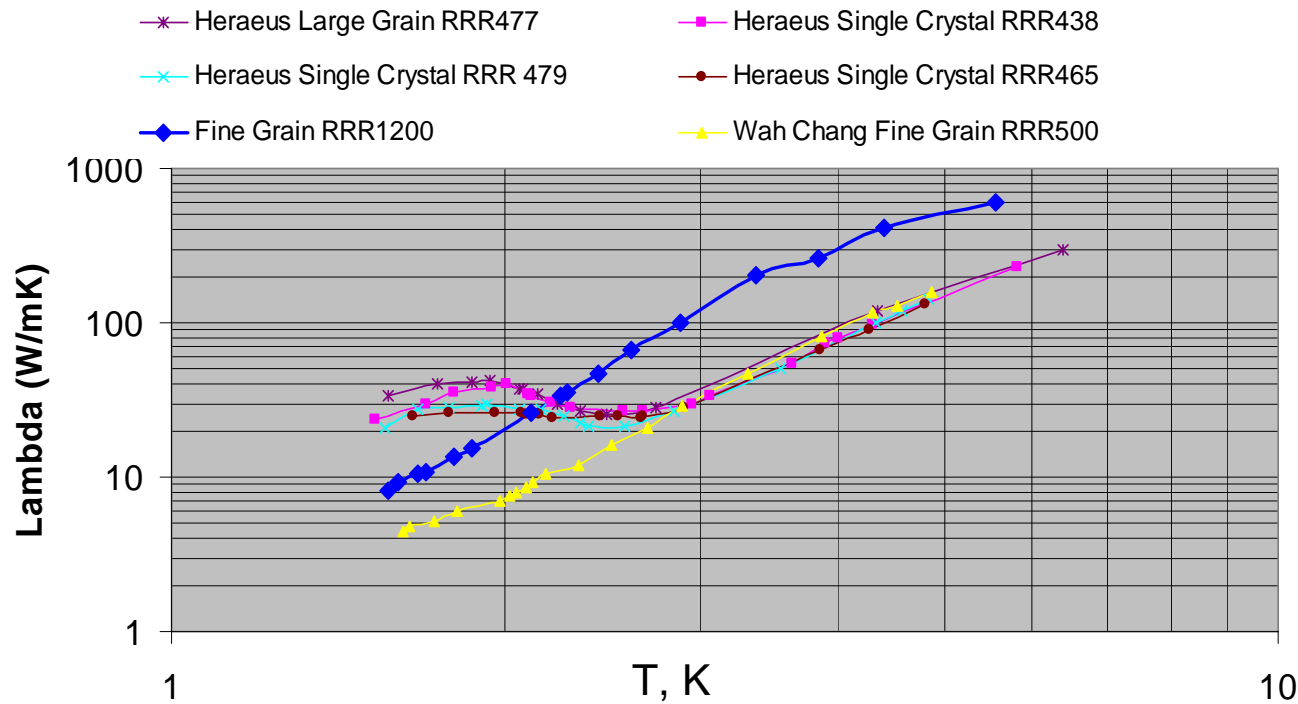


# **Large Grain/Single Crystal Niobium**

W. Singer



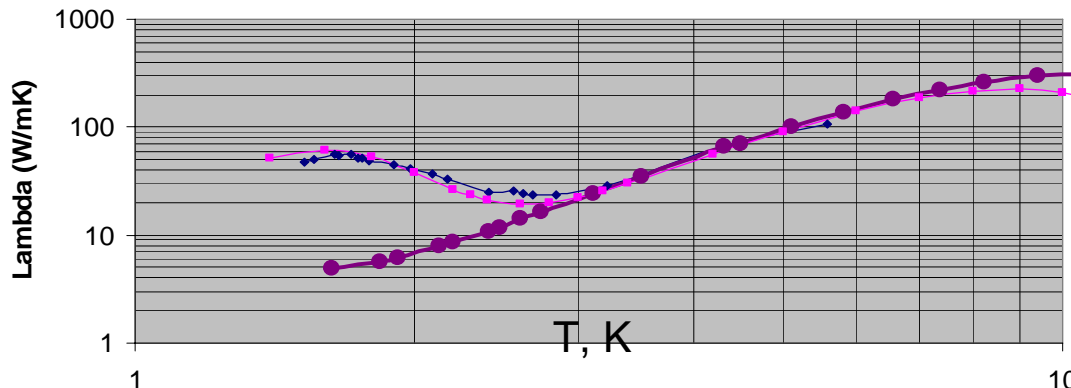
**Thermal conductivity**  
 of single crystals  
 in comparison  
 with  
 polycrystalline  
 material. Phonon  
 peak is clearly  
 pronounced for  
 single crystals.

Already small  
 deformation  
 destroy the  
 phonon peak

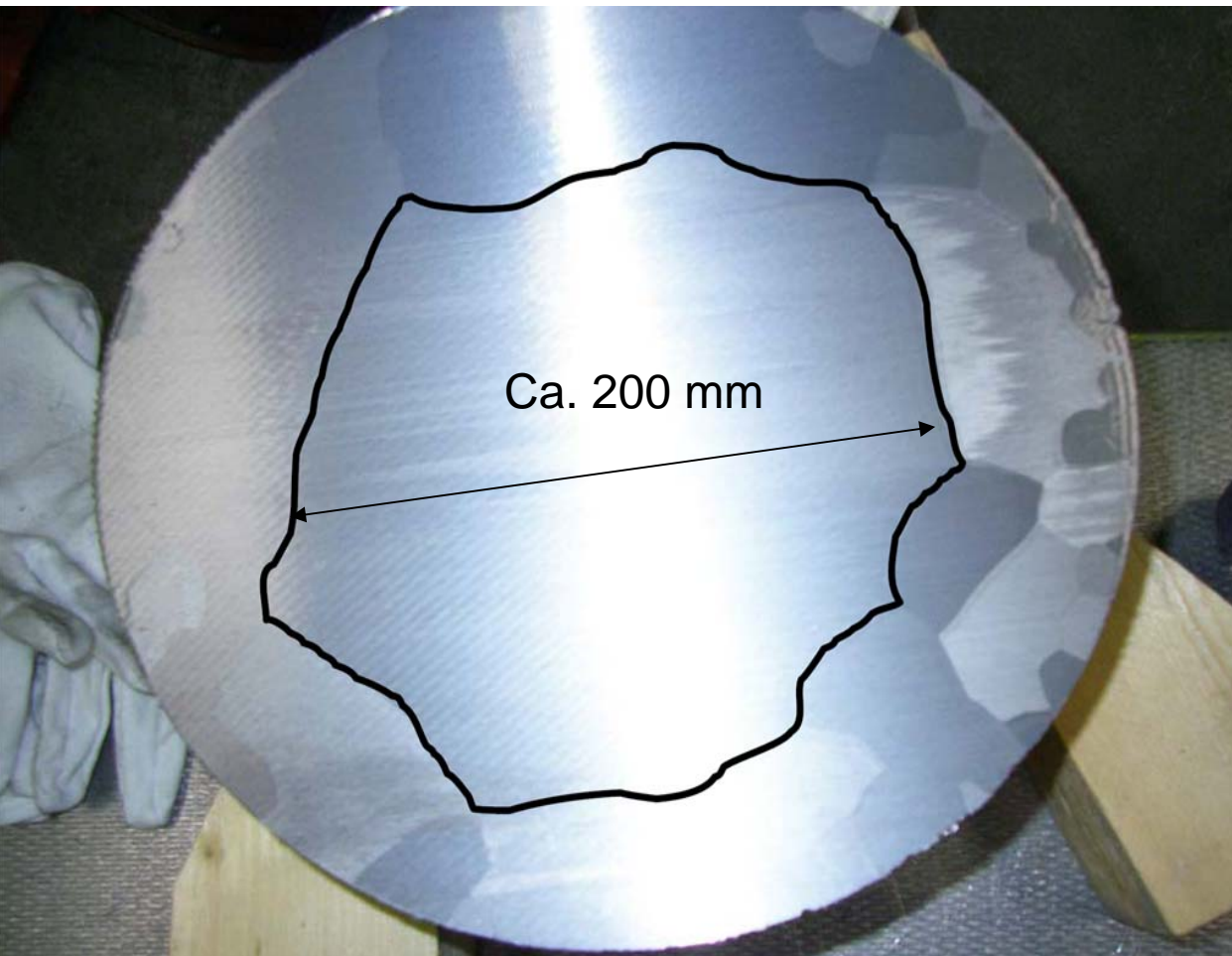
Parameterizations of F. Koechlin and B. Bonin

$$\lambda(T, RRR, G) = R(y) \cdot \left[ \frac{\rho_{295K}}{L \cdot RRR \cdot T} + a \cdot T^2 \right]^{-1} + \left[ \frac{1}{D \cdot \exp(y) \cdot T^2} + \frac{1}{B \cdot G \cdot T^3} \right]^{-1}$$

- ◆ Heraeus Single Crystal Before Deformation RRR255
- Heraeus Single Crystal After Deformation (8.5% length extension) RRR 237
- ◆ RRR255 Theory mfp=3mm



# Fabrication aspect

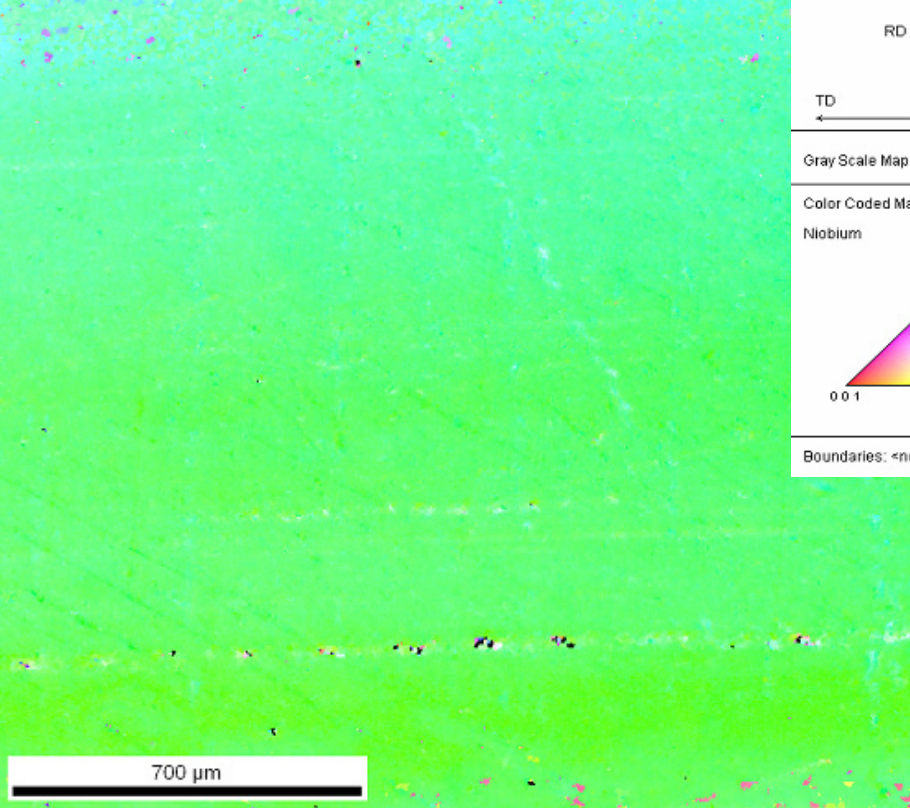


Last HERAEUS Ingot of RRR300 with a central single crystal

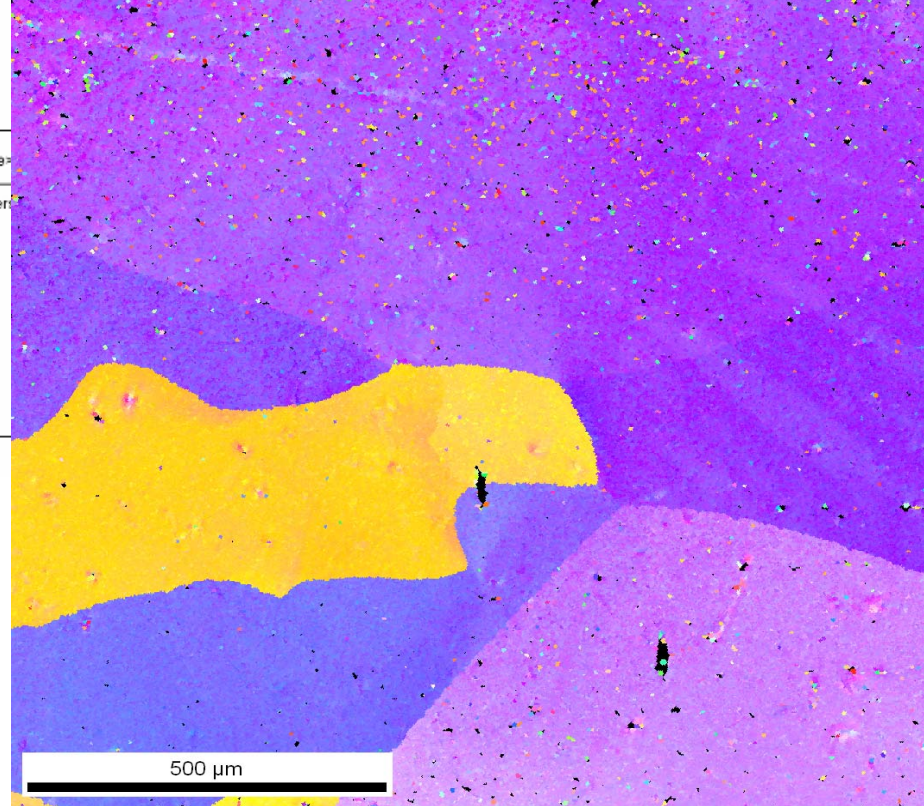


Increasing of diameter by rolling.

Ca. 50% deformation degree of cross rolling is required



Orientation stability of Nb SC (100) after 50% cross rolling and annealing at 1200 °C



Recrystallization in Nb single crystal (111) after 50% rolling and annealing at 1200° C for 3 hours

Fabrication from sheets with the orientation plane (100) parallel to sheet surface is more advantageous

# Summary

- Thermal conductivity of fine grain (polycrystalline), large grain and single crystal niobium samples were measured at low temperatures.
- The experimental results are emphasis pronounced phonon peaks on large grain and single crystal heat treated at 800°C niobium samples while no 'phonon peak' on fine grain samples independently on RRR value are observed. The dependence of the phonon peak on crystallographic orientation was not dedicated.
- Phonon peak may be destroyed due to plastic deformation. Already a small plastic deformation of 8.5% has made the phonon peak totally disappeared.
- Niobium single crystals of (001) rolled up to 50% keep their orientation after annealing at the temperatures 800-1200°C.
- Single crystals of rolling plane of (111) deformed with the strain of 50% are recrystallized during annealing at temperature 1200°C, but have just dislocation recovery at the lower temperatures.