

# Measurement of thermal conductivity of sapphire rods

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# Motivation

- The sapphire rods which have the thick edge can be made by Moltech and Impex.
- these special rods are useful for KAGRA cryogenic payloads.
- However, these special sapphire rods cannot be polished.
- thermal conductivity of unpolished materials is worse than that of polished materials.
- So, we need to measure the thermal conductivity of these special sapphire rods.



Moltech sapphire rod

# Purpose

- Search for difference of thermal conductivity between polished sapphire rods and unpolished ones.
- Search for difference of thermal conductivity between Photoran sapphire rods and Namiki sapphire rods.
- Measure thermal conductivity of Moltech and Impex special sapphire rods.

Now, we take data about Photoran polished rod only.

# How to measure

- Sample size  
diameter :  $\phi 1.8\text{mm}$   
sample length : 100mm
- One dimensional approximation.

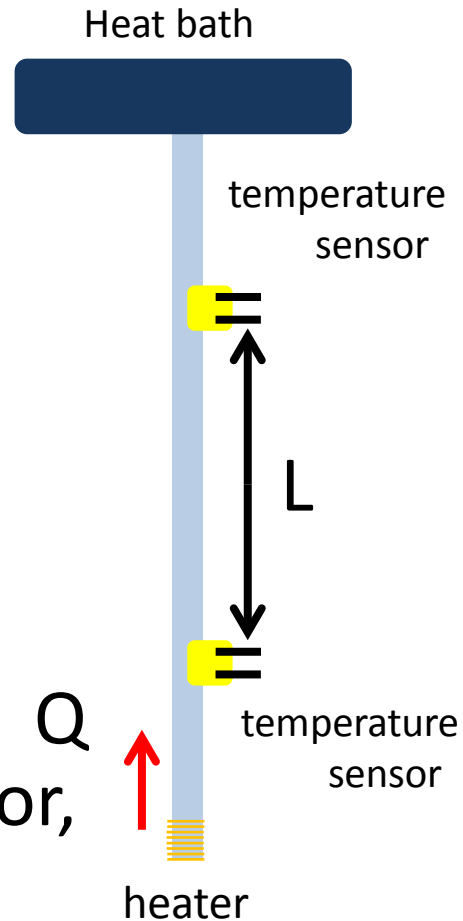
$$\kappa = \frac{LQ}{A\Delta T}$$

$\kappa$  :thermal conductivity

L :length between two temperature sensor,

Q:heat flow, A :sample cross section,

$\Delta T$ :difference of values of two temperature sensor



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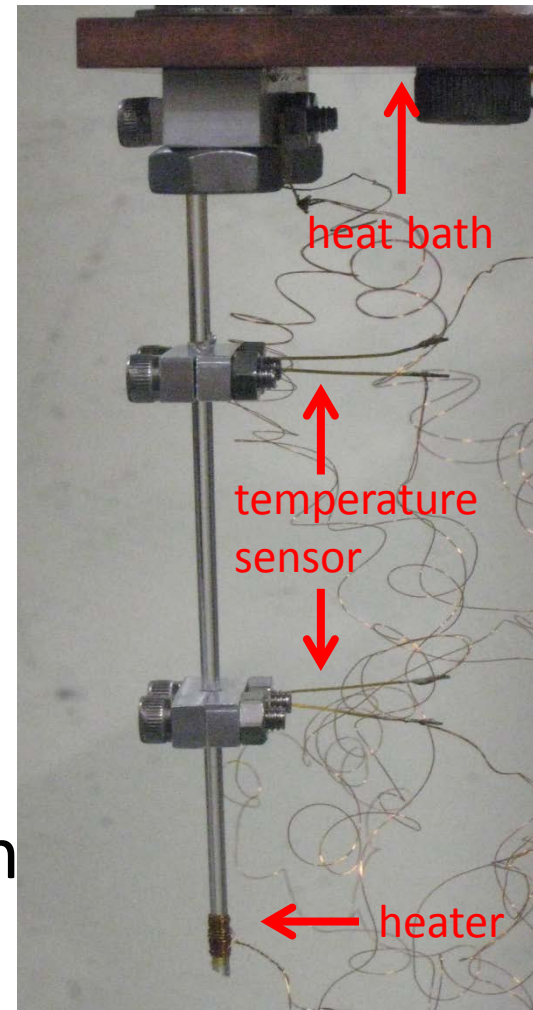
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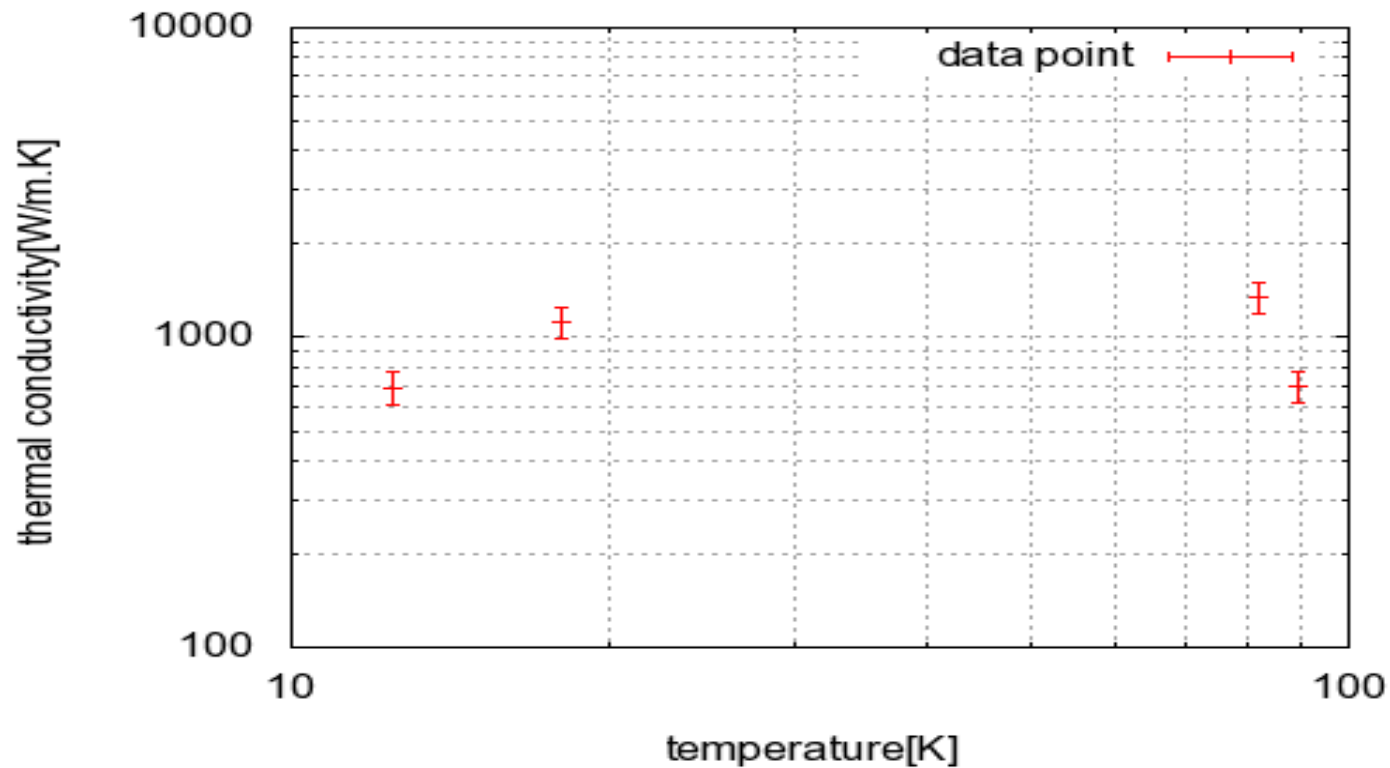
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# Result



- We can take 4 data about Photoran polished rod. (2 data at lq.He temp. and 2 data at lq. N<sub>2</sub> temp.)

# Discussion

- We cannot take data from 20K to 80K because of the shortage of lq.He.
- This result is consistent with the result of Tomaru-san's measurement[1].  
(measurement about sapphire fiber  $\phi 390\mu m$ )
- However, the thickness of sapphire is different.
- We need to measure thermal conductivity of other sapphire rods and compare each results.

[1]T. Tomaru et al, Phys. Lett. A 301, 215 (2002)



# Future work

- Measure thermal conductivity of Photoran unpolished sapphire rod and compare with the result in this time.
- Measure thermal conductivity of Namiki unpolished sapphire rod.
- Measure thermal conductivity of Moltech and IMPEX special sapphire rods.

# Summary

- We measure thermal conductivity of various sapphire rods.
- We can get thermal conductivity data about Photoran polished sapphire rod.
- The result is consistent with the result of previous work.
- We should determine which sapphire rod is better to use for cryogenic payload.