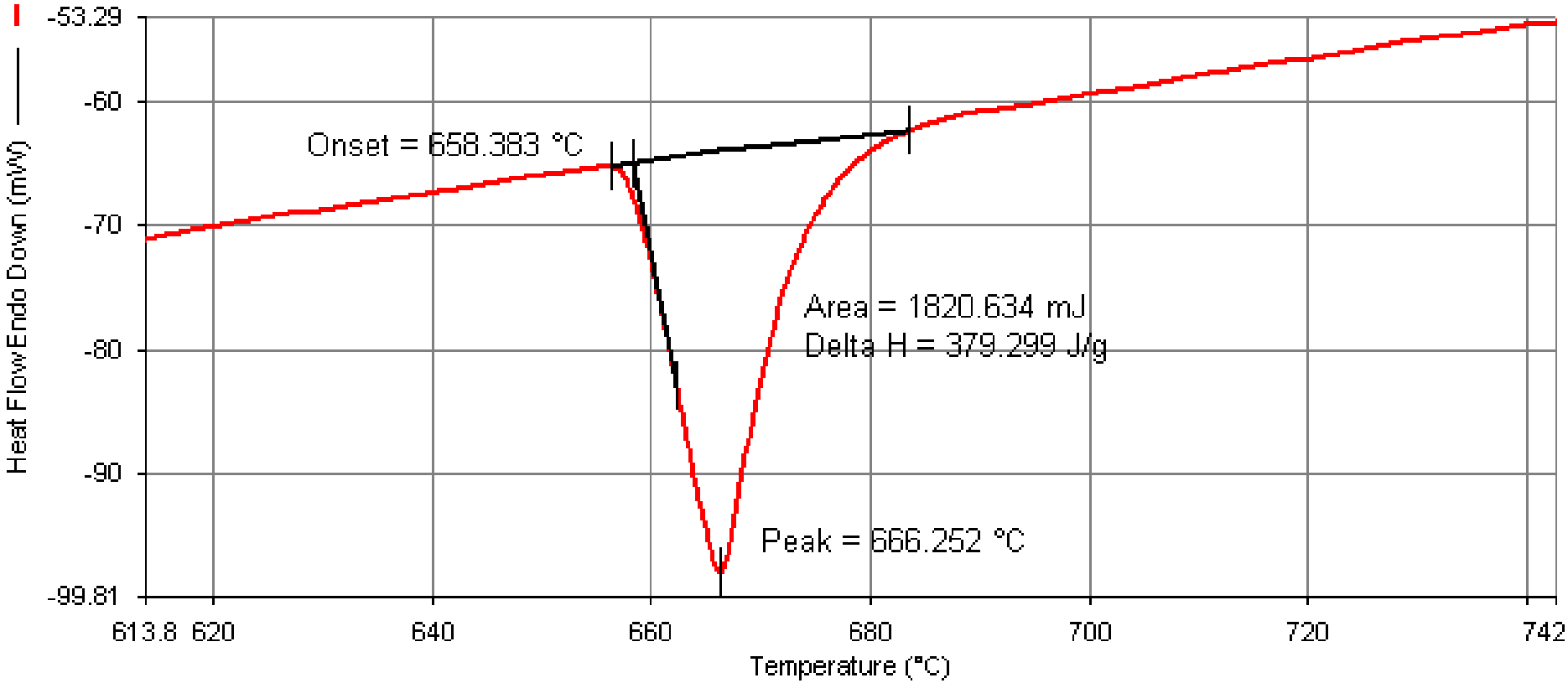
ALLUMINUM CALIBRATION



Standard: Tm = 660.1 C **Heat of fusion = 400.1 J/g**

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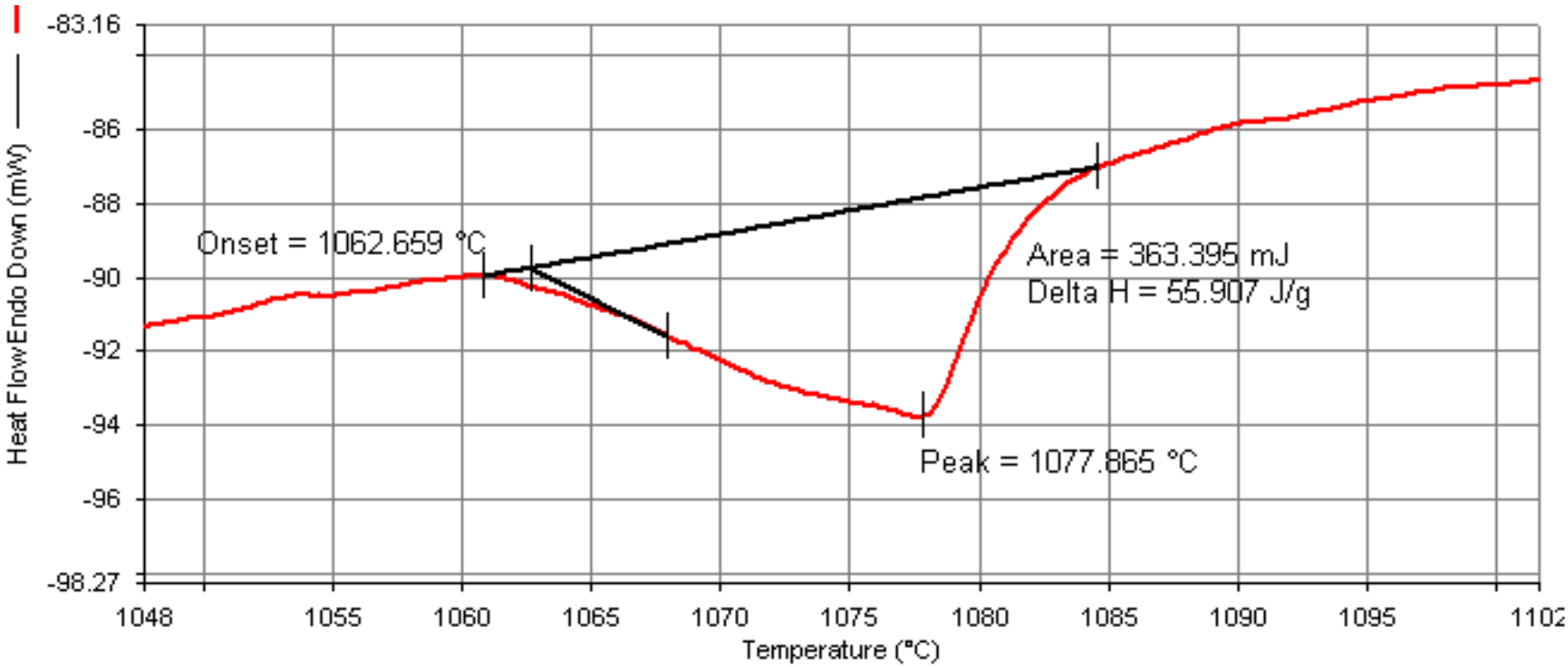
GOLD CALIBRATION



Standard: Tm = 1063 C **Heat of fusion = 63.7 J/g**

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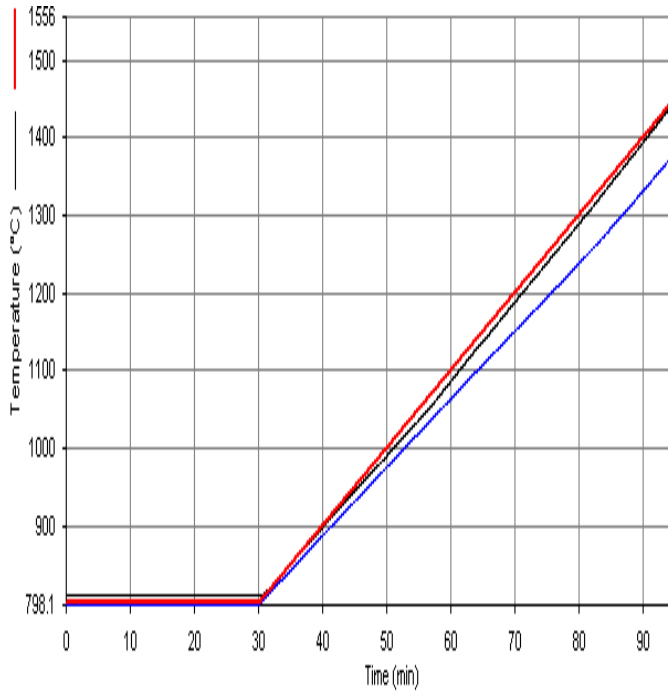
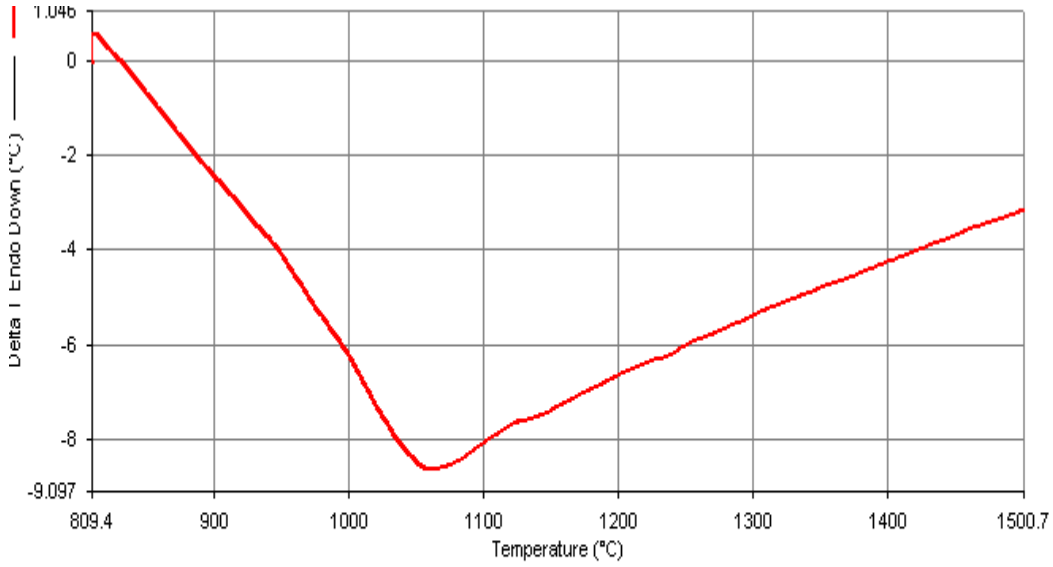
BASELINE





Furnace temperature
Sample temperature
Program temperature

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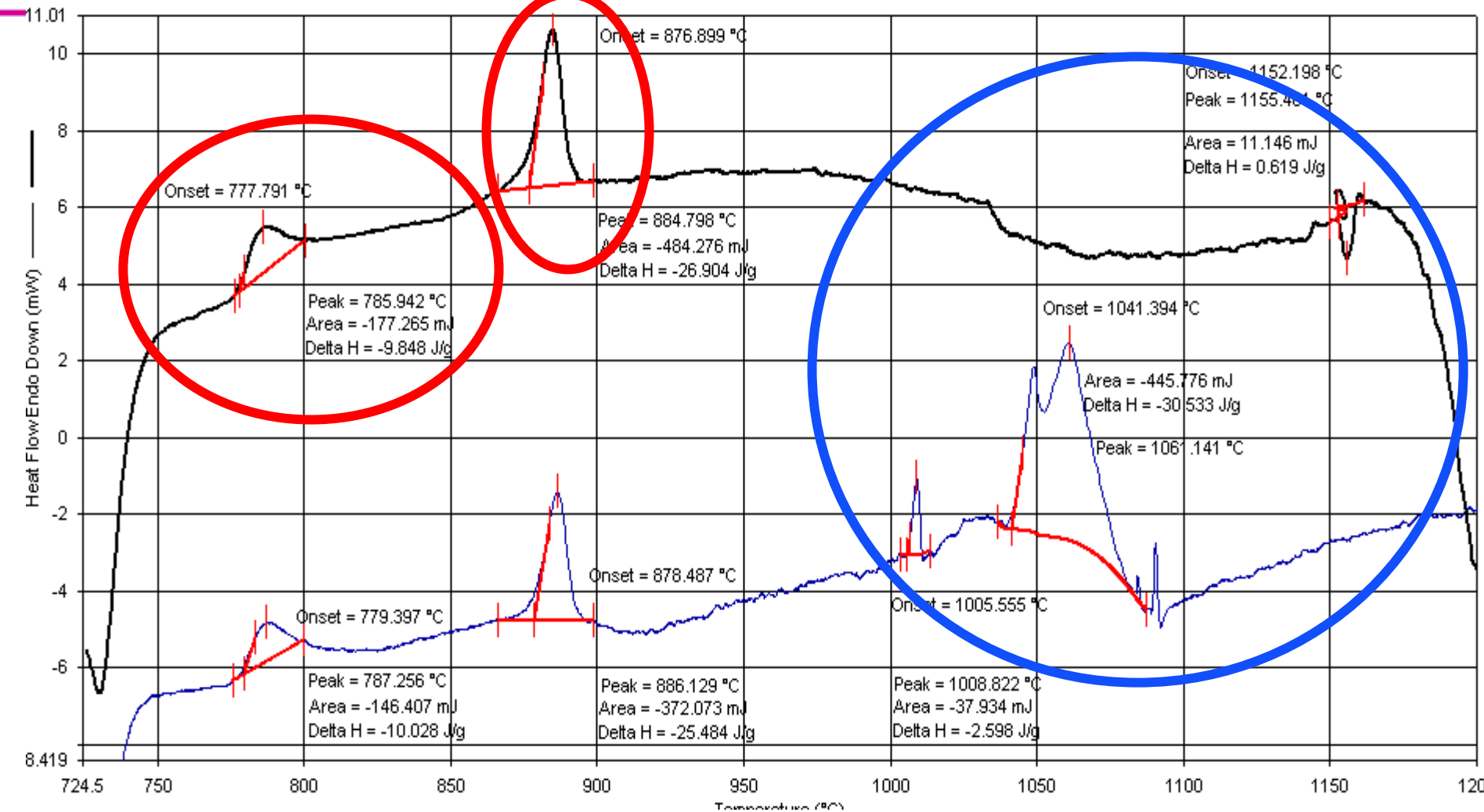
MEASUREMENT



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Conclusions

- Confirmed the amorphous state
  - » By X-ray Diffraction (Brian)
- Confirmed composition
  - » Through thermal analysis on DTA
- Measured strength values (within 10%)
  - » Vicker Hardness test (Maddalena)

Continuation of Work

- » Will characterize full amorphous range for MoRuB
- » Will study the changing trends of phase transitions with changing Boron percentage

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THANKS TO

- **My mentor**: Riccardo De salvo
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