



Mechanical grinding development

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- Introduction
- About the Grinding Machine
- Grinding Bump location
- Grinding Pit location
- Summary



The Kyoto camera system is useful tool for the observation and Shape analysis of spots in cavity inner surface.

We obtained a good tool to understand the problem of the cavity surface for achievement a better gradient yield.

So far, We understand that heating location of a cavity with low E_{acc} field has a spot (Bump or Pit) in its inner surface. (Magnetic field enhancement)

Example : AES#001 hot spots etc...

If these spots are removed, then it has possibility that the cavity performance can be improved.

HOW TO REMOVE its spot? (Method : CP ?, EP ?, Grinding ?)

Study of scratch removal on Nb surface

Intentional scratch
~70μm depth,
~600μm x 1000μm



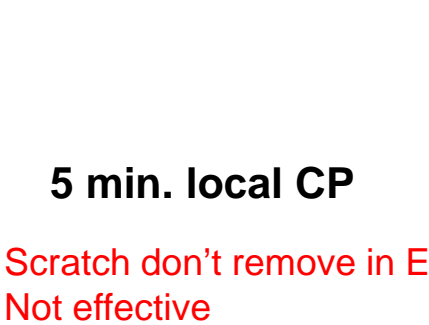
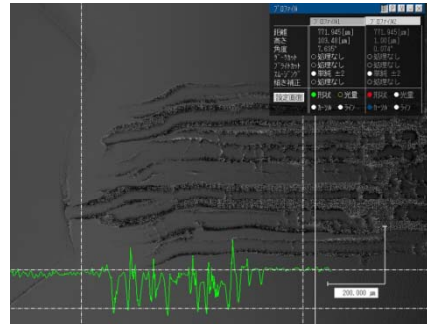
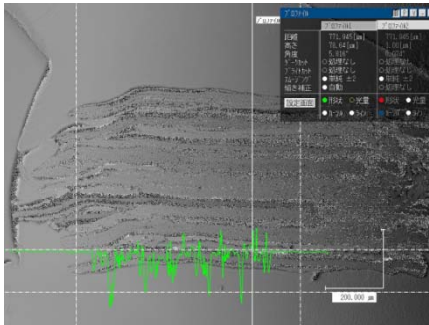
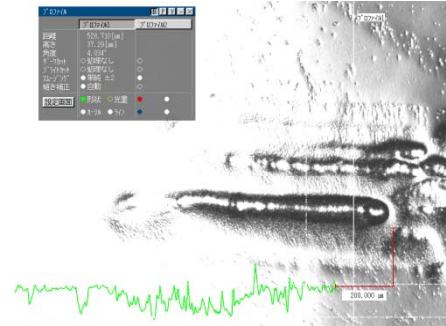
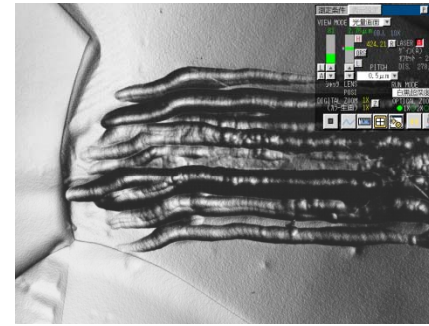
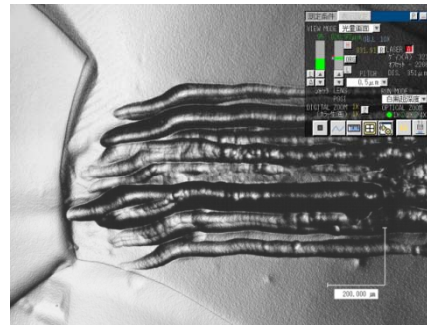
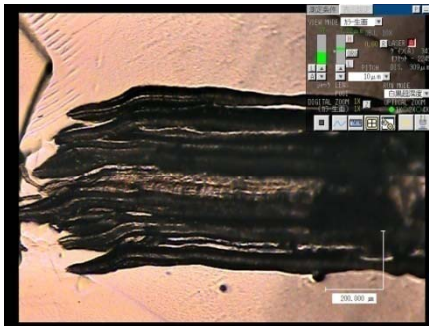
apply 30μm
removal by **EP**



apply additional
(60μm)? removal
by local **CP**



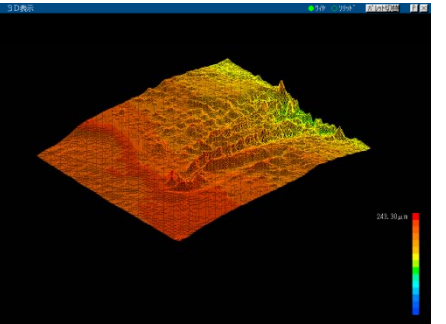
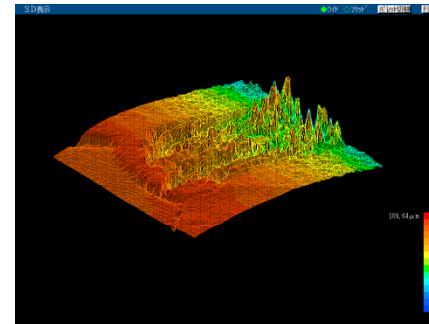
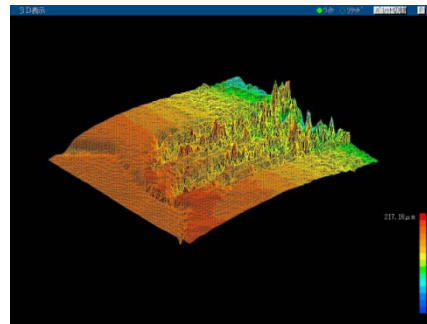
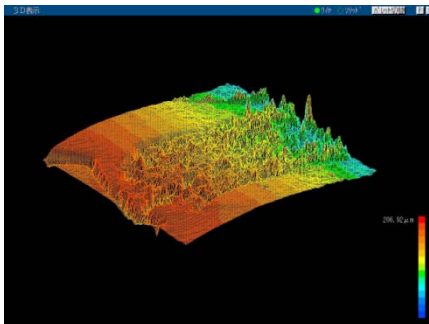
apply additional buff
polishing using 1.5μm
diamond powder



5 min. local CP

20 min. buff polish
Effective

Scratch don't remove in EP and CP
Not effective



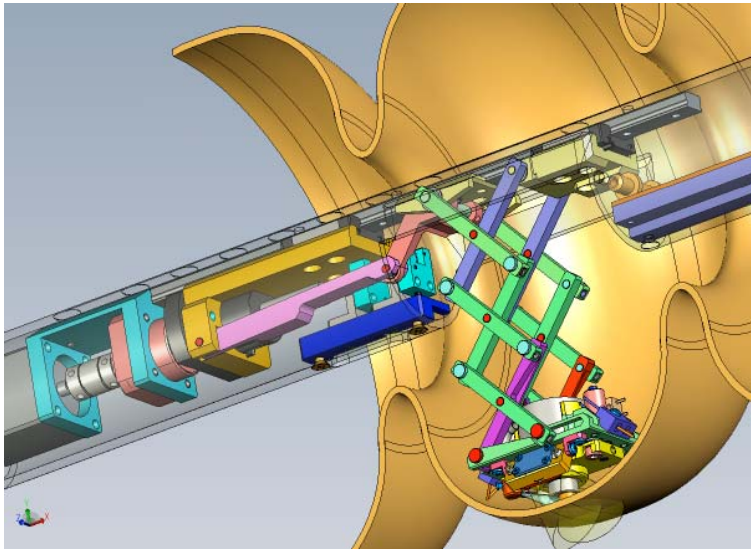
small effect

small effect

well polished



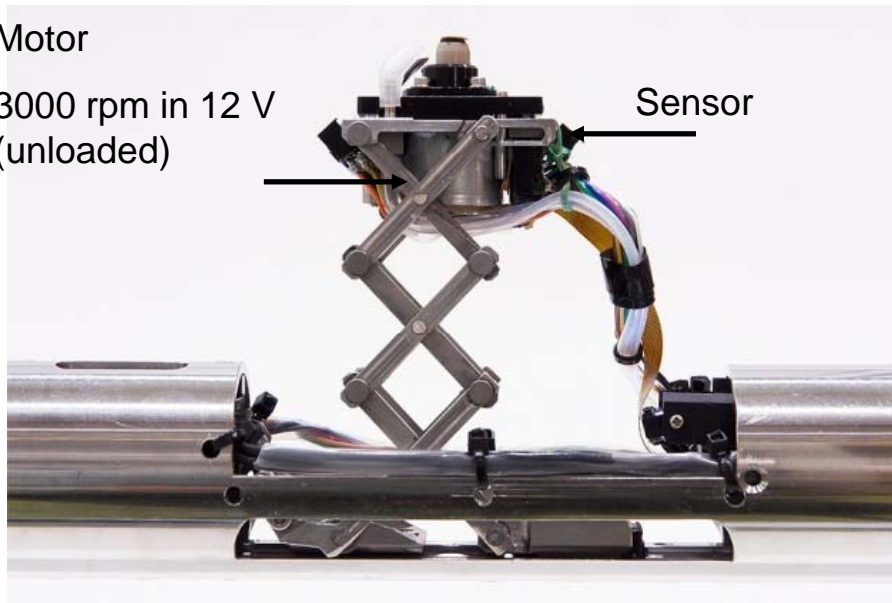
Grinding machine



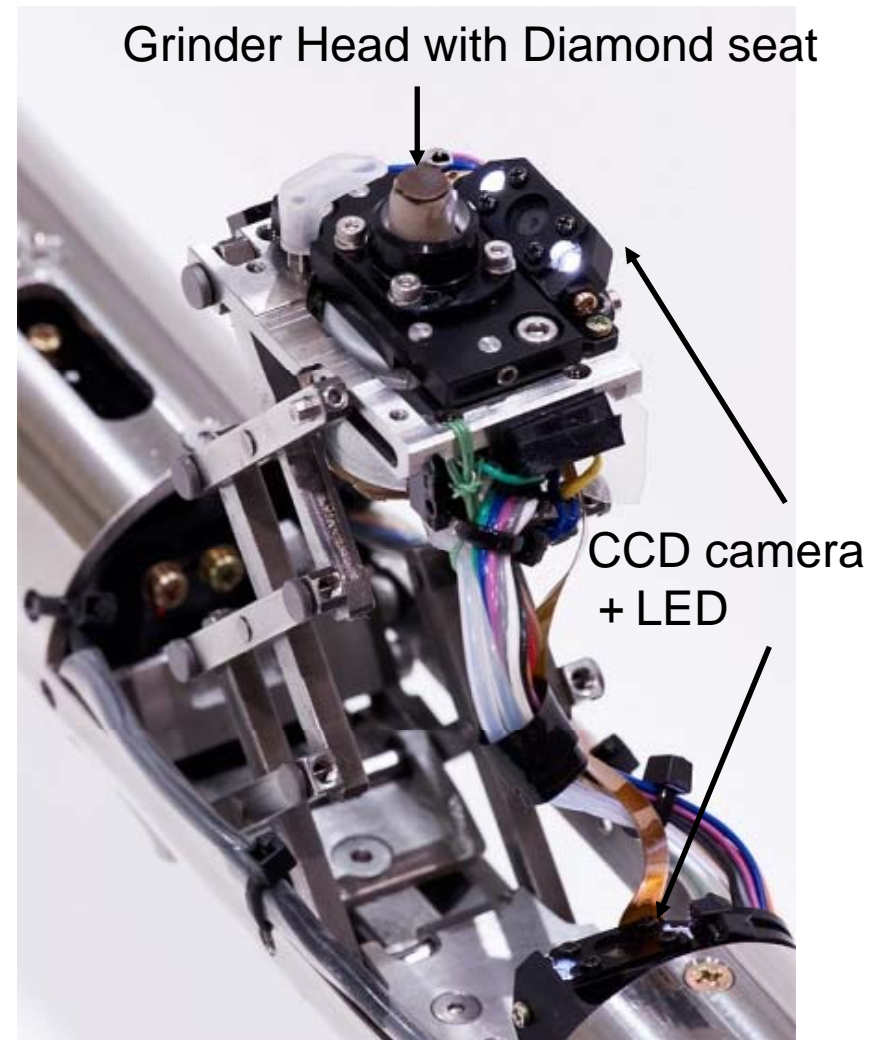
Motor

3000 rpm in 12 V
(unloaded)

Sensor



Grinder Head with Diamond seat

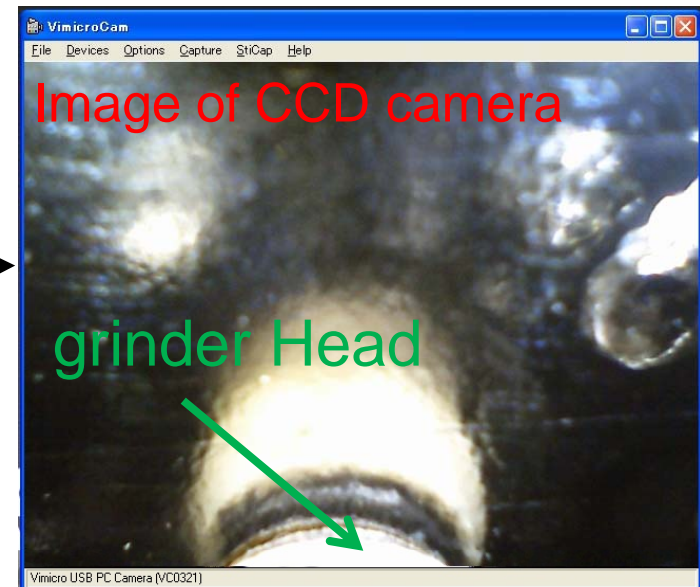
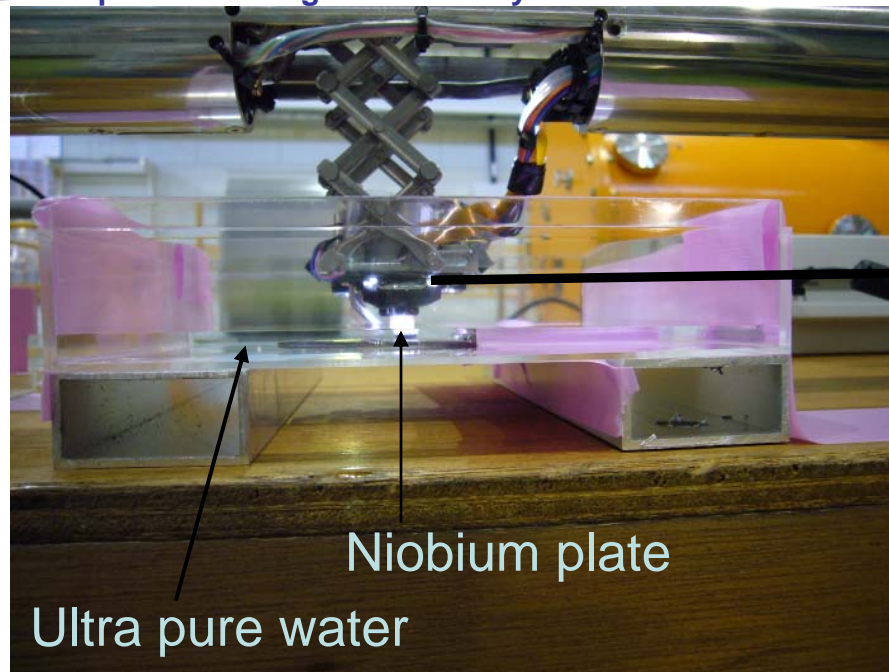


CCD camera
+ LED

**Grinding machine was delivered
from company in last week.**



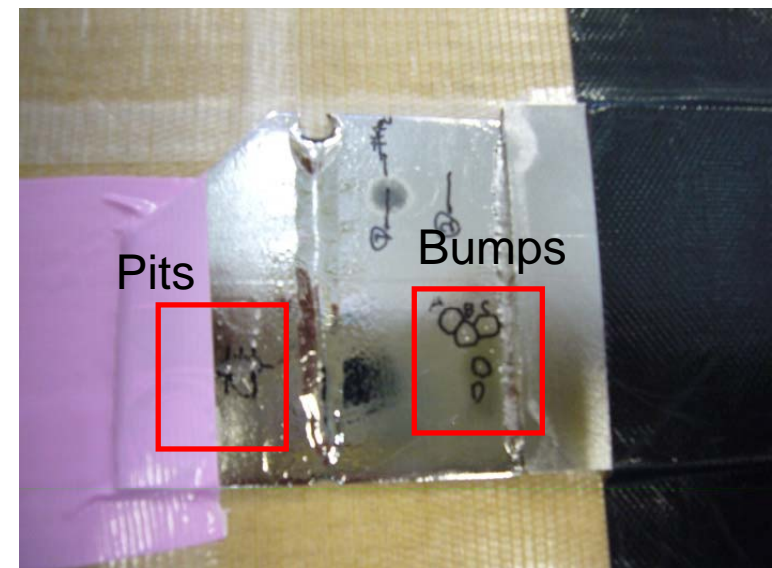
Setup of grinding



Material for grind : Diamond seat #400
(particle size = 40 ~ 60 μm), (POLYMOND)



Fortunately, the niobium plate has Bumps.
The grinding test of bumps was done by
using it.
As for pits, they were made by my self.

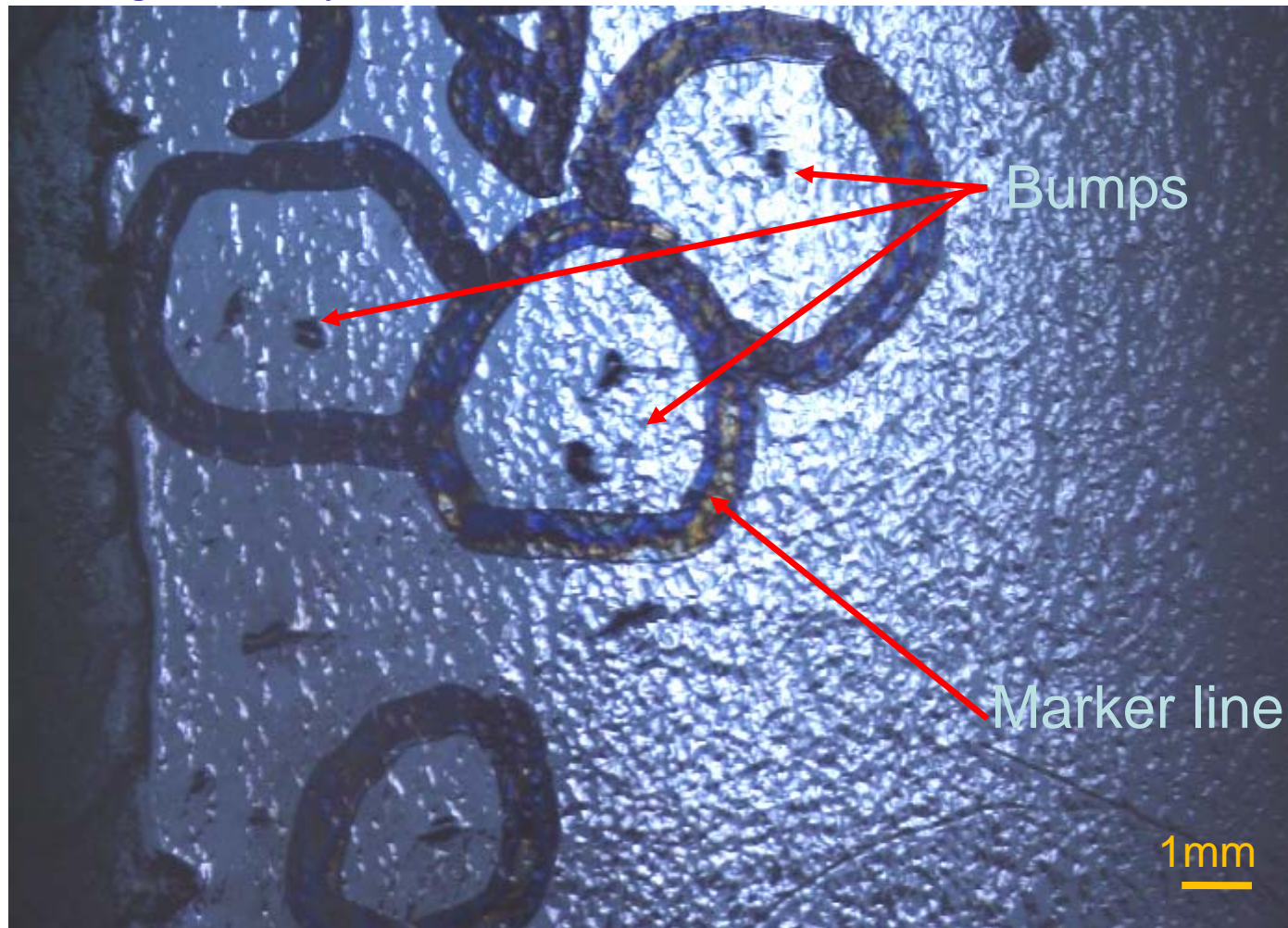


heat resistance resin Diamond particle





Bumps looked by Kyoto camera



Size of bumps : diameter = 200 ~ 350 μm , Height = 20 ~ 50 μm
(Checked by laser microscope and Kyoto camera)



superconducting rf test facility

Grinding Bump location (1)

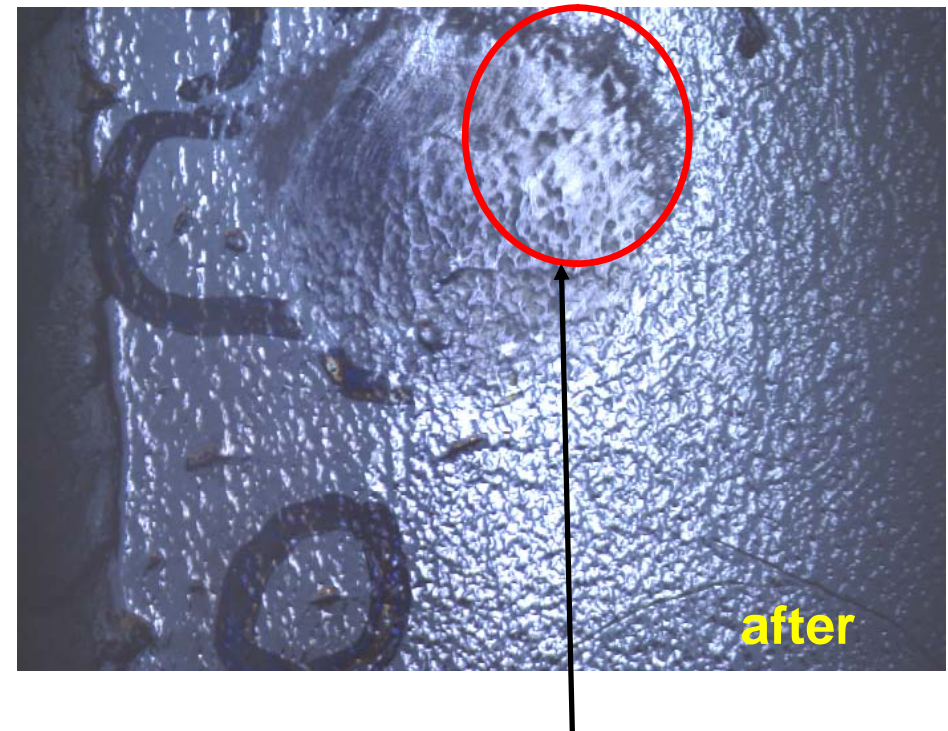
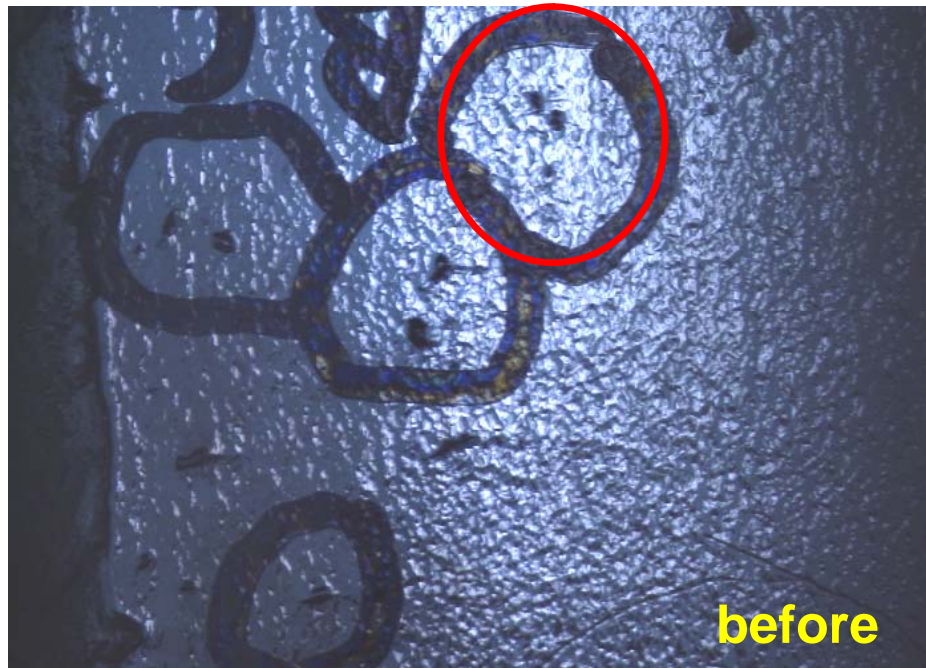


Condition (1)

Motor speed : 3000 rpm (unloaded)

Time : 10 min

Reference : Before grinding



Bumps were removed in the grinding area.



superconducting rf test facility

Grinding Bump location (2)

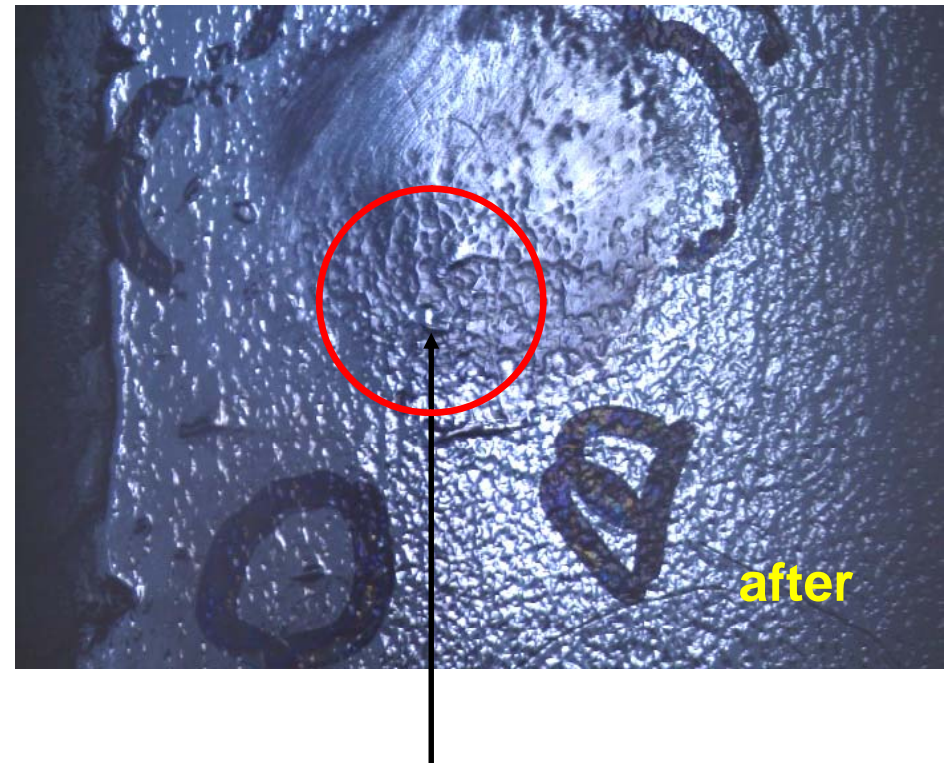


Condition (2)

Motor speed : 3000 rpm (unloaded)

Time : 10 min, change a grinding location.

Reference : after condition (1)



Bump became small, from 50 μm height to 15 μm height.



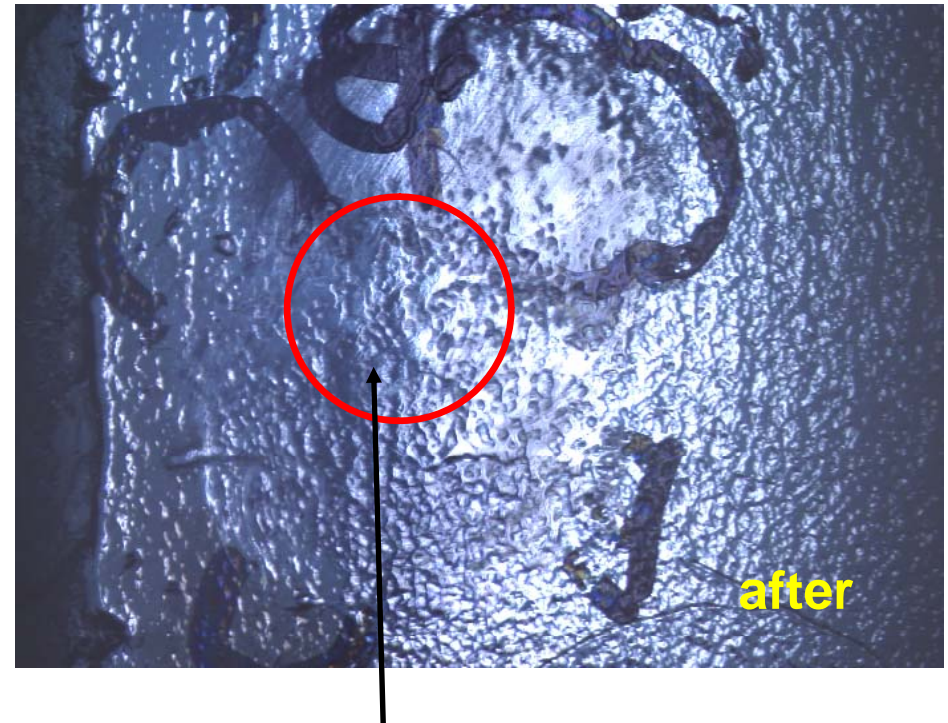
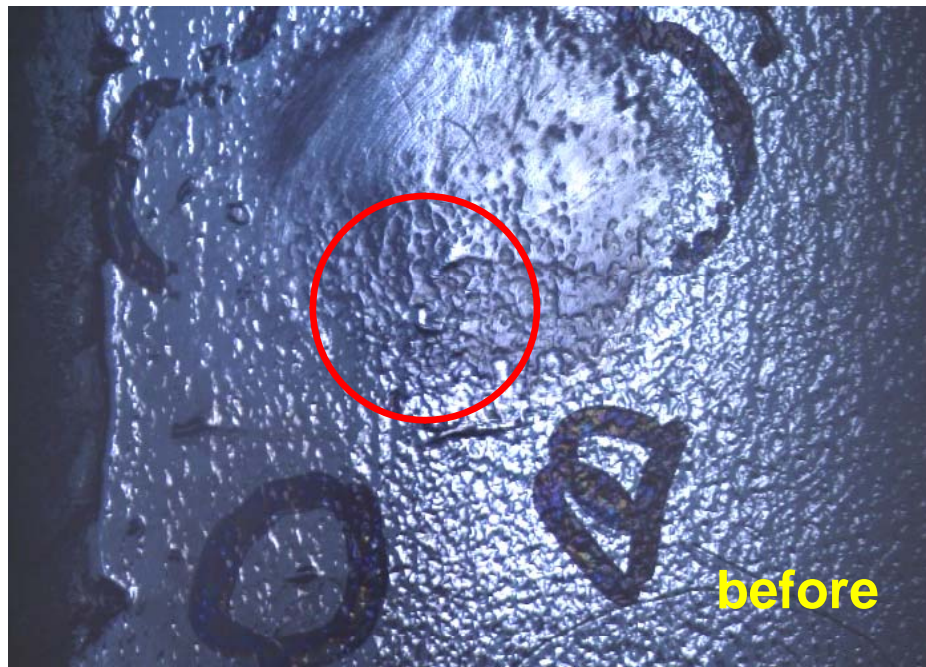
Grinding Bump location (3)

Condition (3)

Motor speed : 3000 rpm (unloaded)

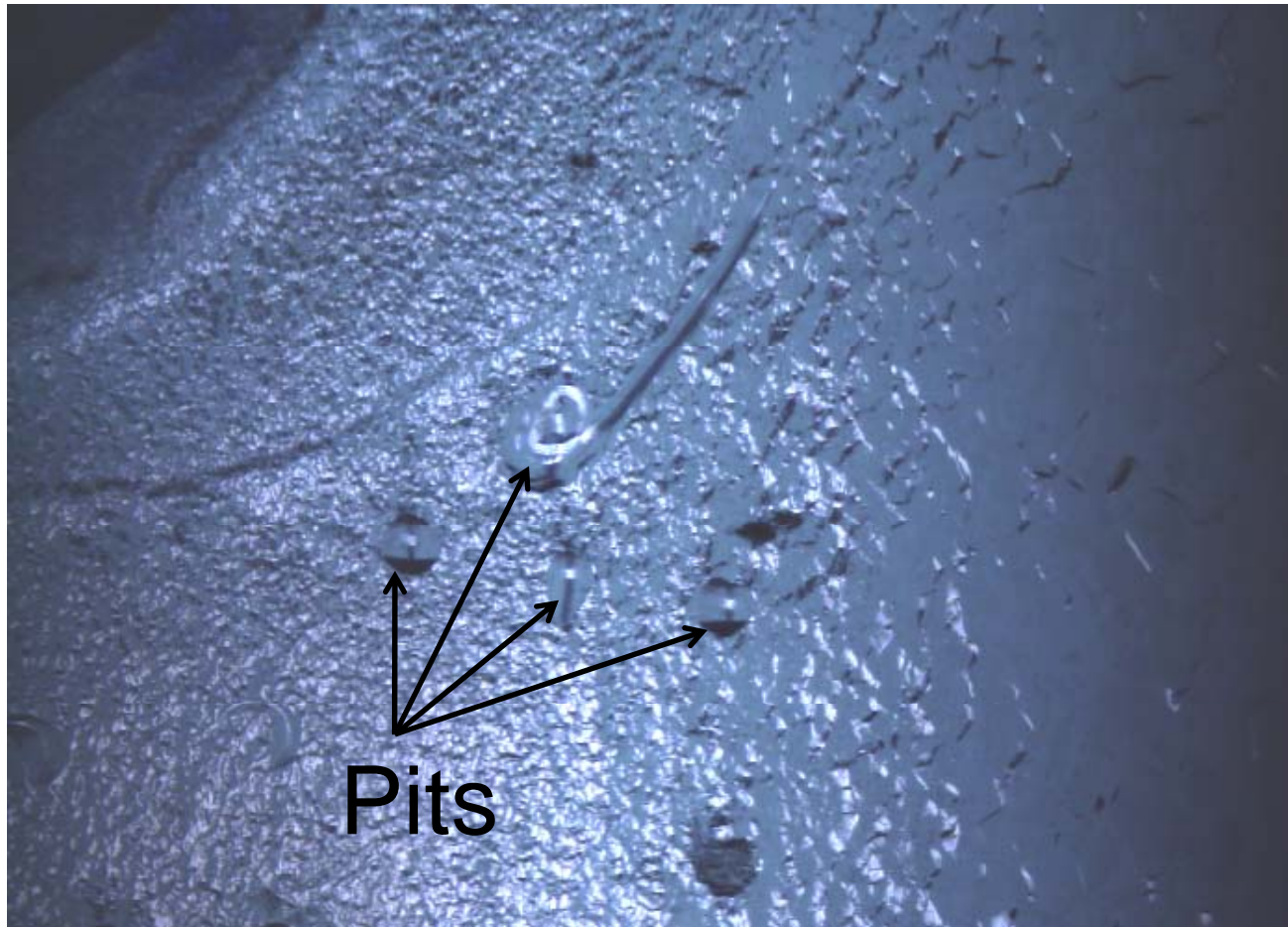
Time : 10 min, change grinding location again.

Reference : after condition (2)



Bump was removed.

Grinding bumps was easy, just 10 ~ 20 min.



Pits size : diameter = $\sim 600 \text{ um}$, Depth = $20 \sim 50 \text{ um}$

(Checked by laser microscope and Kyoto camera)



superconducting rf test facility

Grinding Pit location (1)

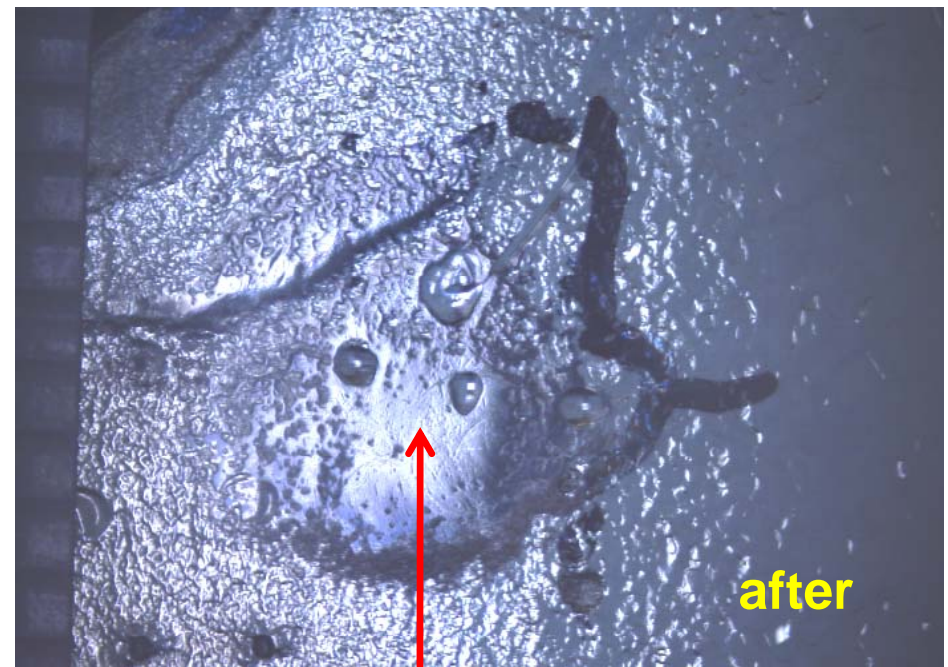
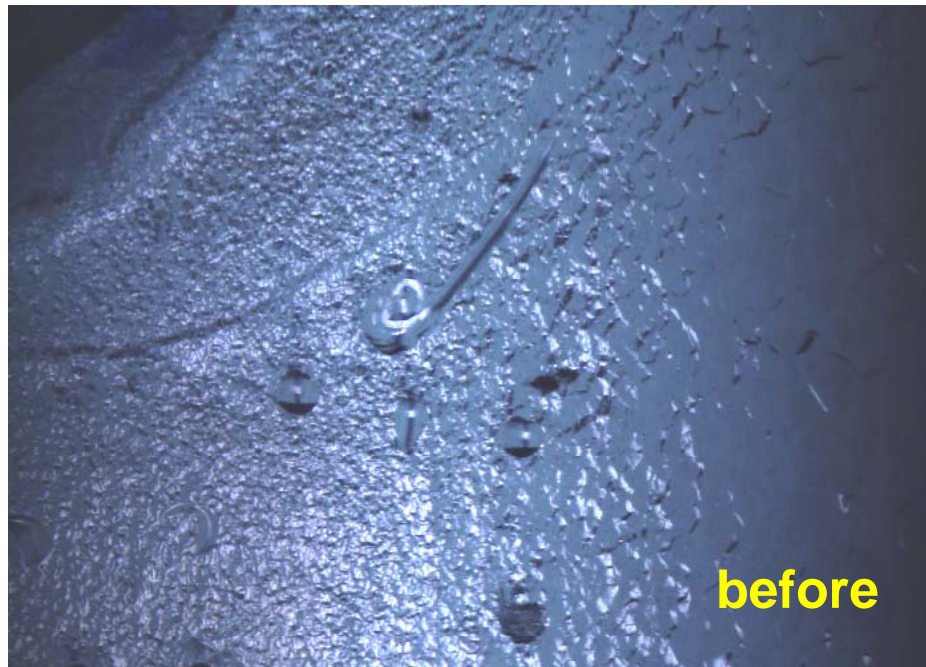


Reference : before grinding

Condition (1)

Motor speed : 3000 rpm (unloaded)

Time : 60 min



The amount of grinding was small.
Change a new diamond seat and try again a grinding.



Grinding Pit location (2)

Reference : after condition (1)

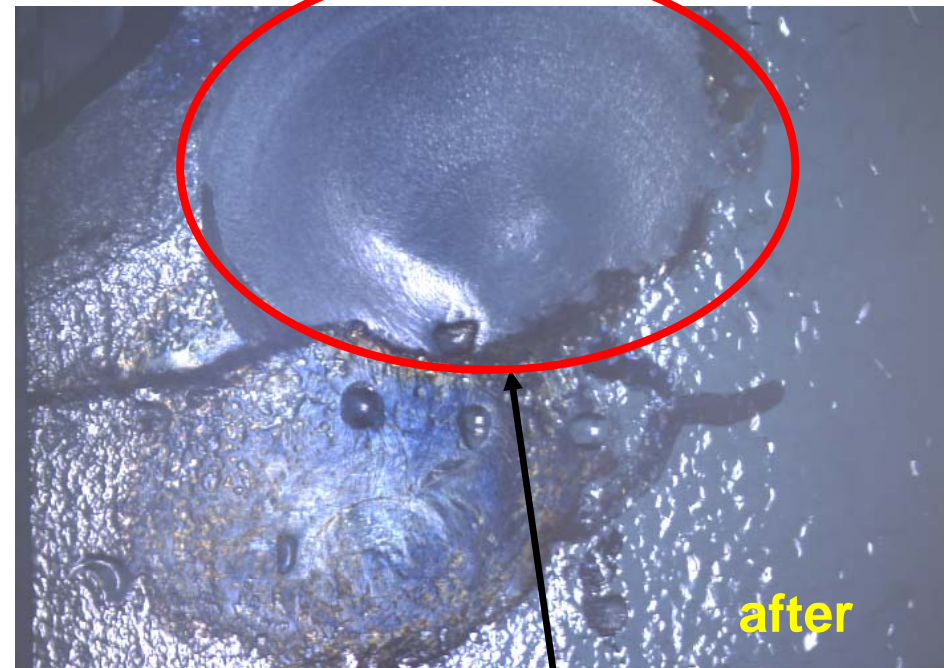
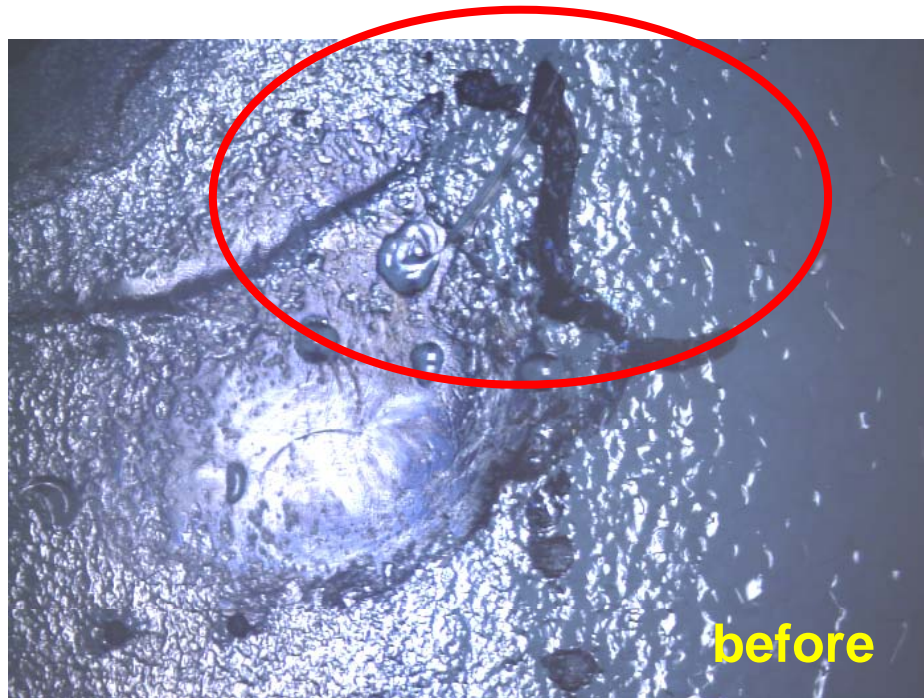
+ more grinding (45 min) before
changing New Diamond seat.
however, effective was small

Condition (2)

Motor speed : 3000 rpm (unloaded)

Time : 45 min

Changing New diamond seat (#400)



The amount of grinding was increased, however the grinding location was off the point.....

Grinding area



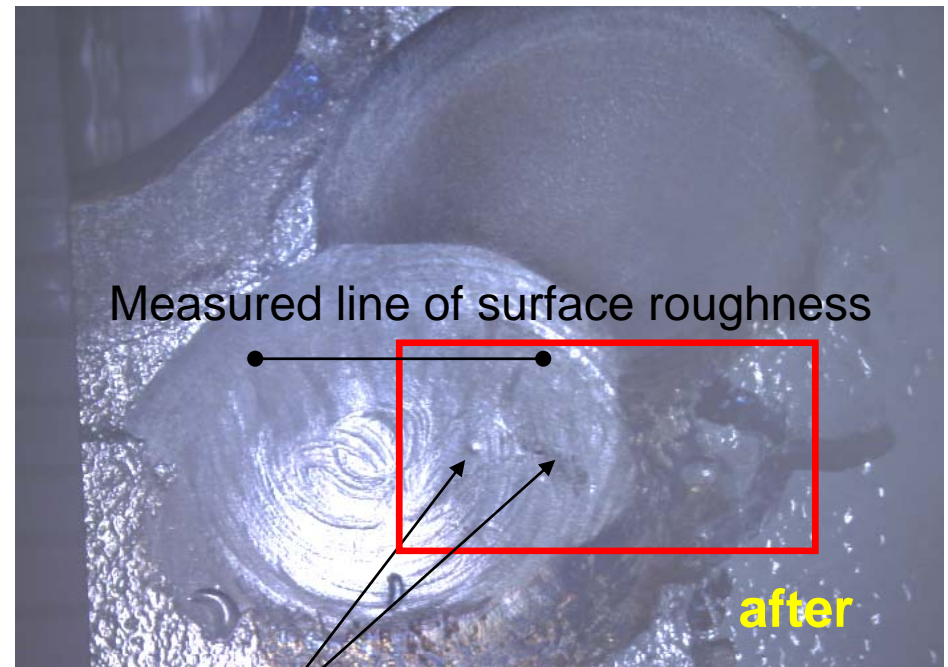
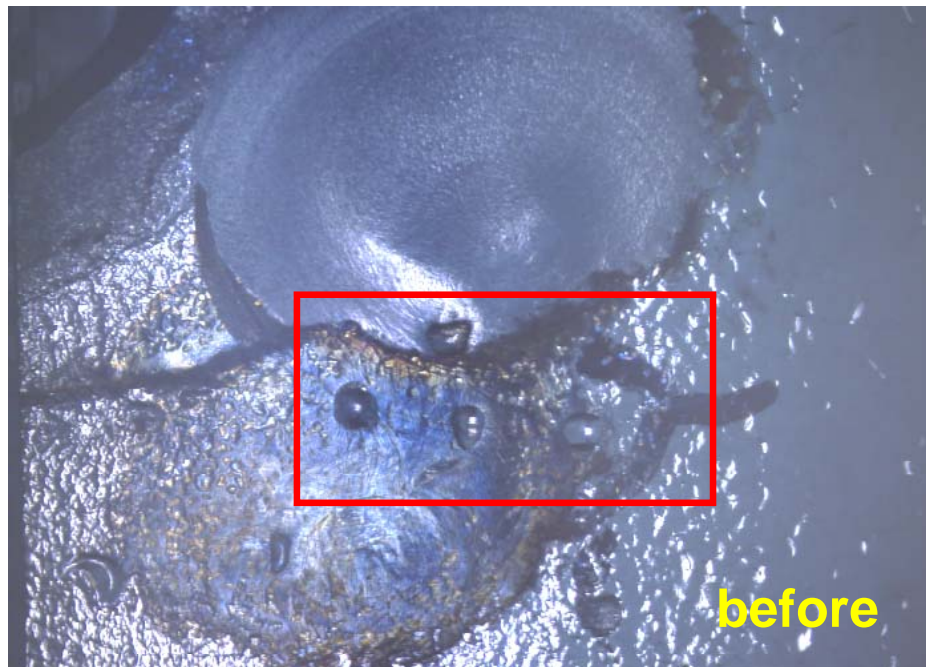
Grinding Pit location (3)

Condition (3)

Motor speed : 3000 rpm (unloaded)

Time : 30 min

Reference : after condition (2)



The Pits could remove at 30 min.

Try to measure a surface roughness in the grinding area.
Result is $Ra=1.34\mu m$, $Rz=8.32\mu m$ (ISO) .



The grinding machine study is started in Nov 2008.

We tried to grind using a Niobium sample plate.

Result :

Bumps and Pits can be ground with less than 30 min by using diamond seat #400.

Next step,

Improvement the grinding machine.

Optimization the grinding condition and tool.



Thank you your attention