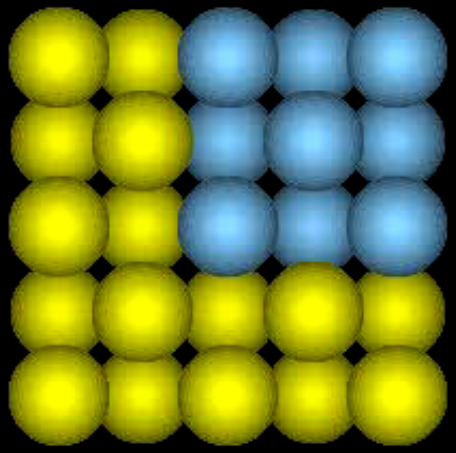
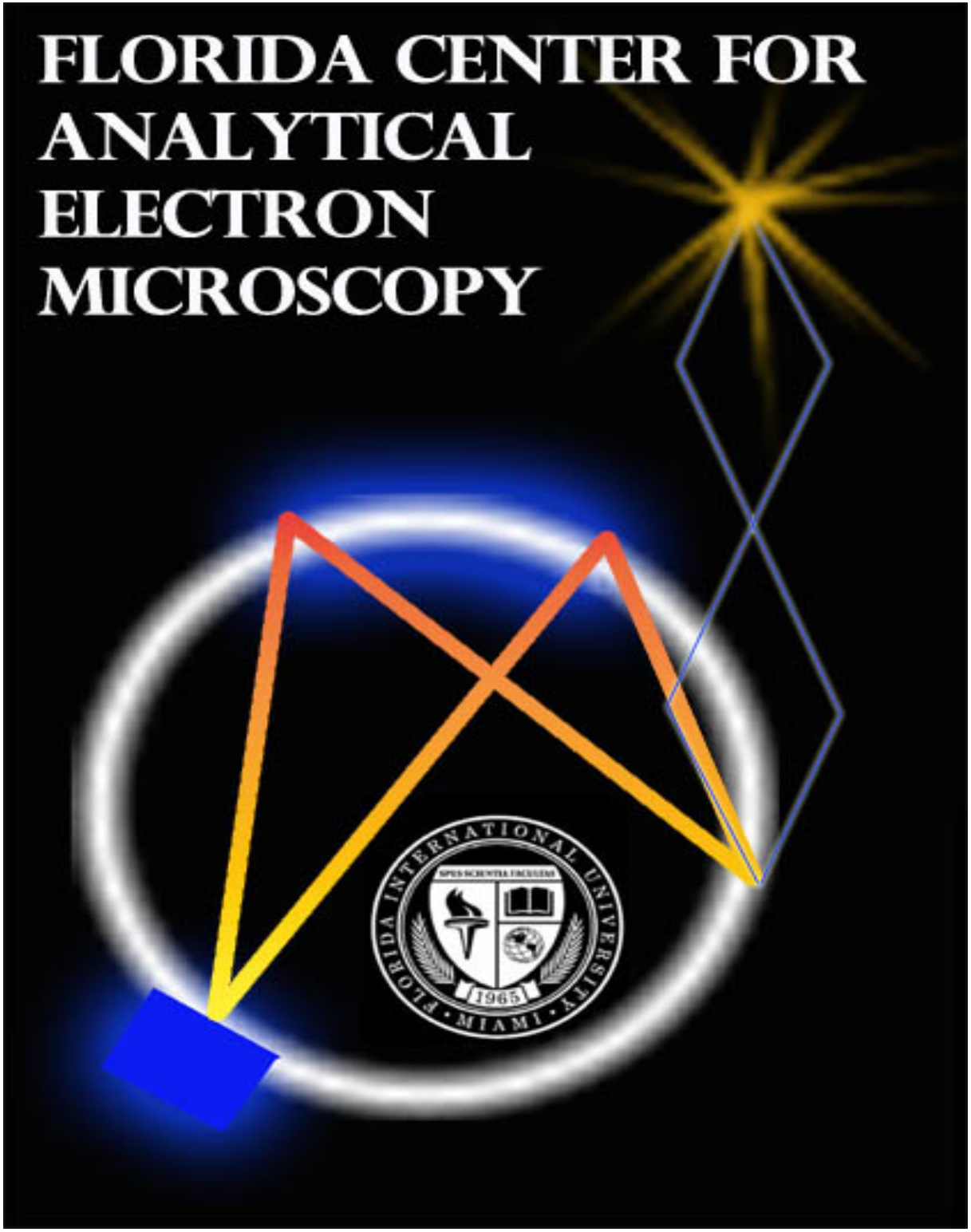
FIU Center for the study of matter at extreme conditions

CeSMEC



FLORIDA CENTER FOR ANALYTICAL ELECTRON MICROSCOPY



At FIU, we have created very unique experimental facilities

These facilities permit us to study materials properties at any condition of pressure, temperature and composition

Since such facilities require not only funds but also expertise in handling and maintaining the equipment, it may be an attractive proposition to access the facilities with remote operation

Binary Quasicrystals Discovered That Are Stable and Icosahedral

Titanium makes move toward mainstream

Aeronautical engineers use titanium because it's strong, lightweight, and corrosion-resistant. Golfers like titanium in their clubs for similar reasons. So why doesn't everyone drive a car made of this supermetal? Sadly, titanium possesses one fatal weakness—its cost.

Now, a novel method for producing titanium could make it more competitive process, that also suffers from the disadvantage of using and producing corrosive and volatile substances.

As an alternative, researchers have sought to use electric current to obtain titanium. In the 1890s, scientists developed just such an electricity-based extraction method for aluminum. The price of aluminum subsequently fell so much that

Callaway

Little Big Wire

High-temperature superconductivity makes a bid for the power grid

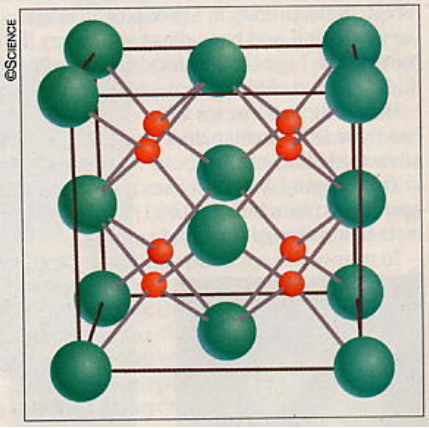
Scientists belt out a novel nanostructure

Oxidized plutonium reaches a higher state

Expose a silvery piece of plutonium to air and it tarnishes, developing a patina that looks yellow or green, depending on the sample. For many years, scientists thought that this unpredictable film was plutonium dioxide, considered the most stable oxide of this radioactive element.

Now, a team of researchers has taken the luster out of this description. They've found that plutonium dioxide reacts very slowly with water and oxygen to form higher oxide phases. In air, these phases—intensely green in color—are actually more stable than plutonium dioxide, which is yellow. The additional compounds "were there all along, but no one

©SCIENCE



The world of materials

Where the Gems Are

Technique adds new facet to emeralds' origins

- Researchers coerced argon to join other elements to form a stable, neutral compound (158: 132).

Looking for Mr. Goodoxide

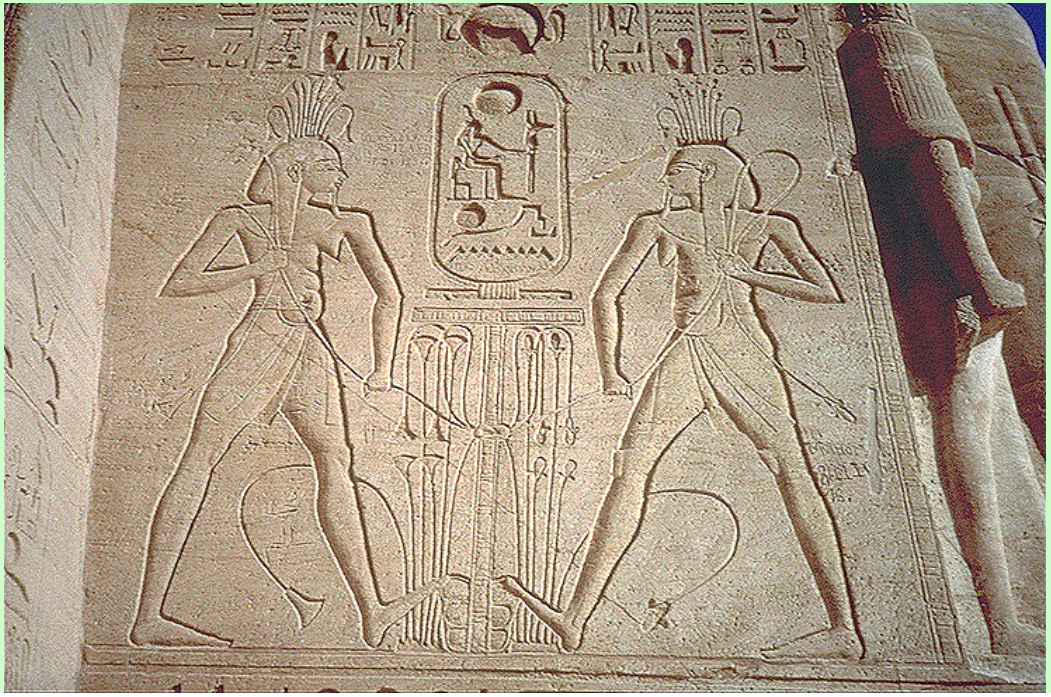
The hard-pressed semiconductor industry strives to replace silicon's near-perfect mate

How can we create a super material?

Man's quest for indestructible material has existed from time immemorial

What has changed is the technology

FIU's centers specialize in creating extreme conditions in the lab And studying the behavior of material; the labs can be made into Virtual laboratories operational from any where in the world



300 K

1800 Fe

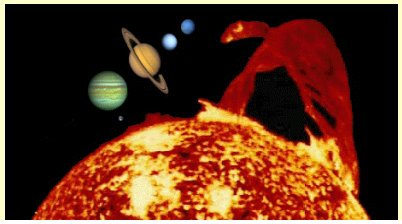
CeSmEC

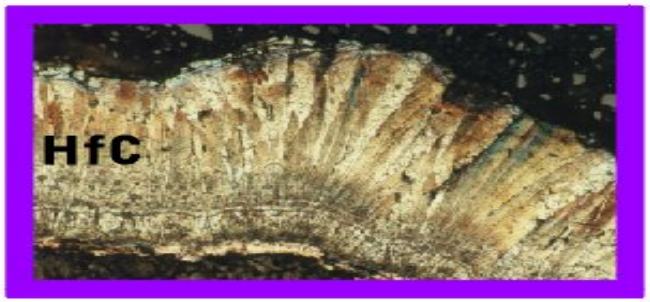
4000 Graphite

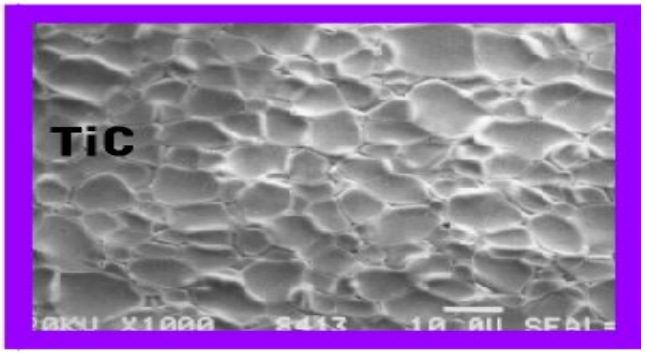
2,000,000

Most Solids Melt

Temperature







How does one measure high to ultra-high temperatures?

4 **Fyrverkeri på Etna** högt ovanför Catania, där 380 000 människor bor. Vid detta utbrott år 1983 tog den sicilianska hamnstaden ingen skada, men år 1669 förstördes större delen av staden av lava.


Raman
Nd-YAG laser
Argon laser
CCD
detector

Experimental possibilities of laser heating system

Determination of:

-melting

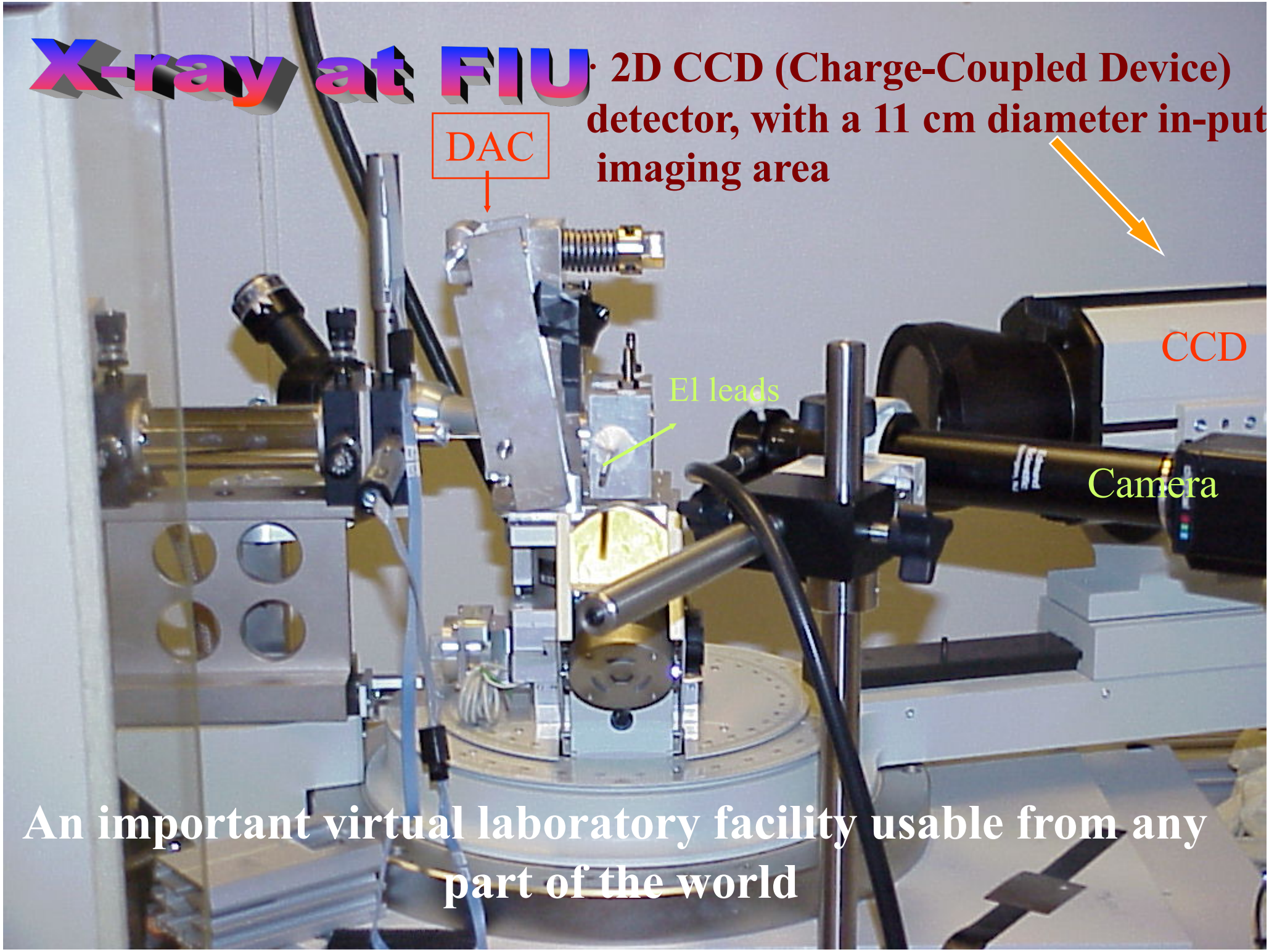
-phase transitions (1st order and higher order,e.g. magnetic)

-transport phenomena: thermal and electrical conductivity, diffusion,

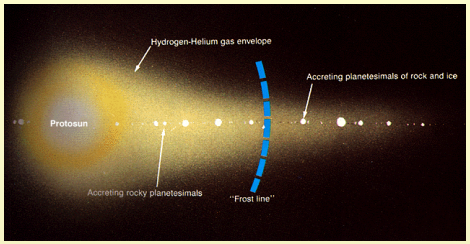
-heat capacity

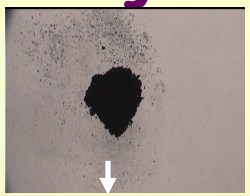
-emissivity

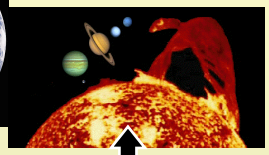
Coupling of the laser heating system to Raman, X-ray, Infrared, etc.


X-ray at FIU
DAC
2D CCD (Charge-Coupled Device) detector, with a 11 cm diameter in-put imaging area
CCD
El leads
Camera
An important virtual laboratory facility usable from any part of the world

Pressure is a very important variable







Pressure

10^{-31} 10^{-19} 10^{-13} 10^{-6} 1 10^{3} 10^{4} 10^{5} 10^{6} 10^{10} 10^{16} 10^{28} 10^{31}

Non-equilibrium "pressure" of hydrogen gas in intergalactic space

Pressure in interplanetary space

Atm. Pressure at altitude of 300 miles

Best vacuum attainable by mechanical pump

Atmospheric Pressure at sea level

Pressure at the greatest depth of oceans

Pressure at which C becomes diamond

Highest pressure attainable before DAC

Pat the center of Earth, attainable by DAC

Pressure at center of sun

Pressure at center of red giant star, and white dwarf stars

Pressure at center of superdense star

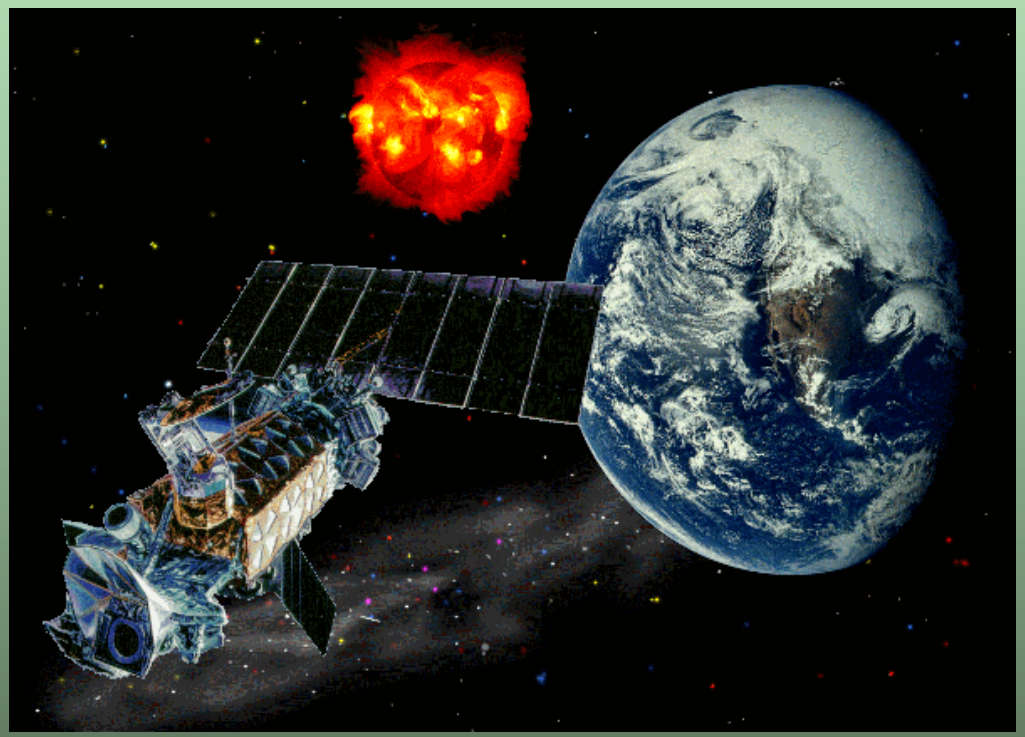
Pressure at center of neutron star

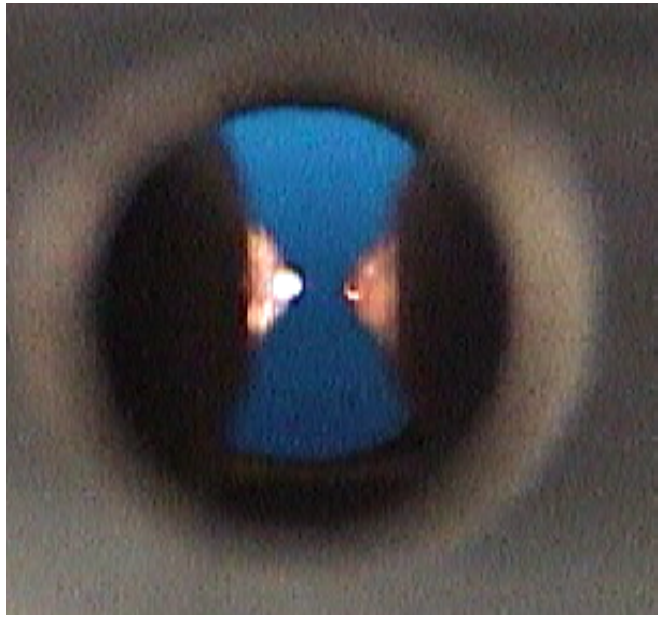
CeSMEC

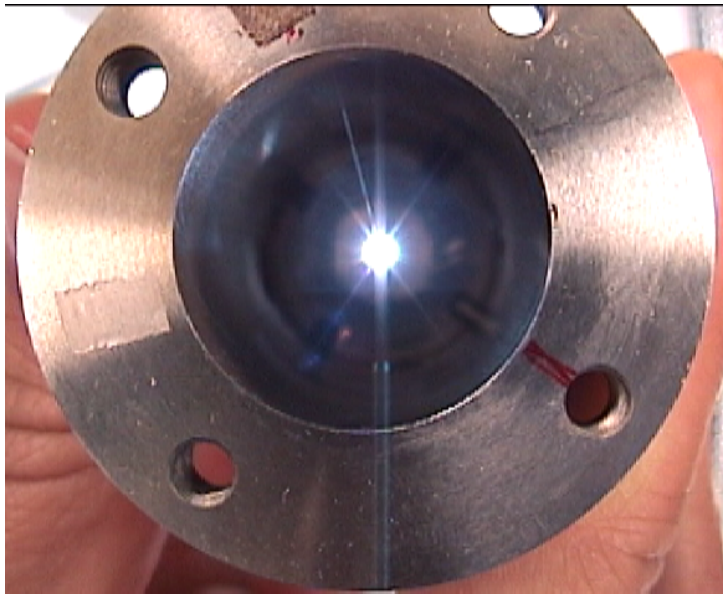
The properties of materials that are important to understand the planetary interiors are the same as are important to materials science

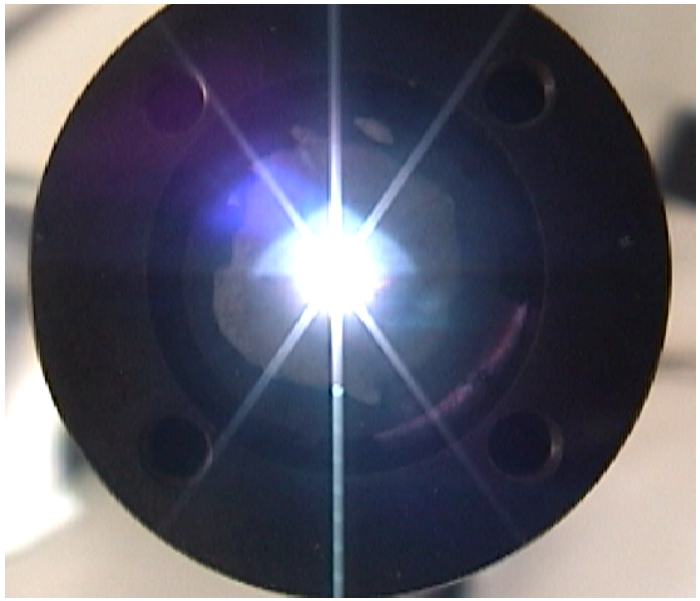
How is the thermal resistant of my space probe?

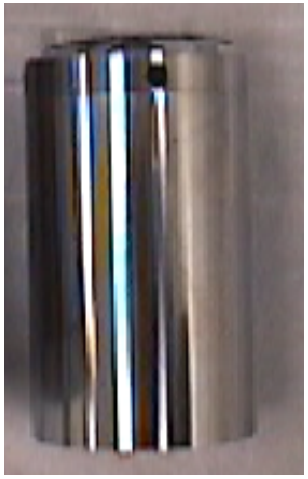
How hard is this bone?

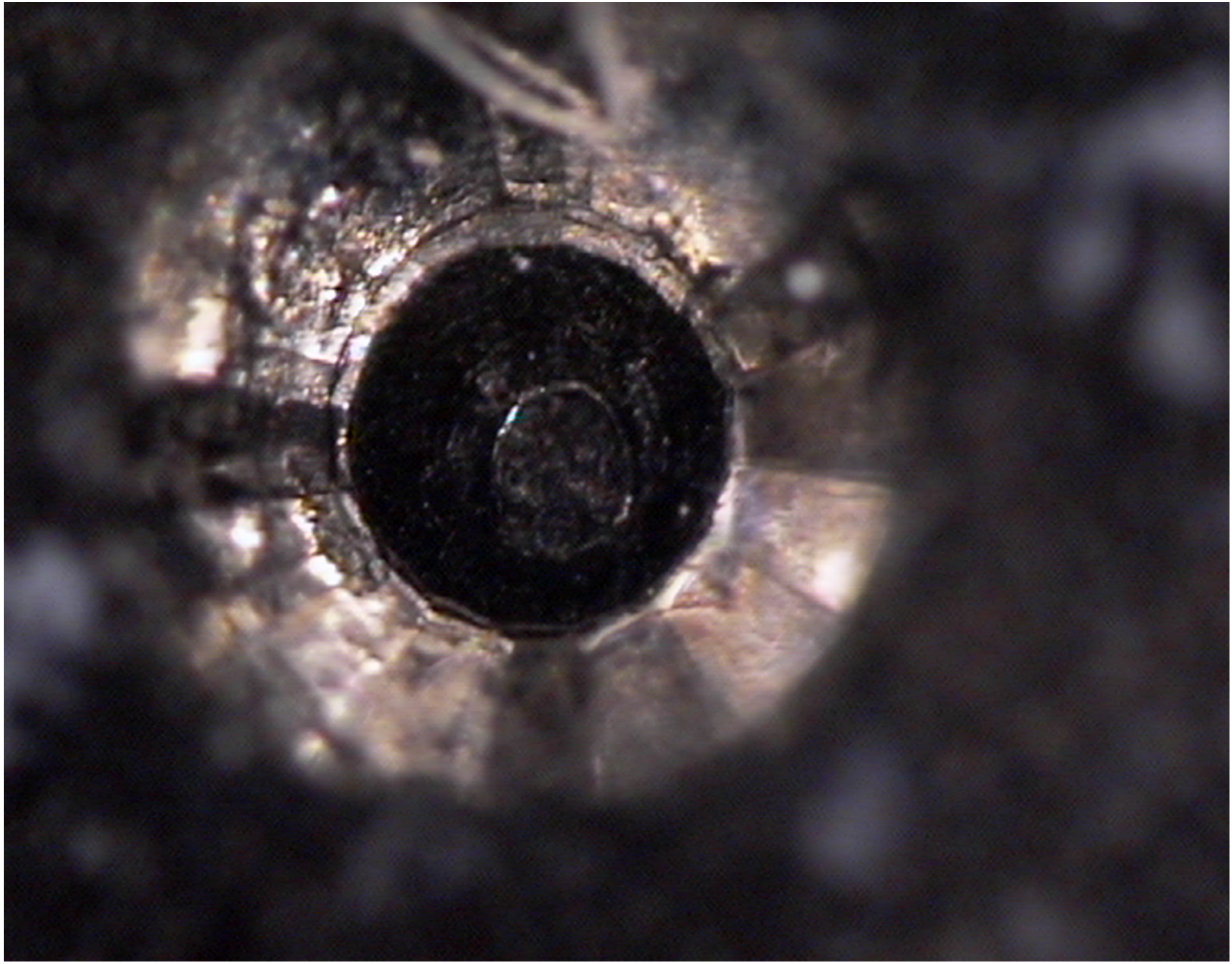




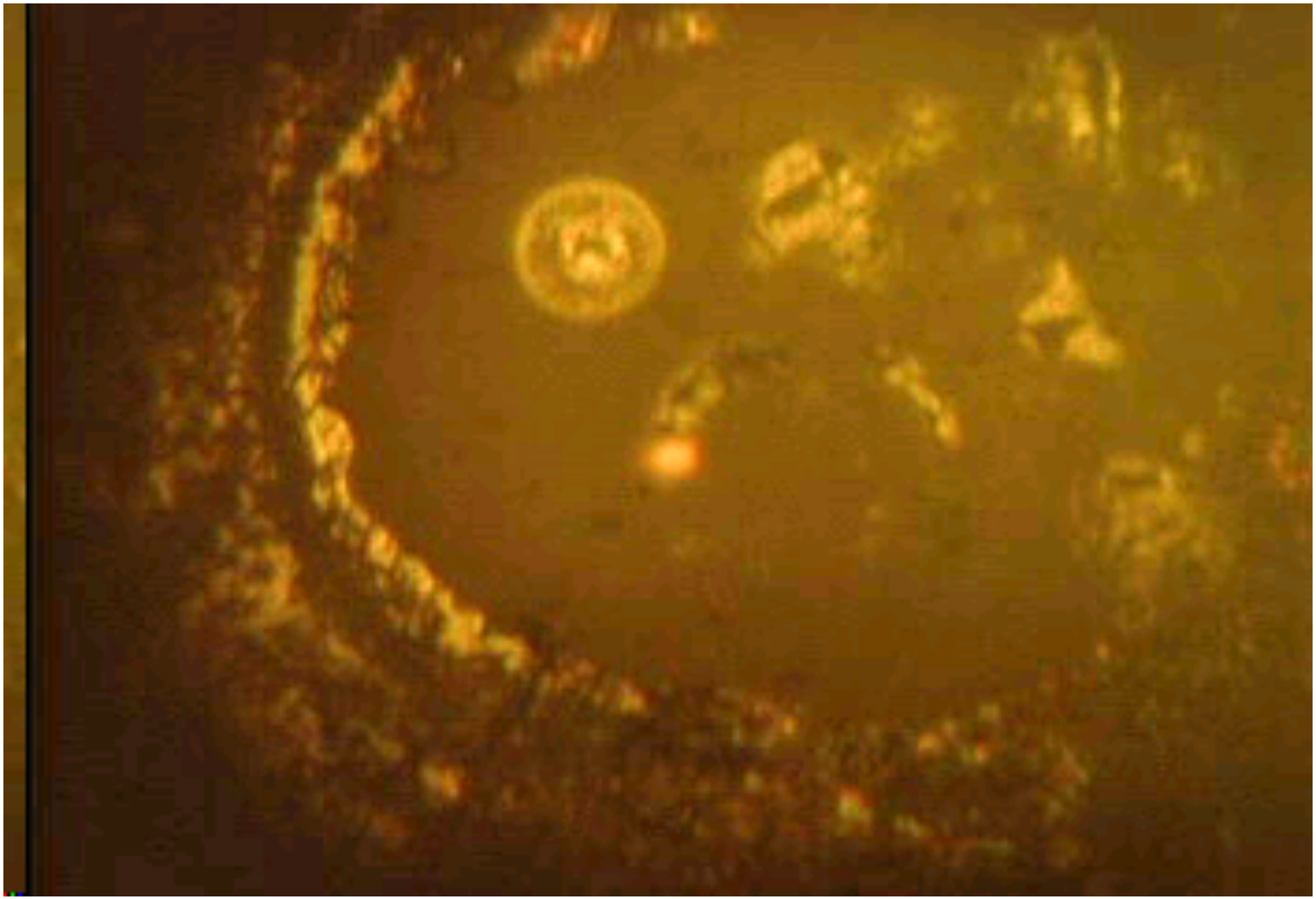




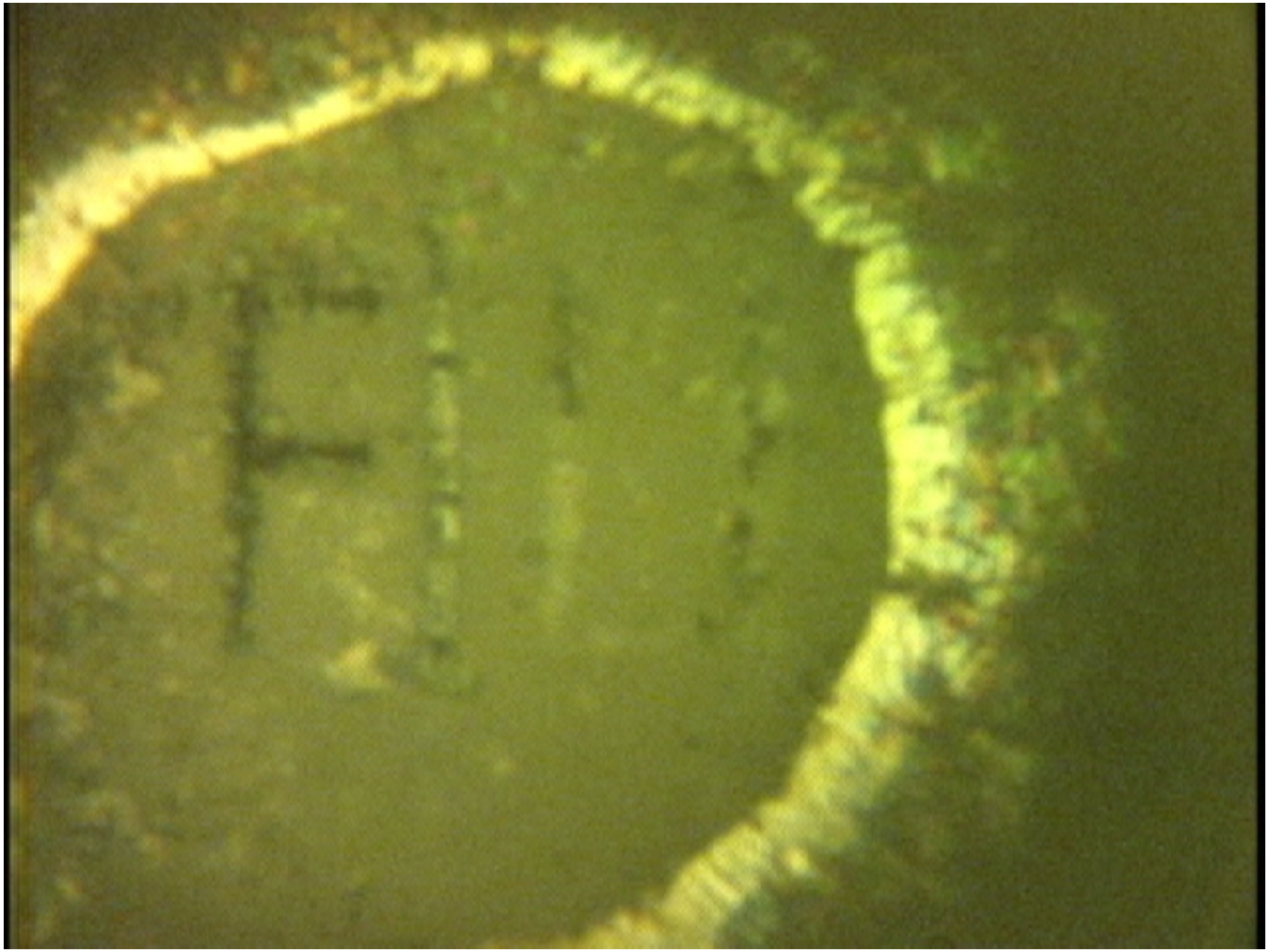


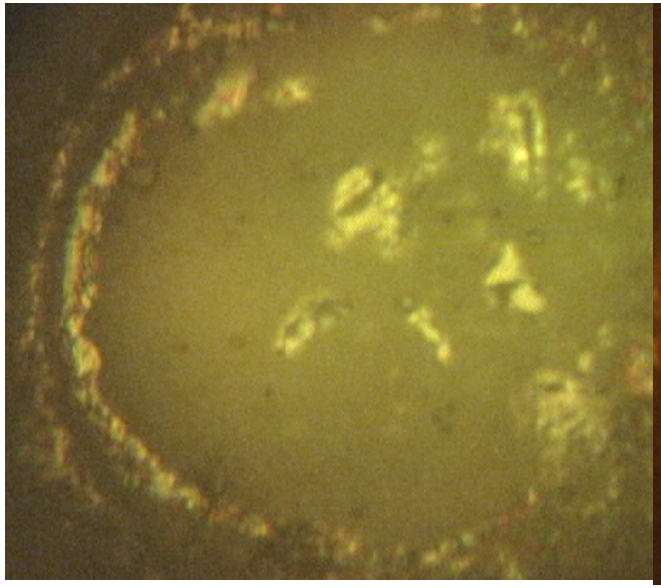
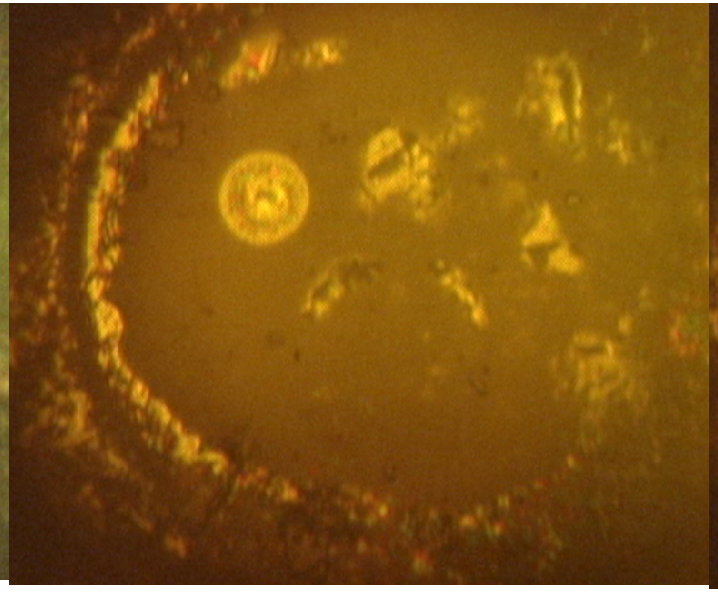
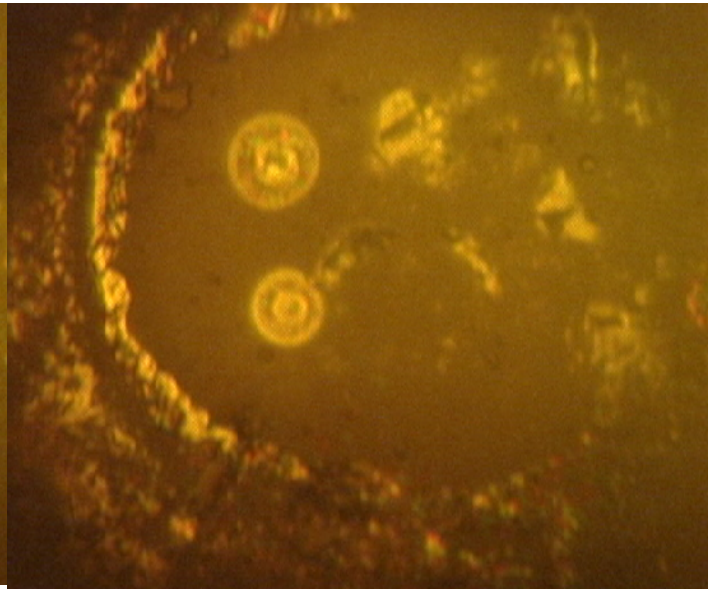
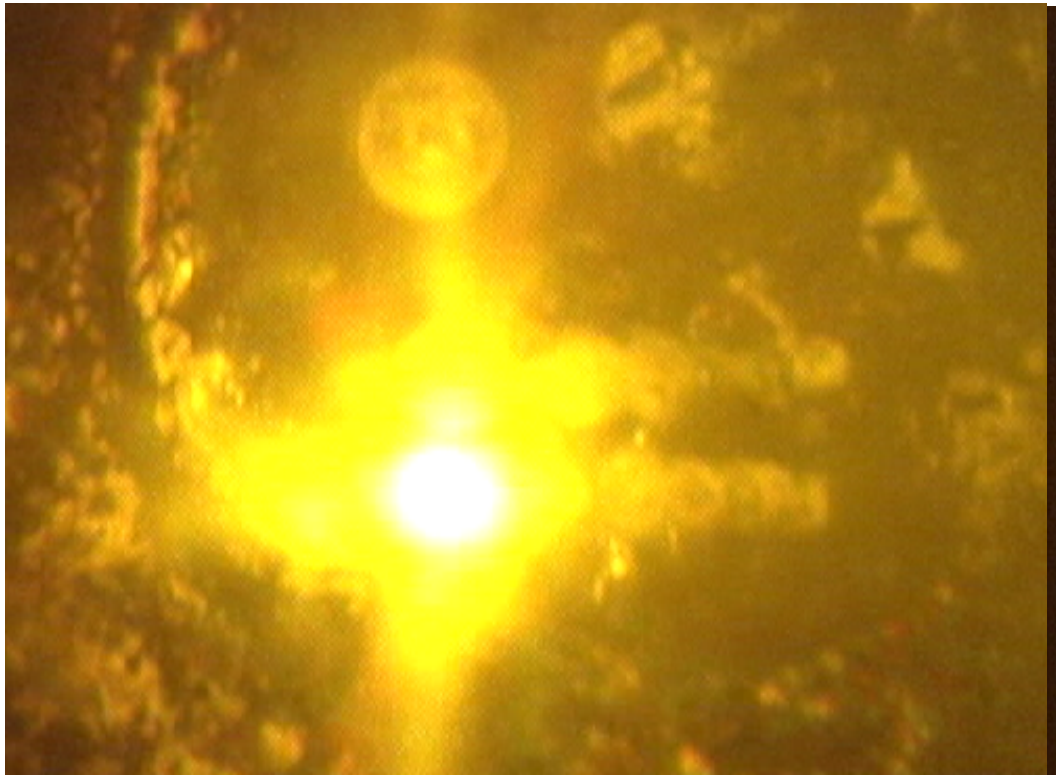


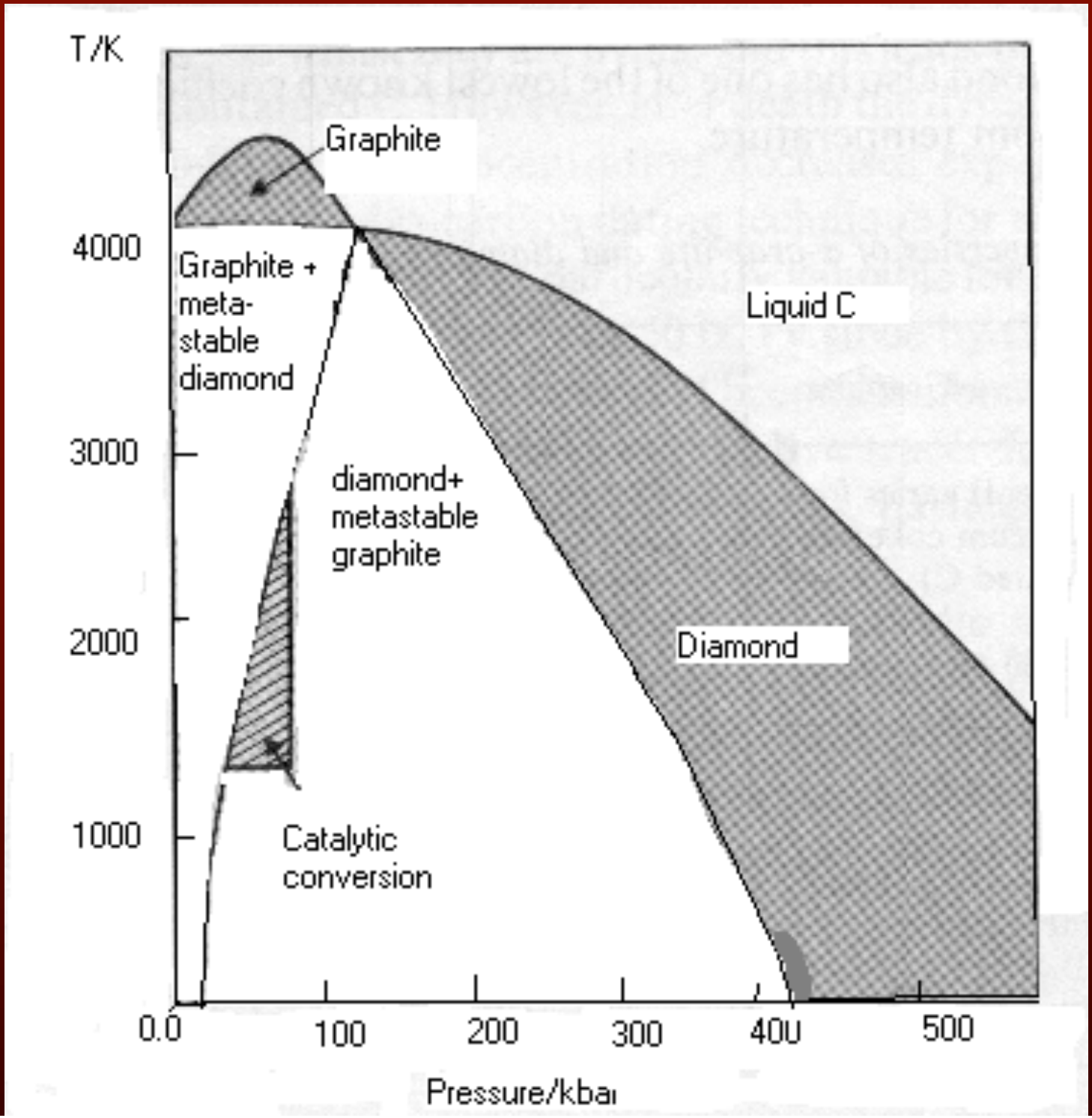
Let us make diamonds!!



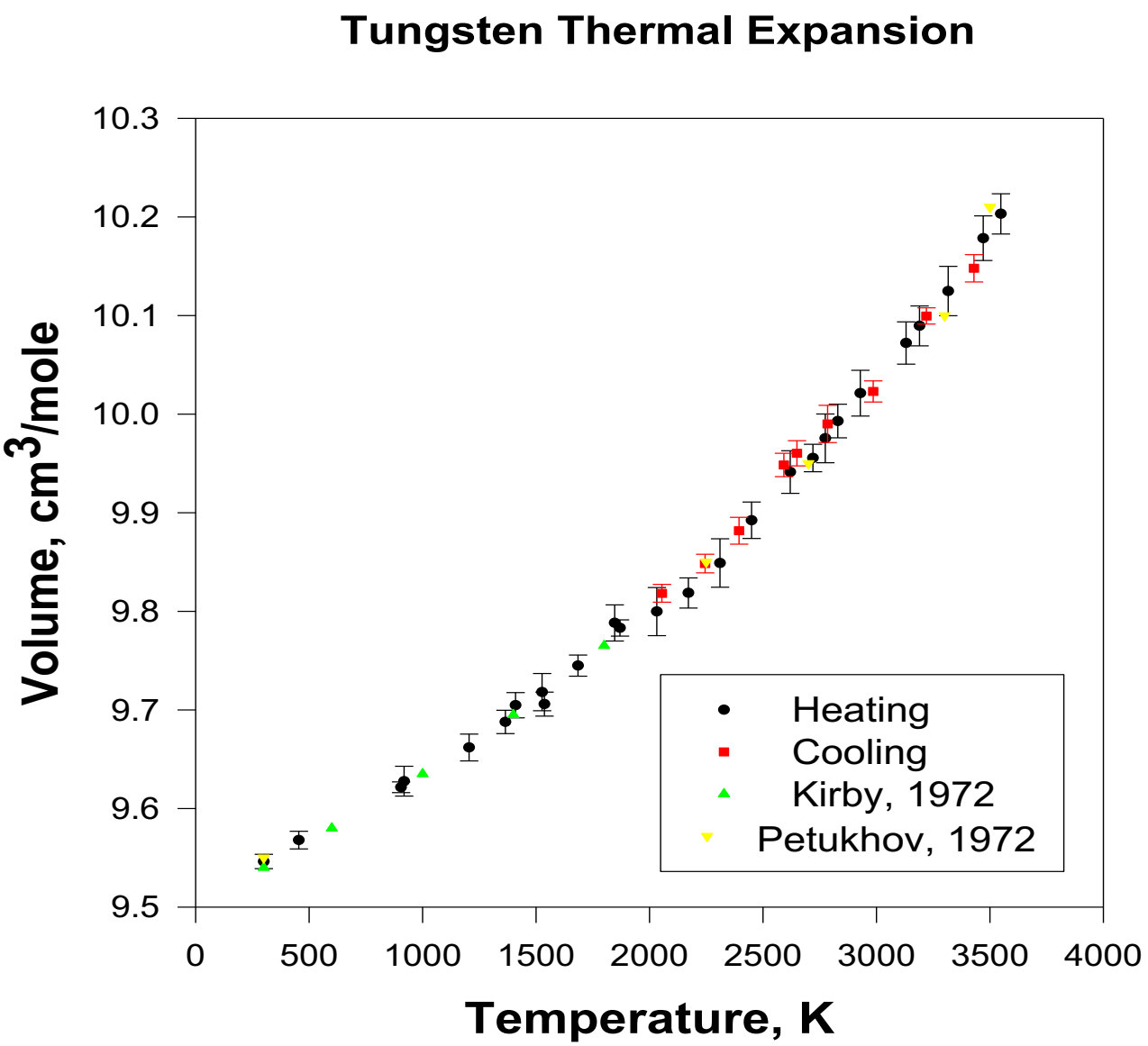
The name of FIU written in diamond



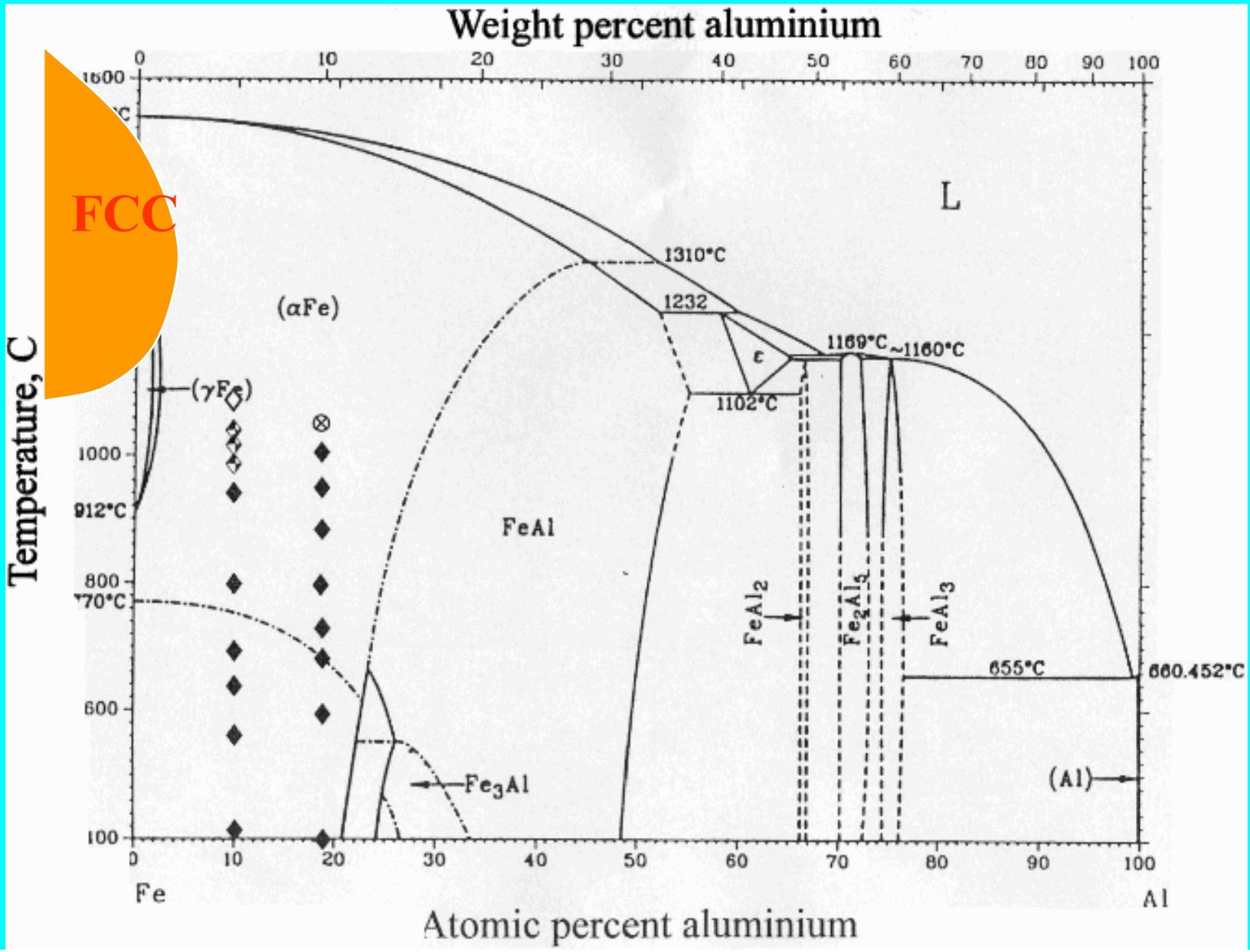





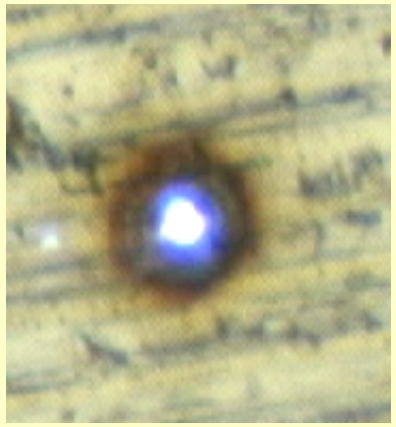
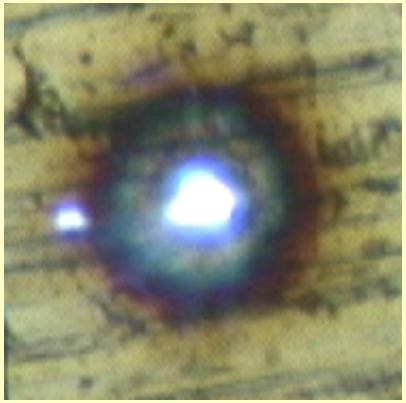
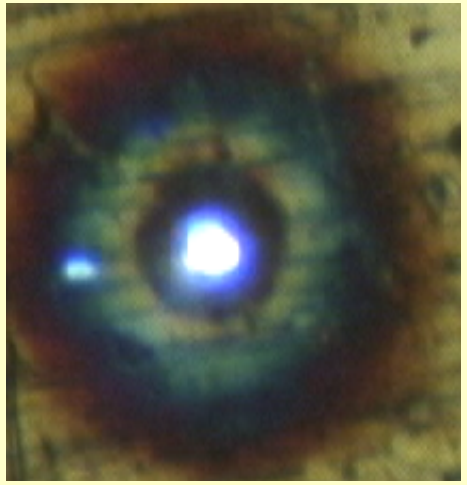


T/K
Graphite
4000
Graphite +
meta-
stable
diamond
Liquid C
3000
diamond+
metastable
graphite
2000
Diamond
1000
Catalytic
conversion
0.0
100
200
300
40U
500
Pressure/kbai

High temperatures to several thousands can be used to determine thermal properties of materials



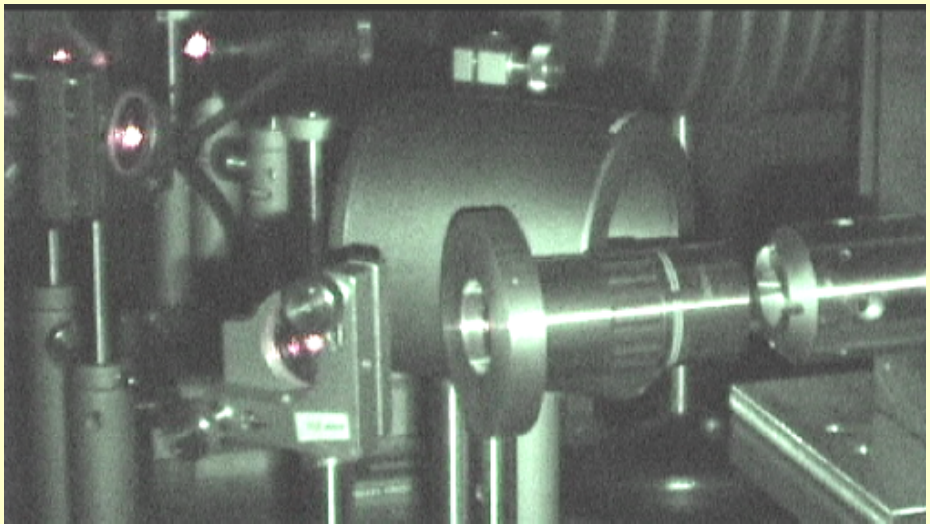
Metallurgists and ceramicists can generate in situ phase diagrams



Lasers are wonderful tools for studying temperature effect.

The figure above shows the formation and growth of an oxidation front in a heated metal. Such operations can be conducted in a virtual lab setting.



Scientists from any corner of the world may be able to operate the facilities for research in materials science creating super hard materials, ceramic and metallurgical phase diagrams

Or for geophysical research studying how pressure affects material properties

Or for high-pressure/temperature chemistry and physics

FIU Virtual Laboratory