Jefferson Lab TF-SRF

Informal talk, July 2005

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"We don't need new ideas, we need people to do the work."

---a prominent member of the EU SRF community said to me Wednesday at the Cornell SRF Workshop

This is a cogent warning, but for ILC, it depends on the funding/political situation, i.e. the flow of money. For us, in the US, this is a serious problem.

In 1966, it might have been said by Berkeley to RR Wilson about his ideas for building Fermilab.

He was also told by a very prominent accelerator physicist that he (Wilson) had no idea how to build a superconducting accelerator. This was true at the time… Most of the R&D then was at BNL.

So, for the ILC, how much time remains before new ideas become a problem, not a solution?

What sets the time scale? What must TF-SRF people do to play in the game? I will give my personal view here:

1. European Science Ministers meet in **2010**.
2. Next SRF Workshop is **2007**. **(in just two years!)**
3. Last SRF Workshop is **2009**.
4. After that, just work and good engineering is needed.

I think most people are well aware of this.

PROPOSED ILC GOALS FOR TF-SRF

2007: single cell, 40-45 MV/m, Q > 10^{10}, little Q slope, low field emission, etc.

2009: 9-cell ILC cavity module, same specs as 2007 single cell, mass production at known and very low cost.

We can meet these goals, I believe. Maybe by more than one route, with a decision to back one in 2009. On mass production cost, it is important to beat the competition by a clear margin at that time.

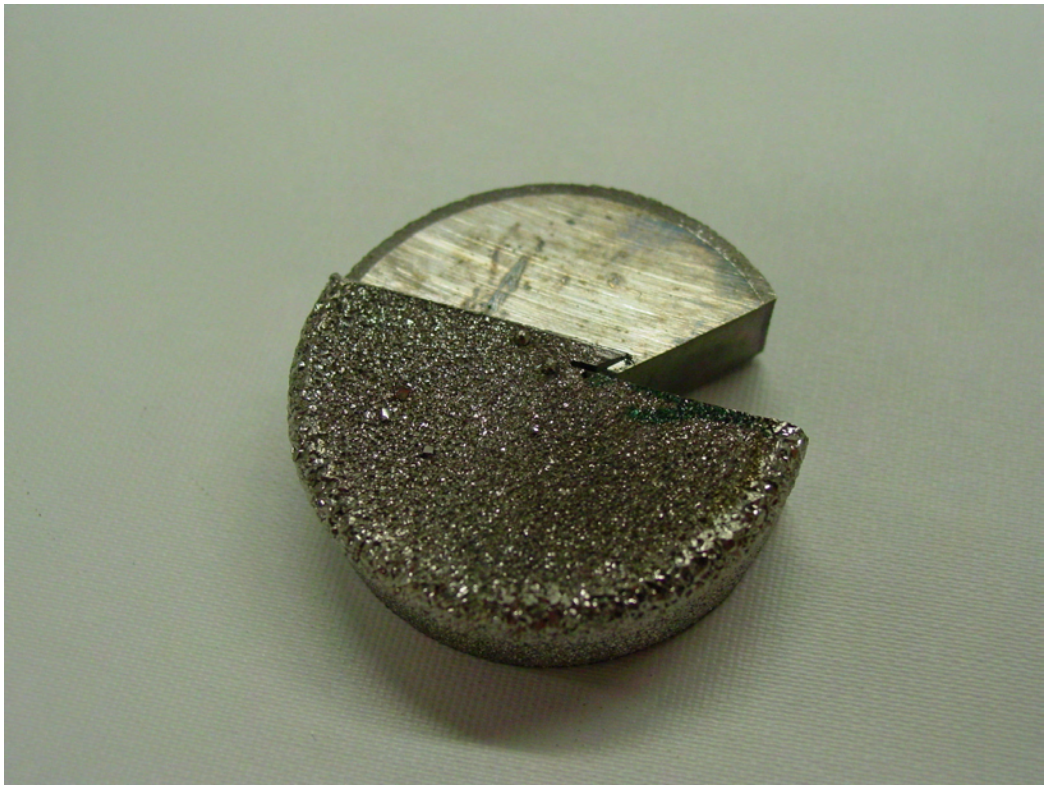
What's my idea for TF-SRF?

1. Injection molded fused silica mandrel sets dimensions of inner cavity surface and surface quality.
2. Iodide process (hydrogen-free) CVD to, say, 100 microns of niobium, which starts with reactor grade Nb and is purified by the process. Large, oriented grains are formed.
3. Electro-deposition of nickel to required thickness, and heat to 1100 C for eutectic Nb-Ni boundary layer. (Heat transmission improved)
4. Mandrel removed by combination of chemistry (Na_2O to form glass) and melting at 850 C.
5. (not important) a few monolayers of NbN to keep oxygen out.

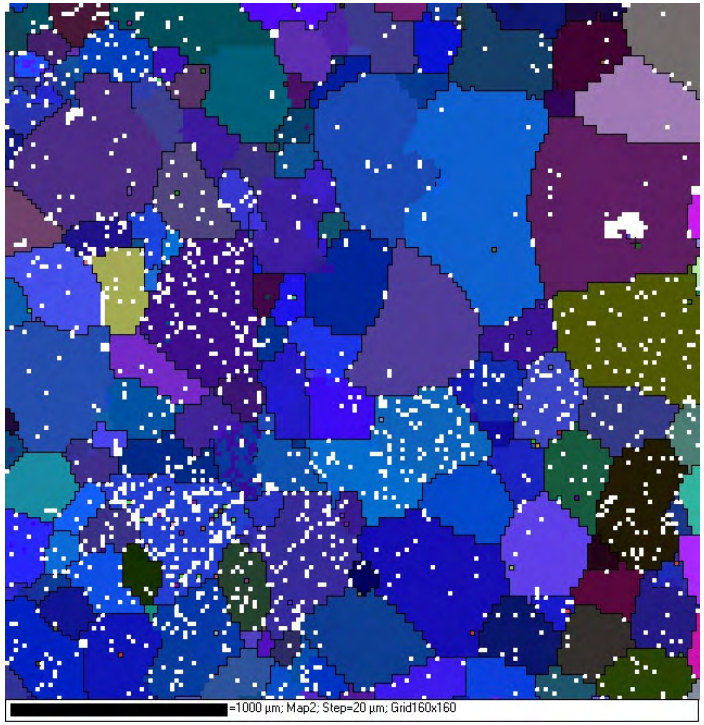
$$2Nb + 5\,I_2 \underset{1000\ C}{\overset{380\ C}{\rightleftharpoons}} 2NbI_5$$ (iodide process)

Studies of commercial CVD Nb:

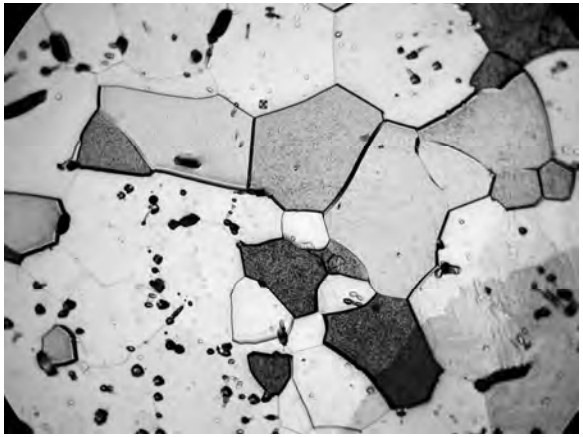
Received sample on molybdenum mandrel from Ultramet. This was probably made by hydrogen reduction of $NbCl_5$ (as in 1864, when Nb was first isolated.



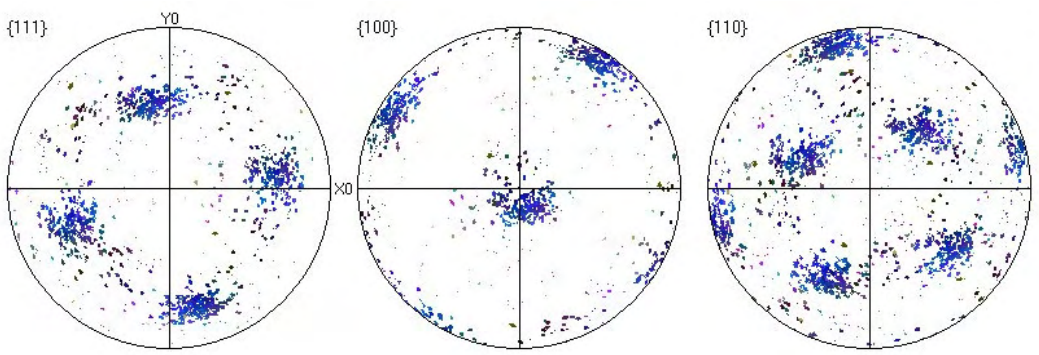
Lots of hydrogen!



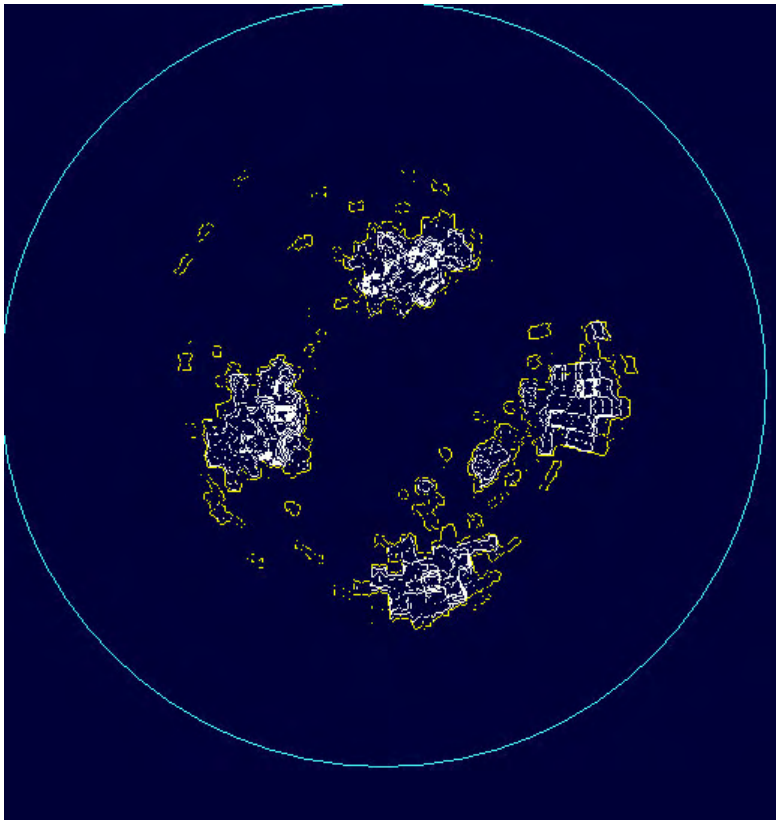
EBSD 3.2 mm x 3.2 mm



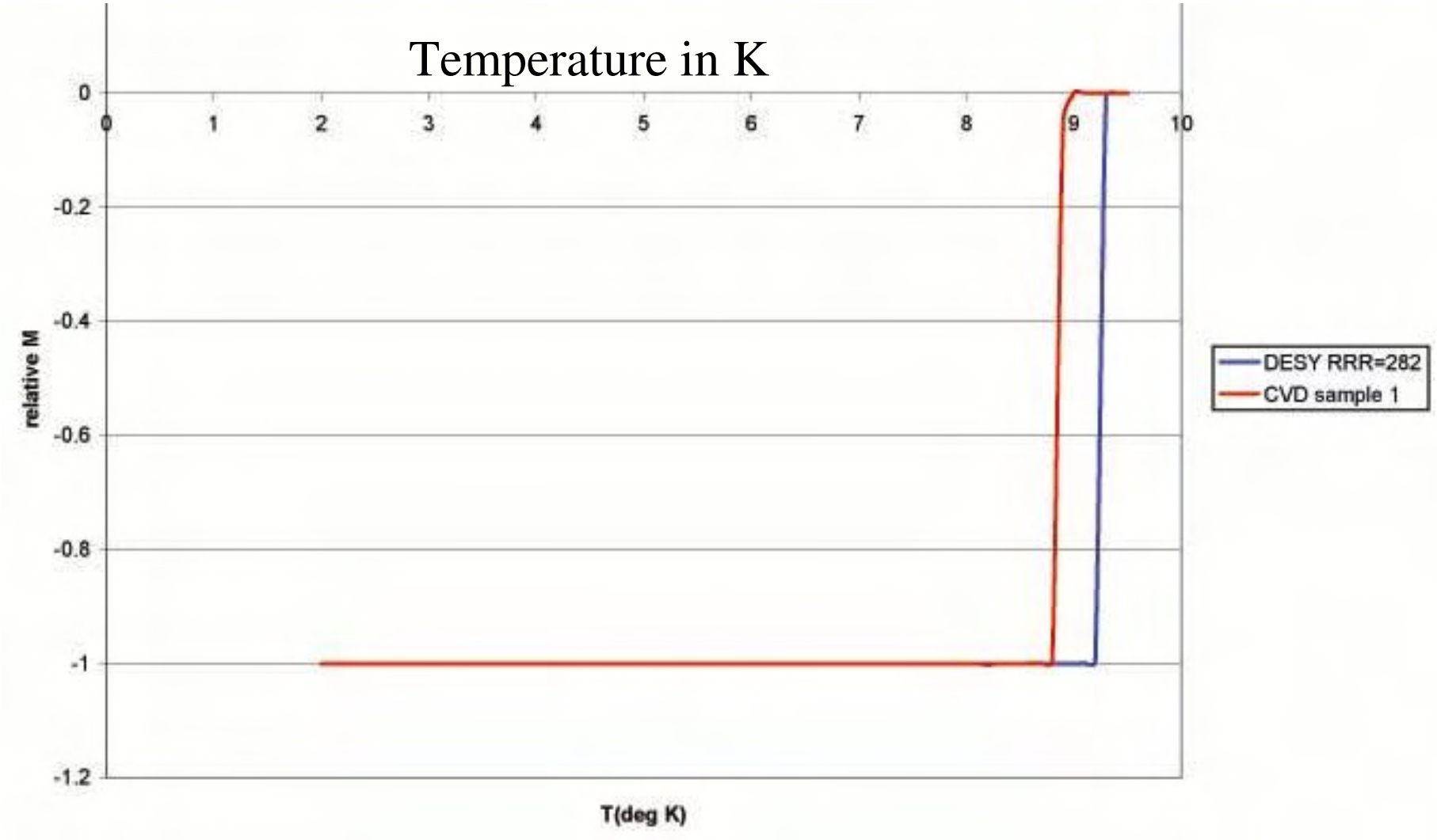
Optical Microscope 100X



Pole figures show oriented grains

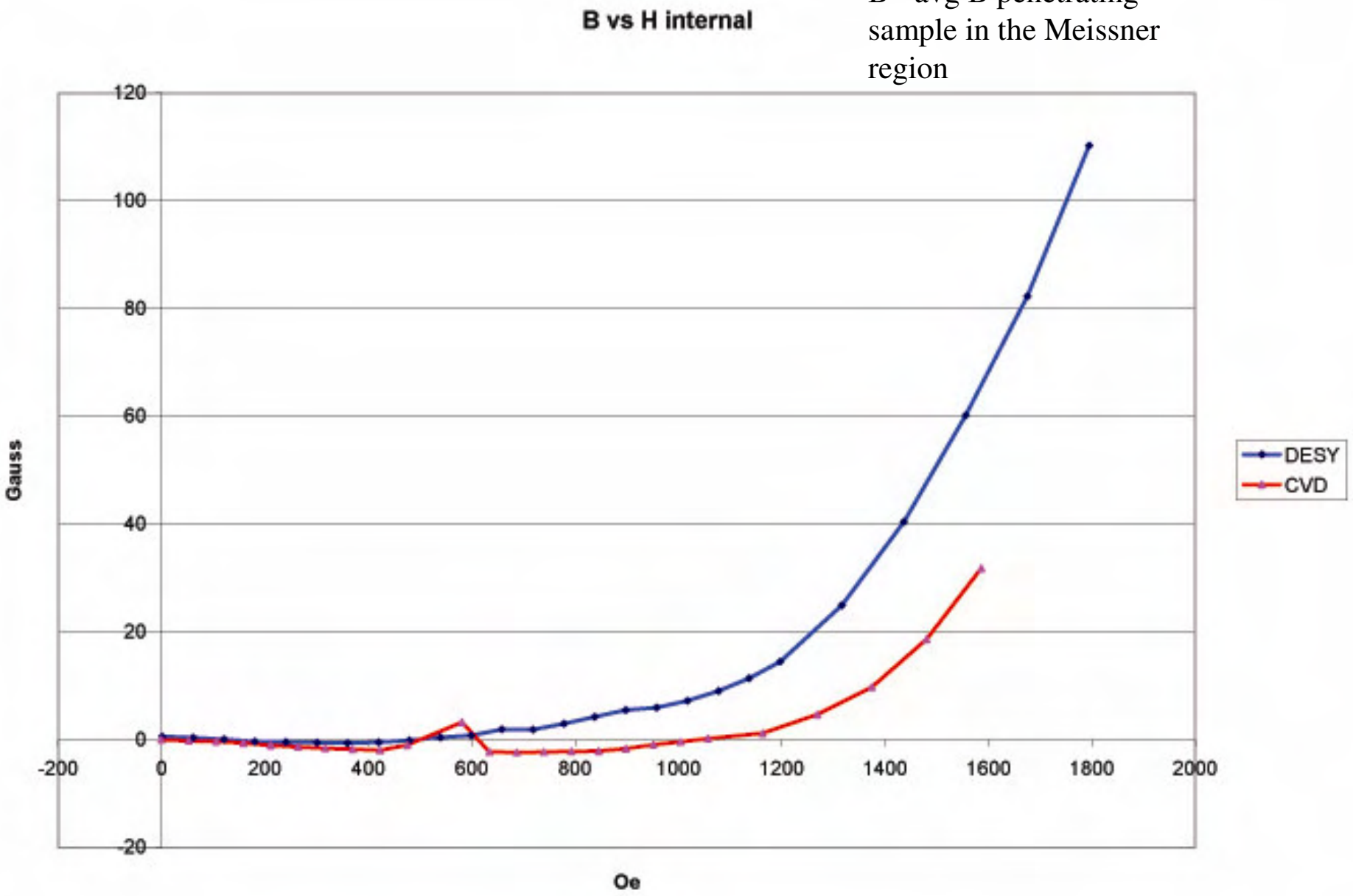


SQUID magnetometer at constant H=10 Oe



NC-SC transition is very sharp < 0.1 K width. Tc is shifted -.38 K down for CVD. H-induced defects?

B= avg B penetrating sample in the Meissner region



SQUID Magnetometer, scaled Hext -> Hint

So, what's wrong with trying to make a single cell TF-SRF cavity by the method proposed in slide 5 above?

Note: thanks to Charlie Sinclair for suggesting CVD to me.