FABRICATION ISSUES IN KEK

ISG8-WG4

Y.Higashi

Outline

1. Fabrication status of T20VG5N
2. Observation of etched surface of the couplers and DDS1,2 disk
3. Characteristics of H.P H_2O rinsed surface
4. Study of Cu-SUS clad disk
5. Surface studies

Study group

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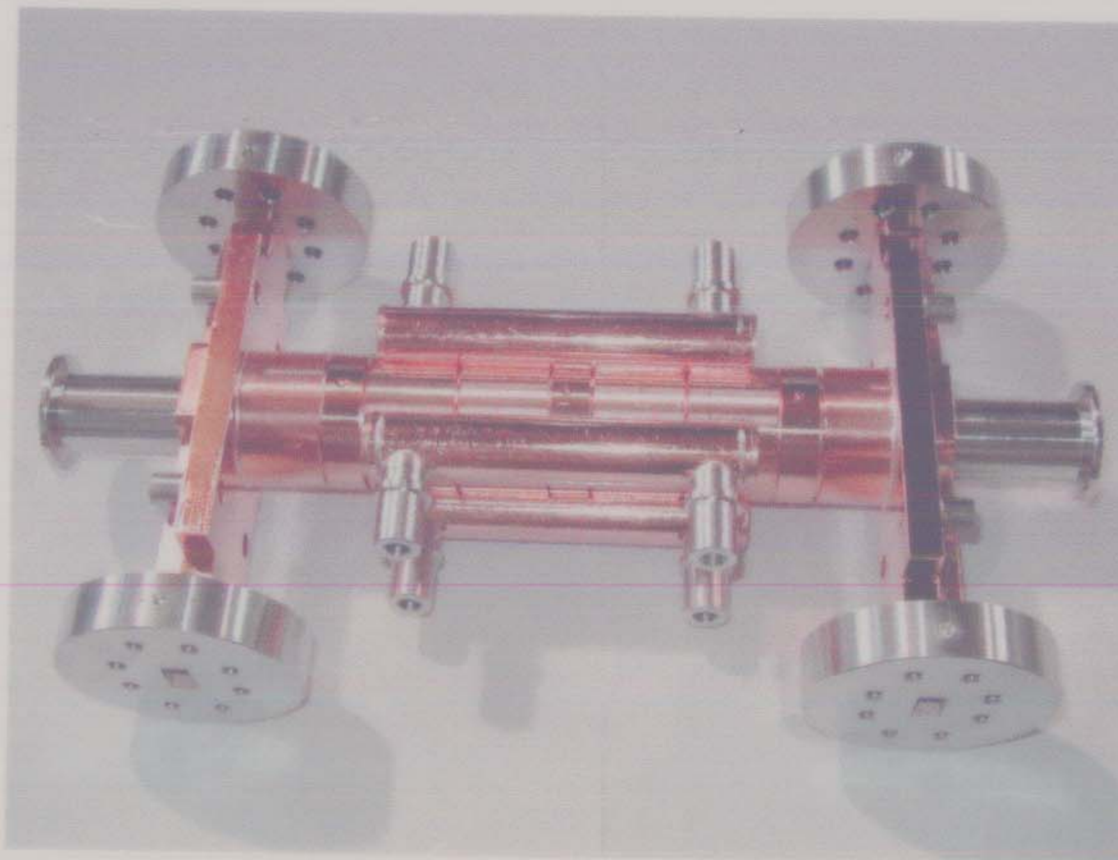
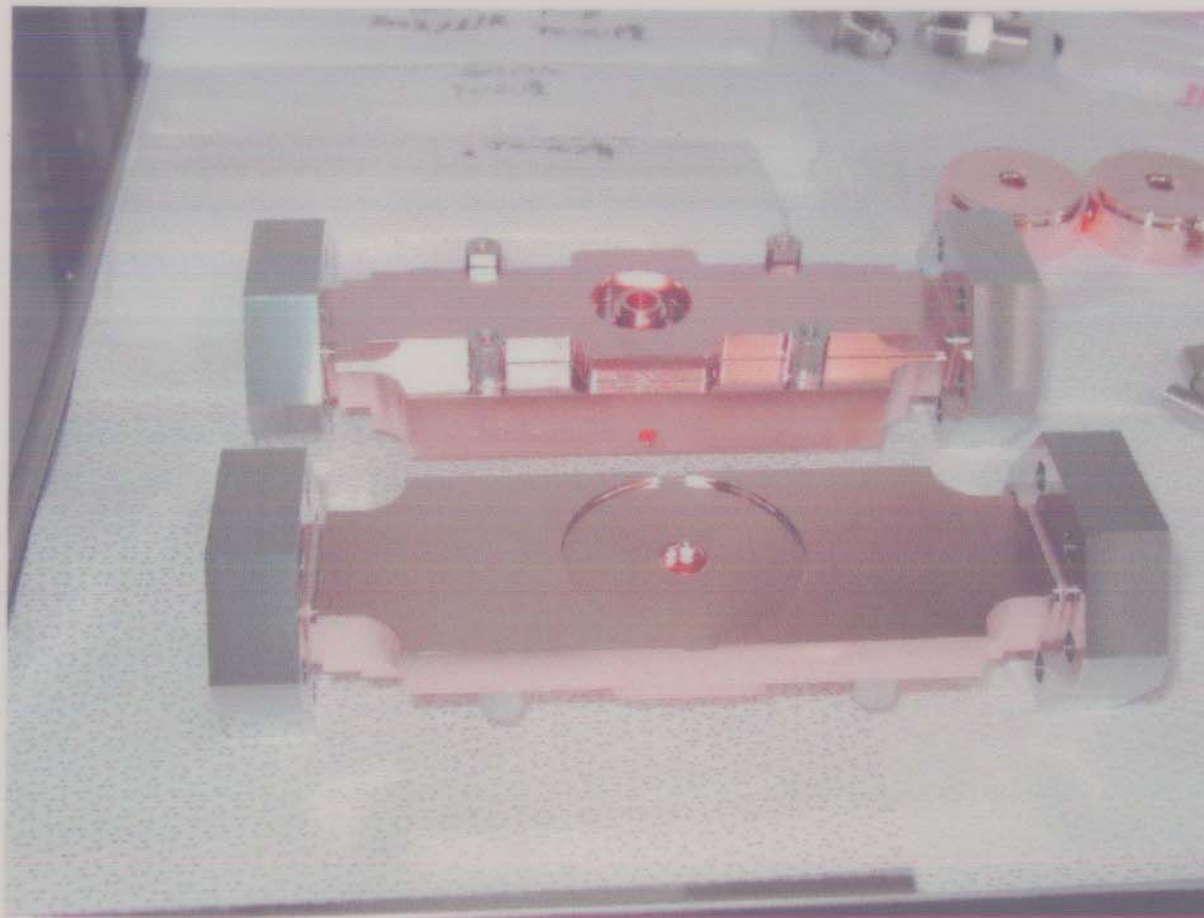
Fabrication status of T20VG5N

- @ Diamond turning of disks
- @ Particles control in assembling environment
- @ 15 second etching for disks
- @ 1 min etching for couplers
- → @ Hydrogen brazing
- @ Glassy carbon characteristics

20 cm model structure for lessons of brazing techniques



Input and Output coupler for T20VG5N

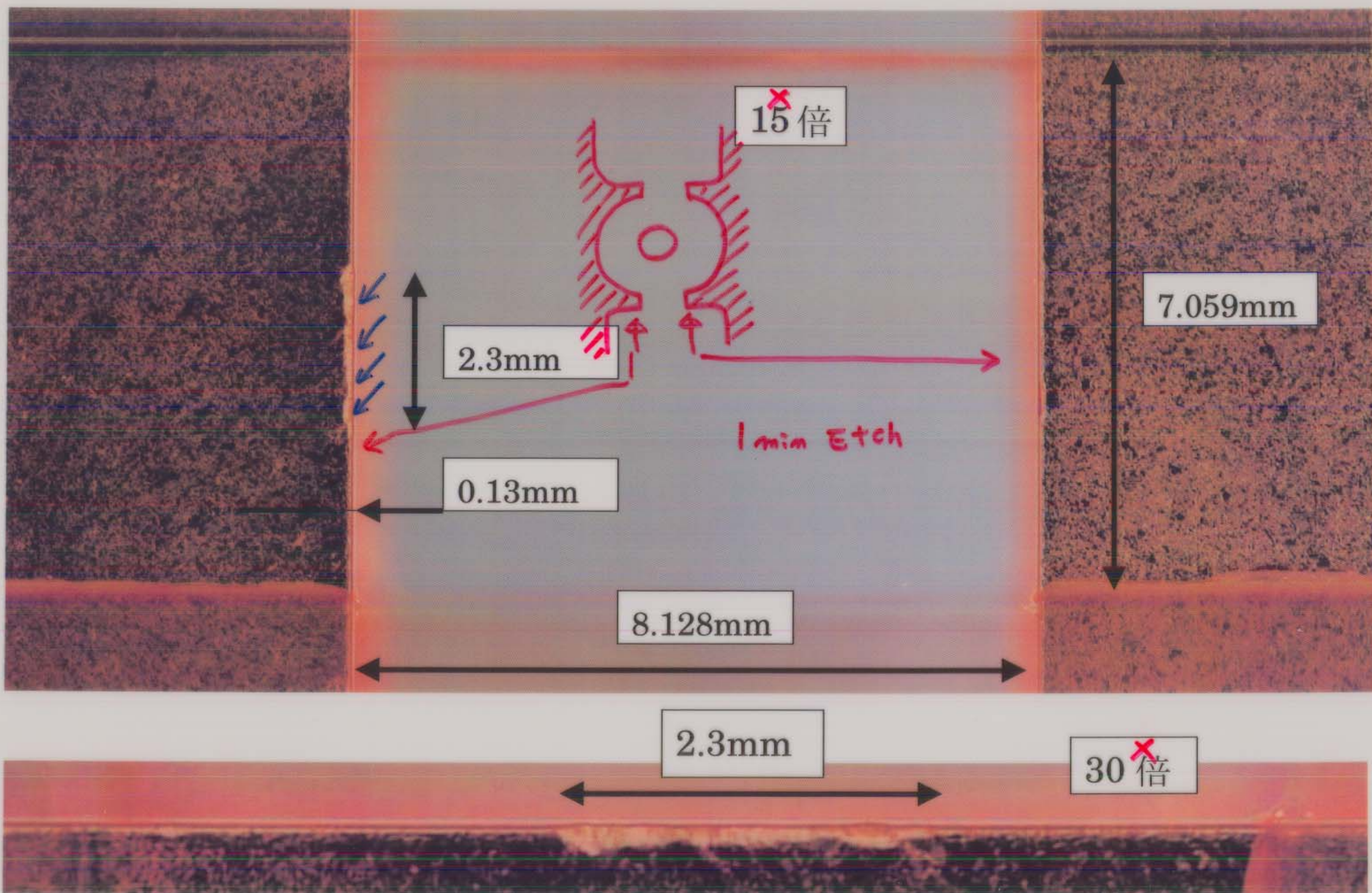


8.128mm

カプラー本体 body

プレート plate

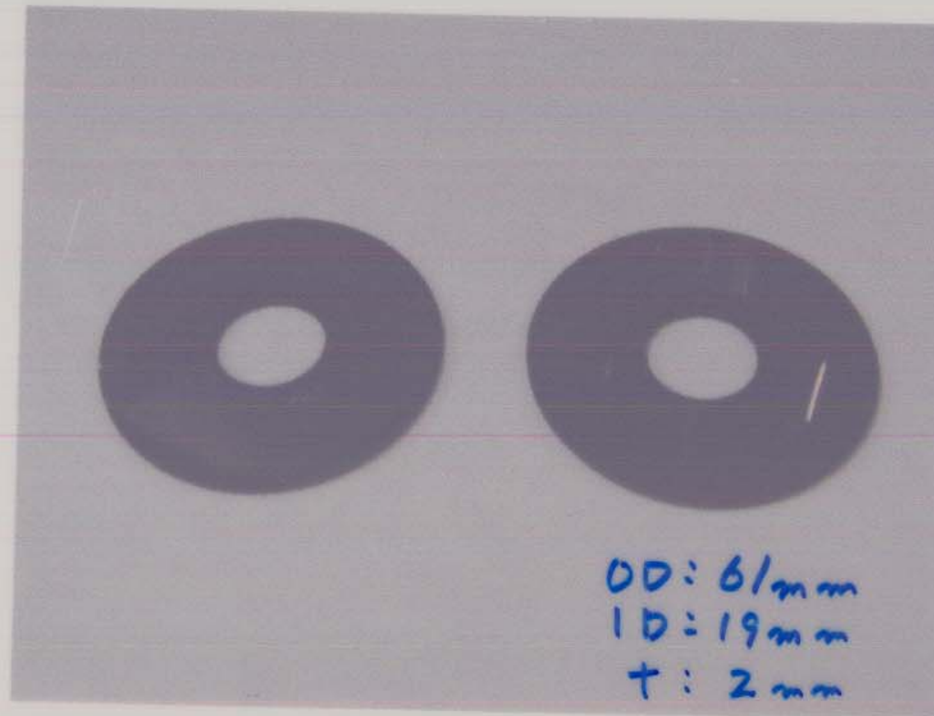
21倍


15倍
7.059mm
2.3mm
1 min Etch
0.13mm
8.128mm
2.3mm
30倍

Properties of grassy (amorphous) carbon plate

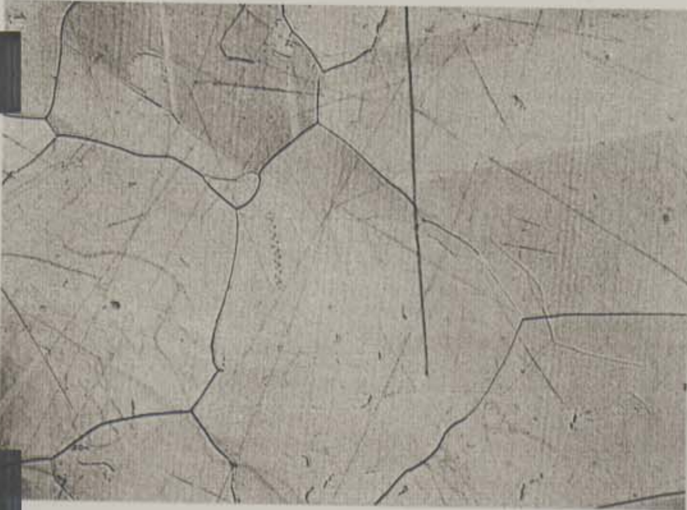
Density: 1.57, Strength: 200Mpa, Thermal expansion: 4.3xe—6,

Rate of gas through: none, Roughness: 10 nmRy, Flatness: 5μm



Contacted surface

* Seems to be smoother than graphite material
* Do not have clacks and powder particles
* Need more test



Good slipped region on the copper surface

100 μm

Bonding region on the copper surface

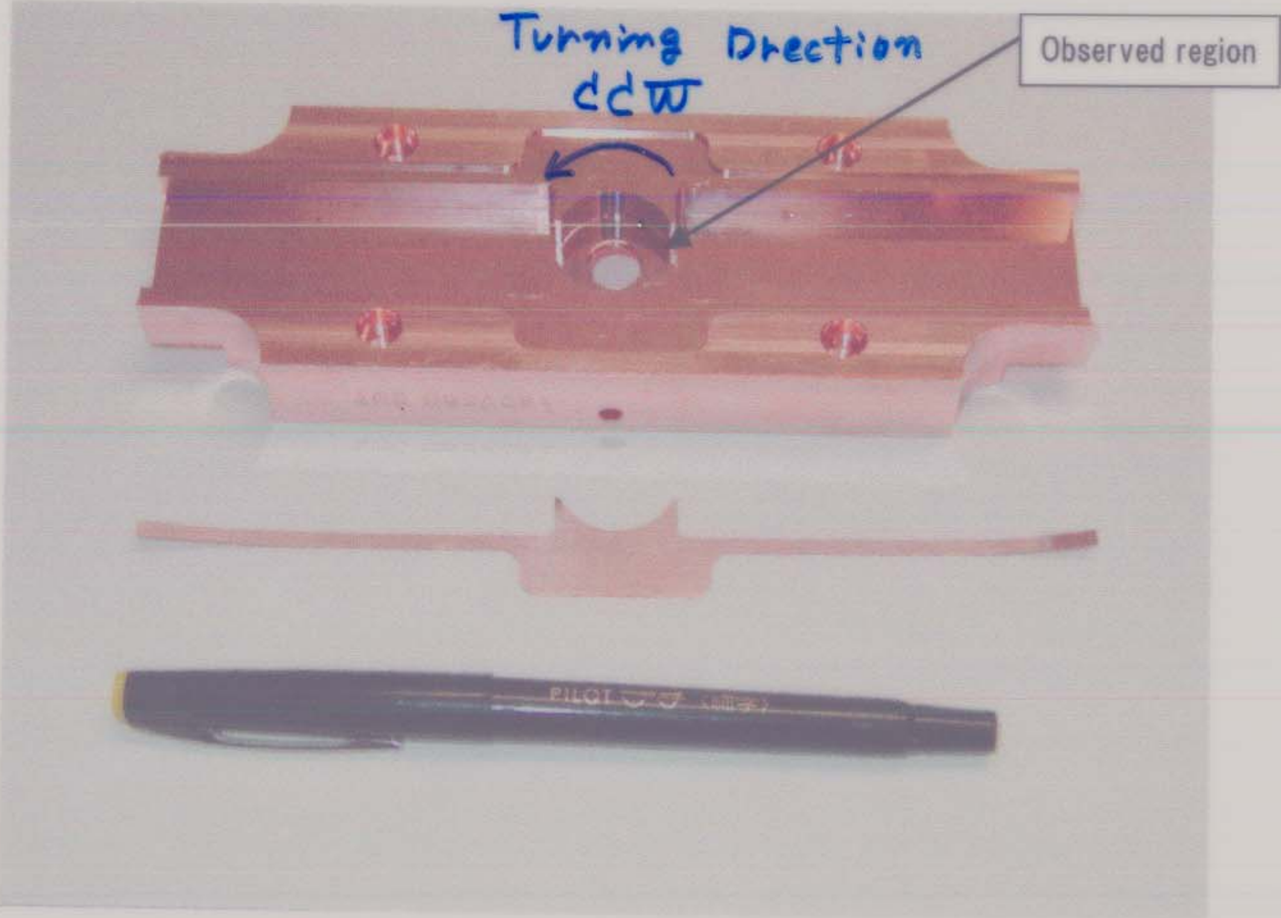
Observation of etched surface of the Couplers for T20VG5N, DDS1,2

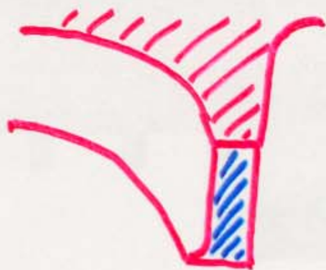
@ Burs of the iris region by machining

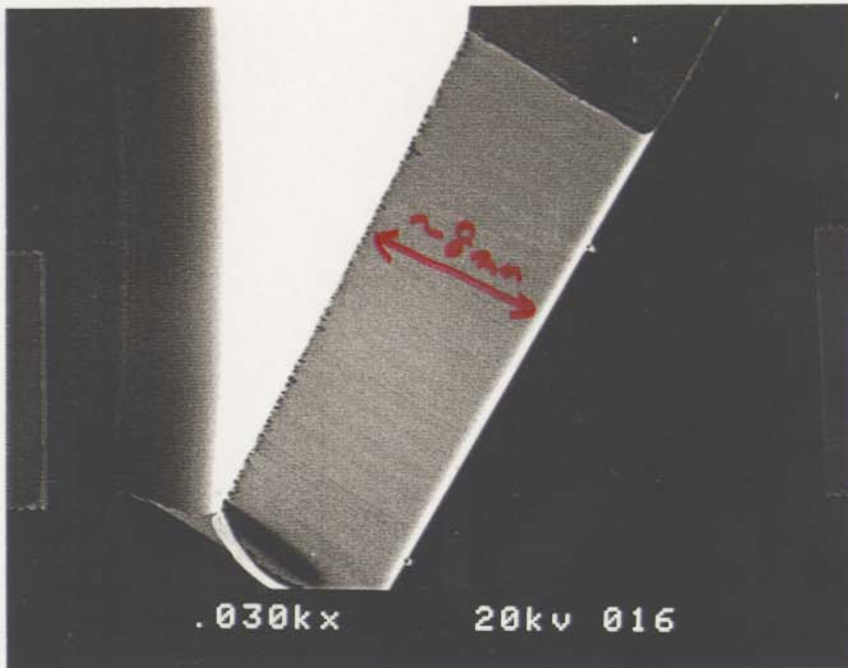
@ Burs removing by etching

@ Particles reduction due to etching

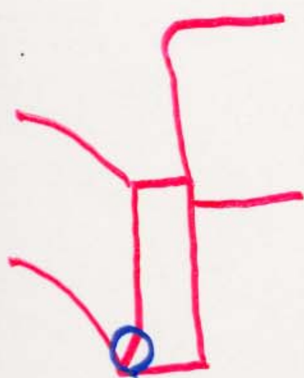
Observation of the coupler iris by SEM

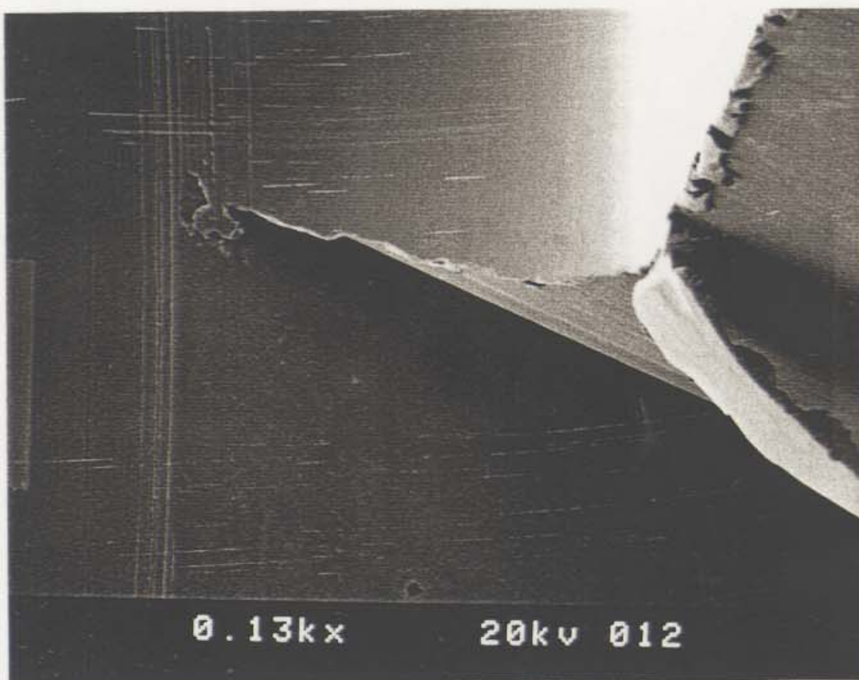


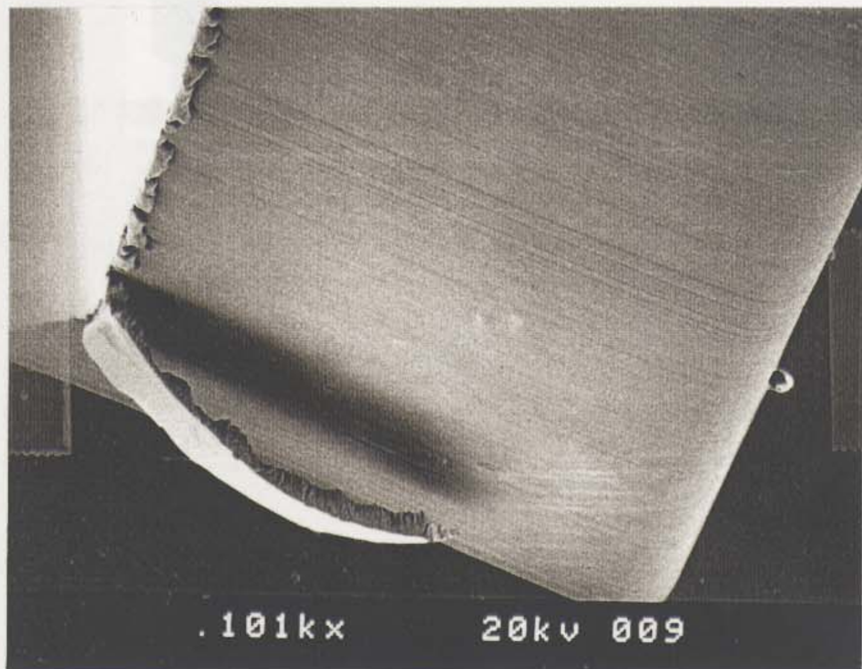




AS Machined

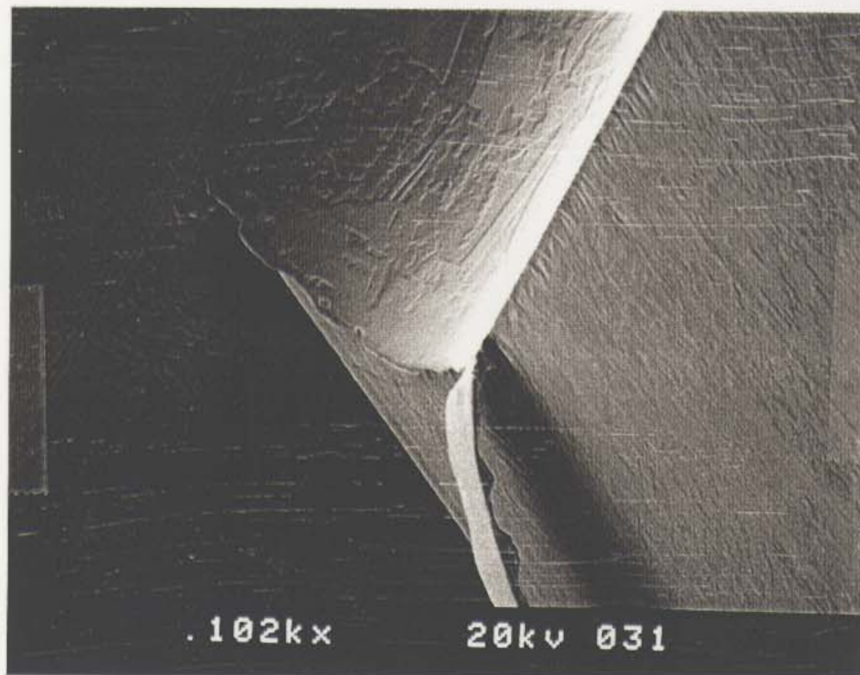






As Mchined

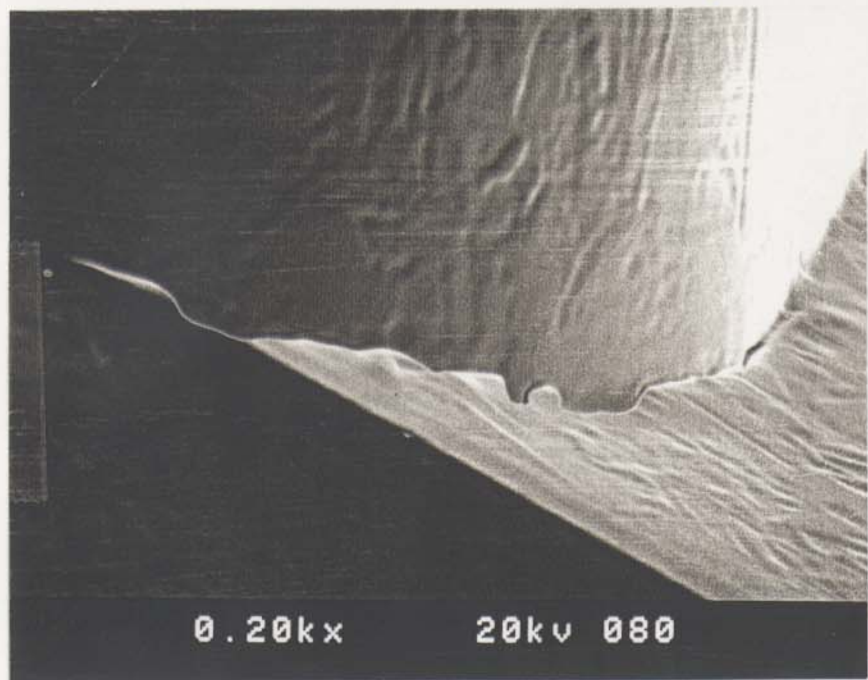
100μm



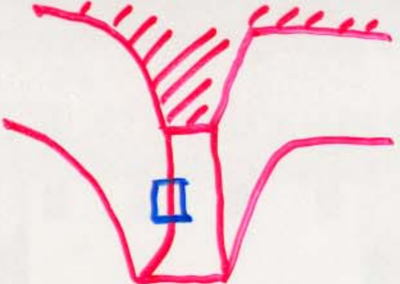
30 sec Etch

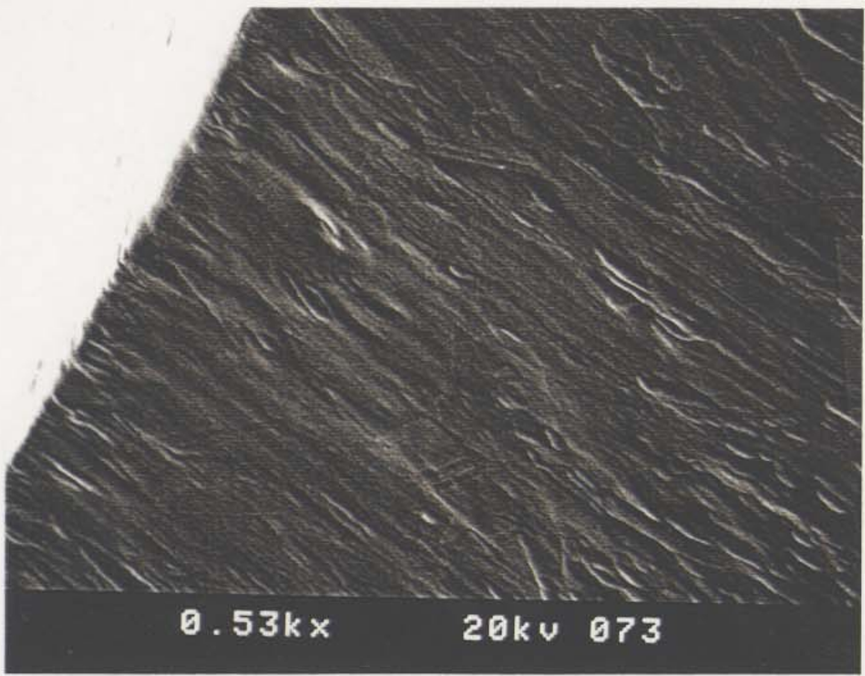
1 min Etch

50μm

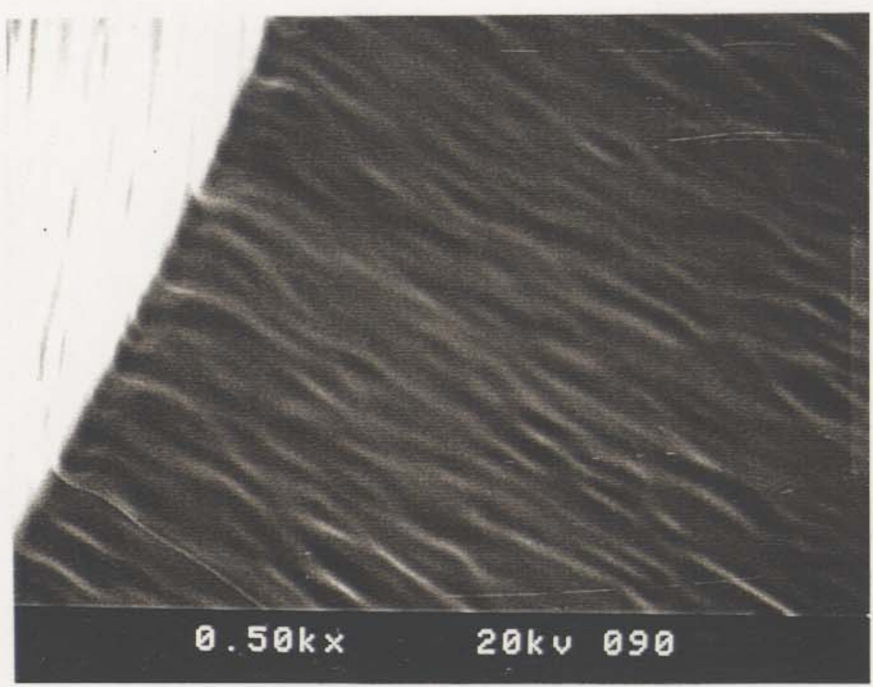


H_2 Baking ~1030°C 20min

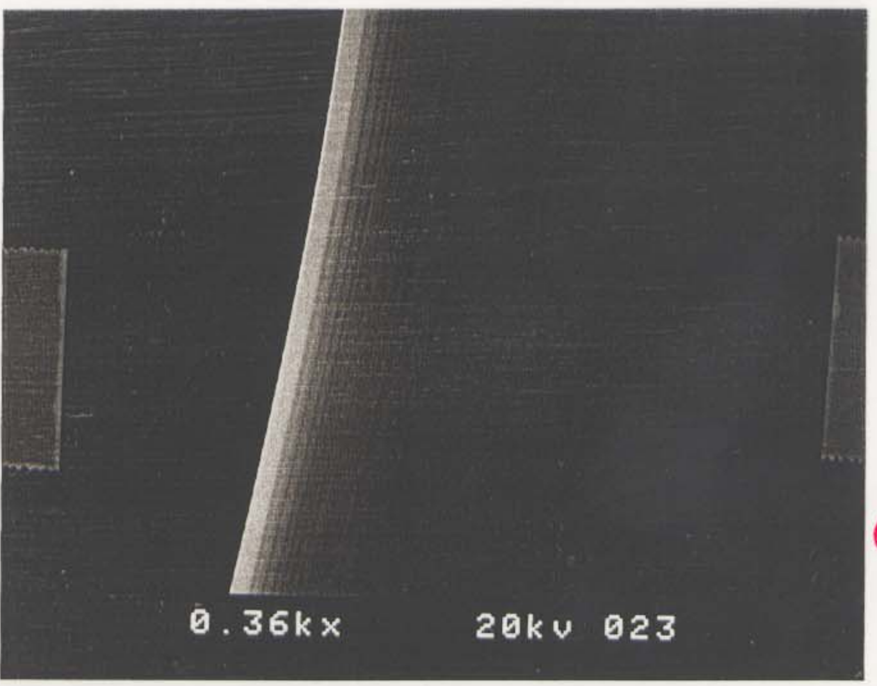




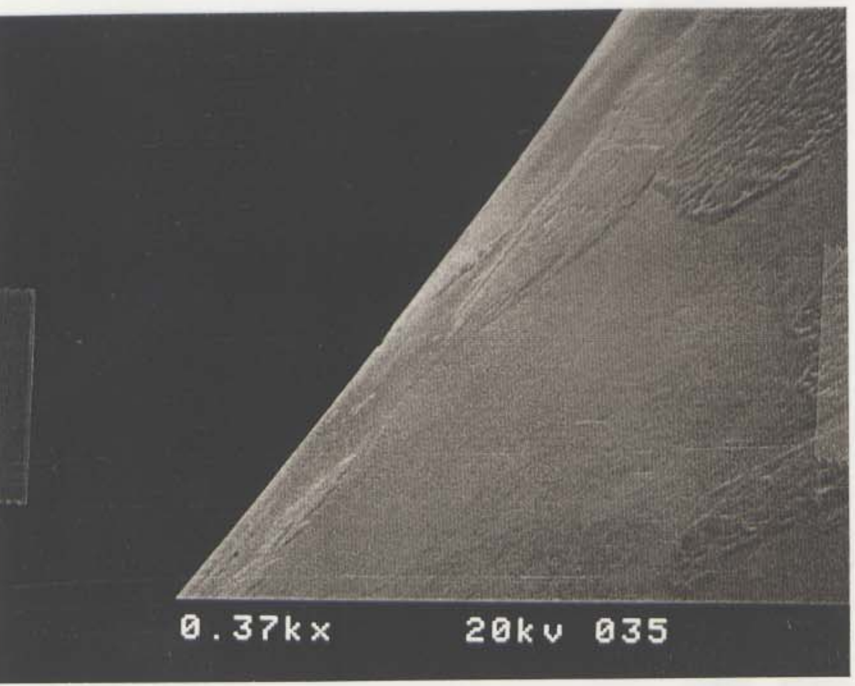
20 µm



2a Iris of Coupler

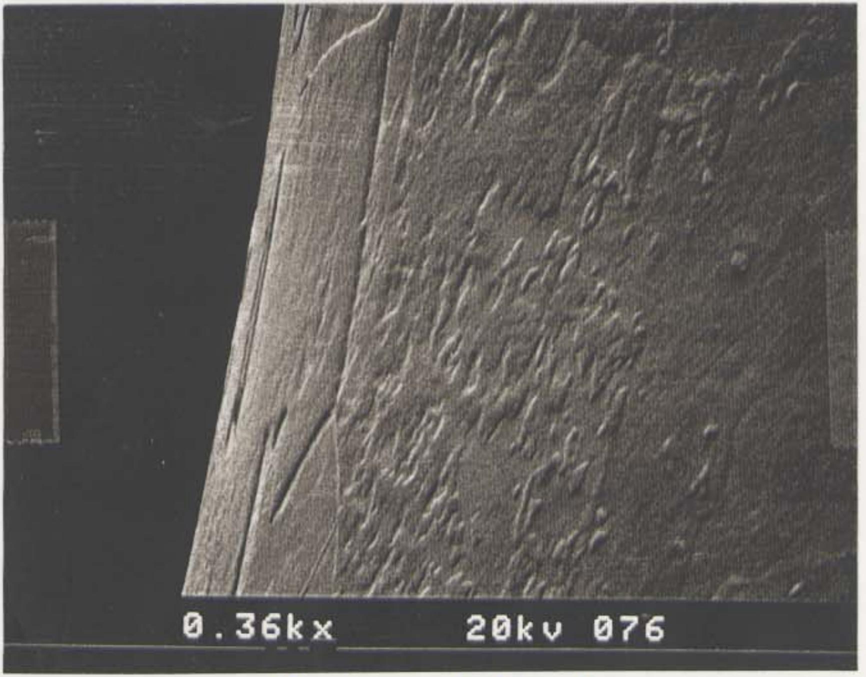


AS Machined

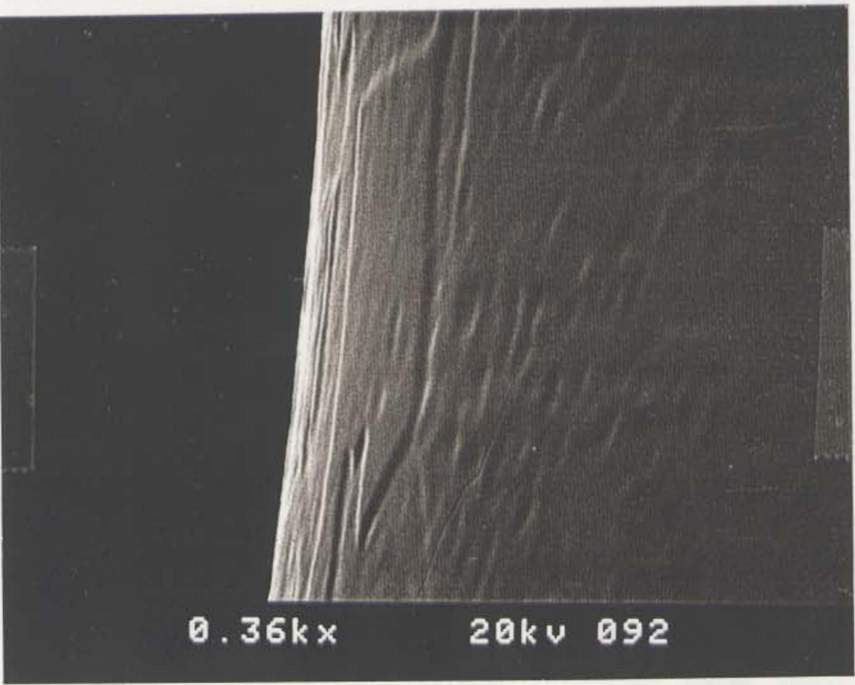


30 sec Etch

30 µm



1 min Etch



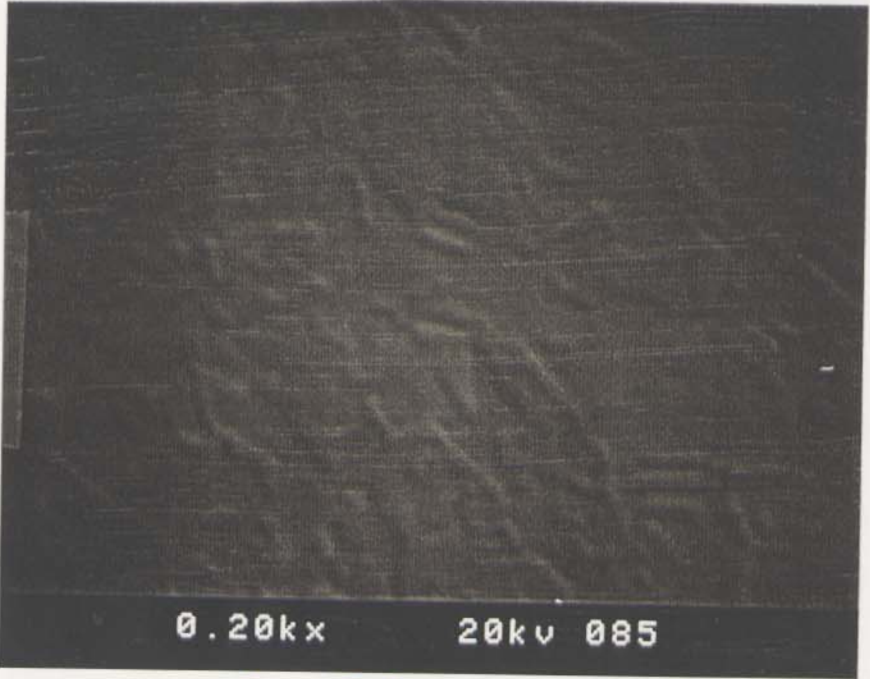
H_2 Baking

AS Machined

50 µm

30 Etch

1 min Etch

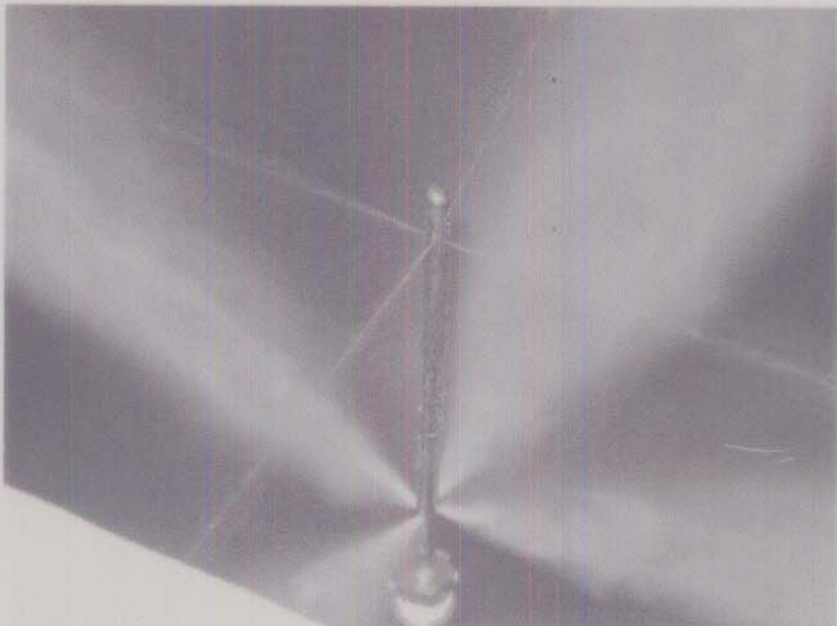


H_2 Baking

Rinsing test of disks

Rinsing test of model disks

Hole dia.: 200 μm, 4 holes, pressure: 5Mpa

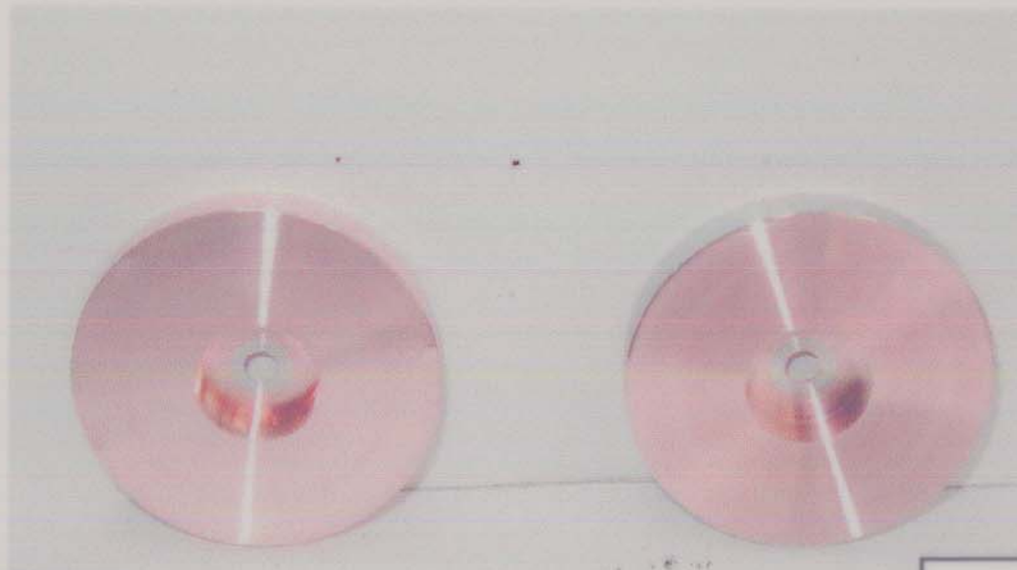


Study of Cu–SUS clad disk

- @ Heat shrinking and diffusion bonding
- @ Copper plating on SUS disk

Study of Cu–SUS clad disk

(Heat shrinking and diffusion bonding) (Copper plating on SUS disk)



Heat shrink 200degC
Diffusion bonding
1030degC, 30min in H2

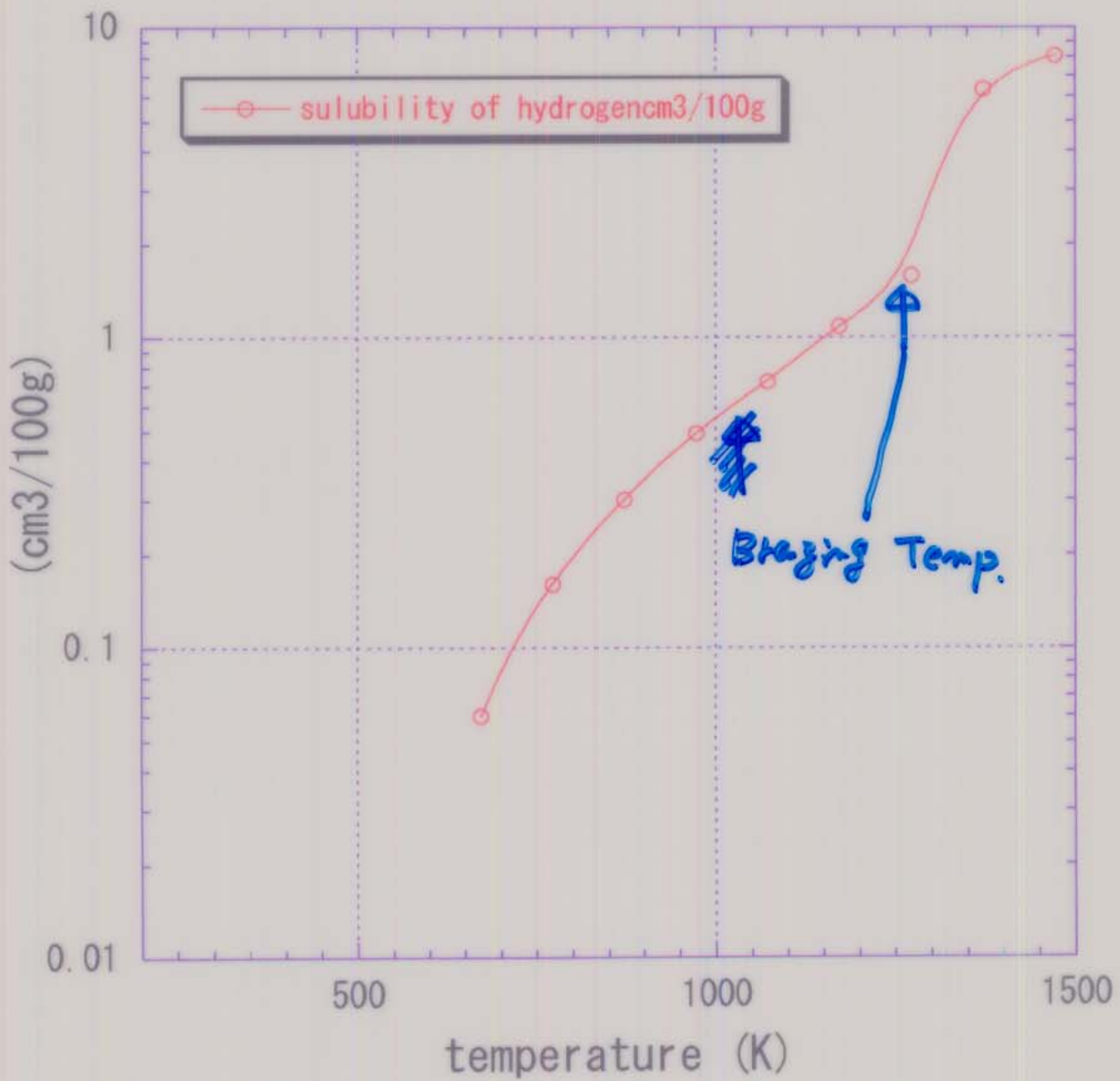
Ni strike on SUS 2 μm
Thickness of plating
400 μm

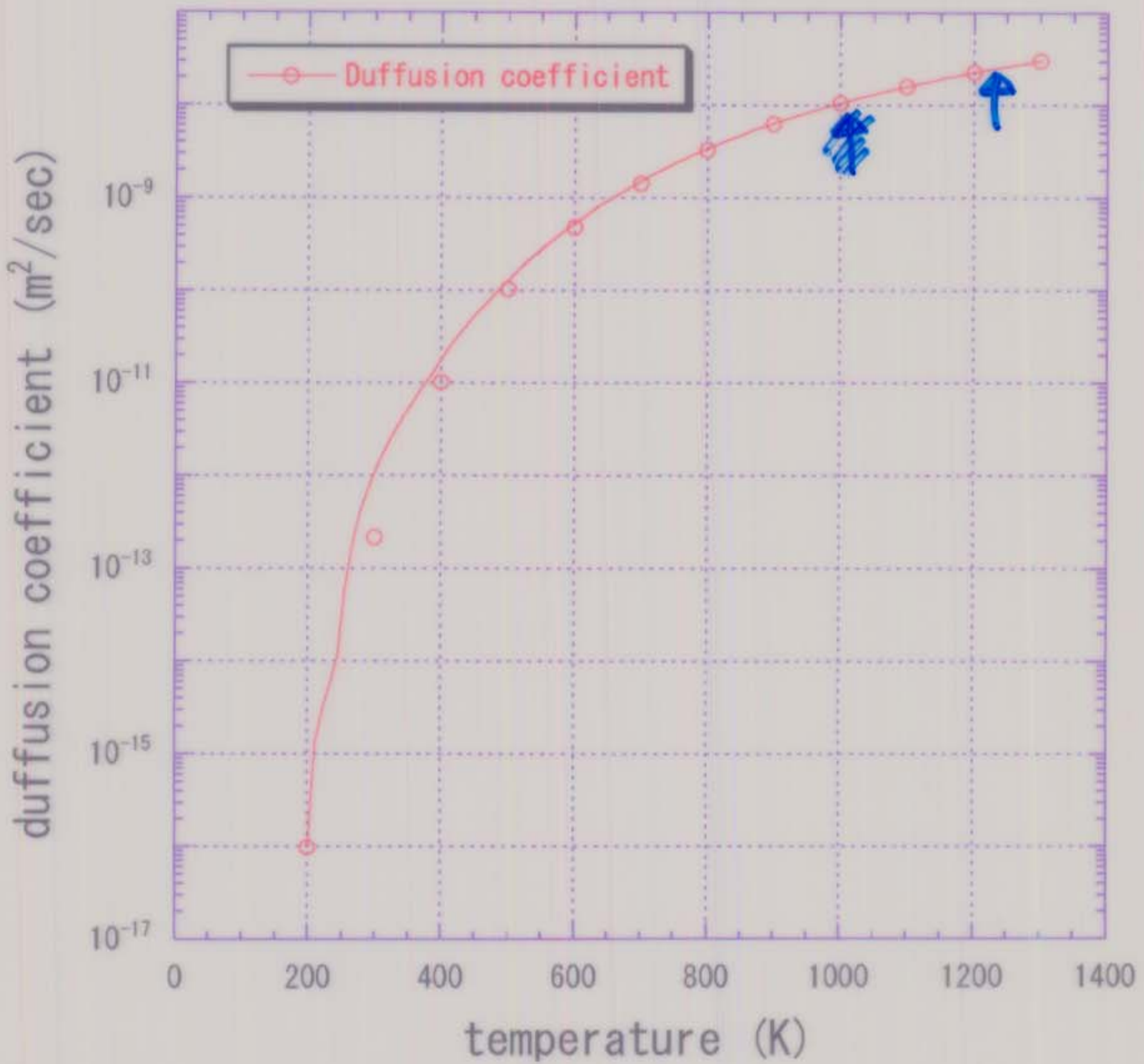
20μm shrink

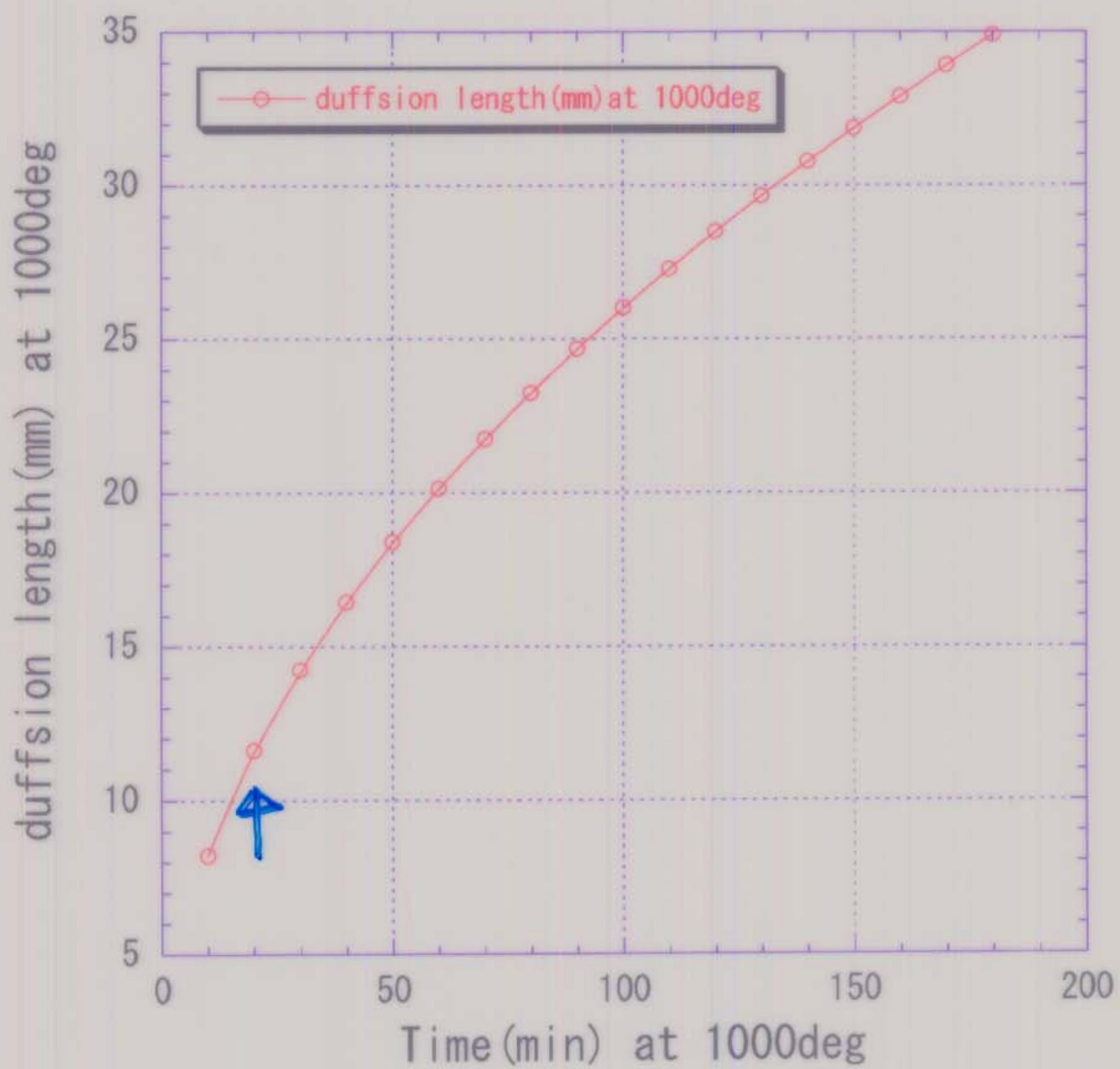
Surface studies

- @ Diffusion of hydrogen through copper
- @ Surface characteristics of etched surface
- @ Decomposition of Cu_2O

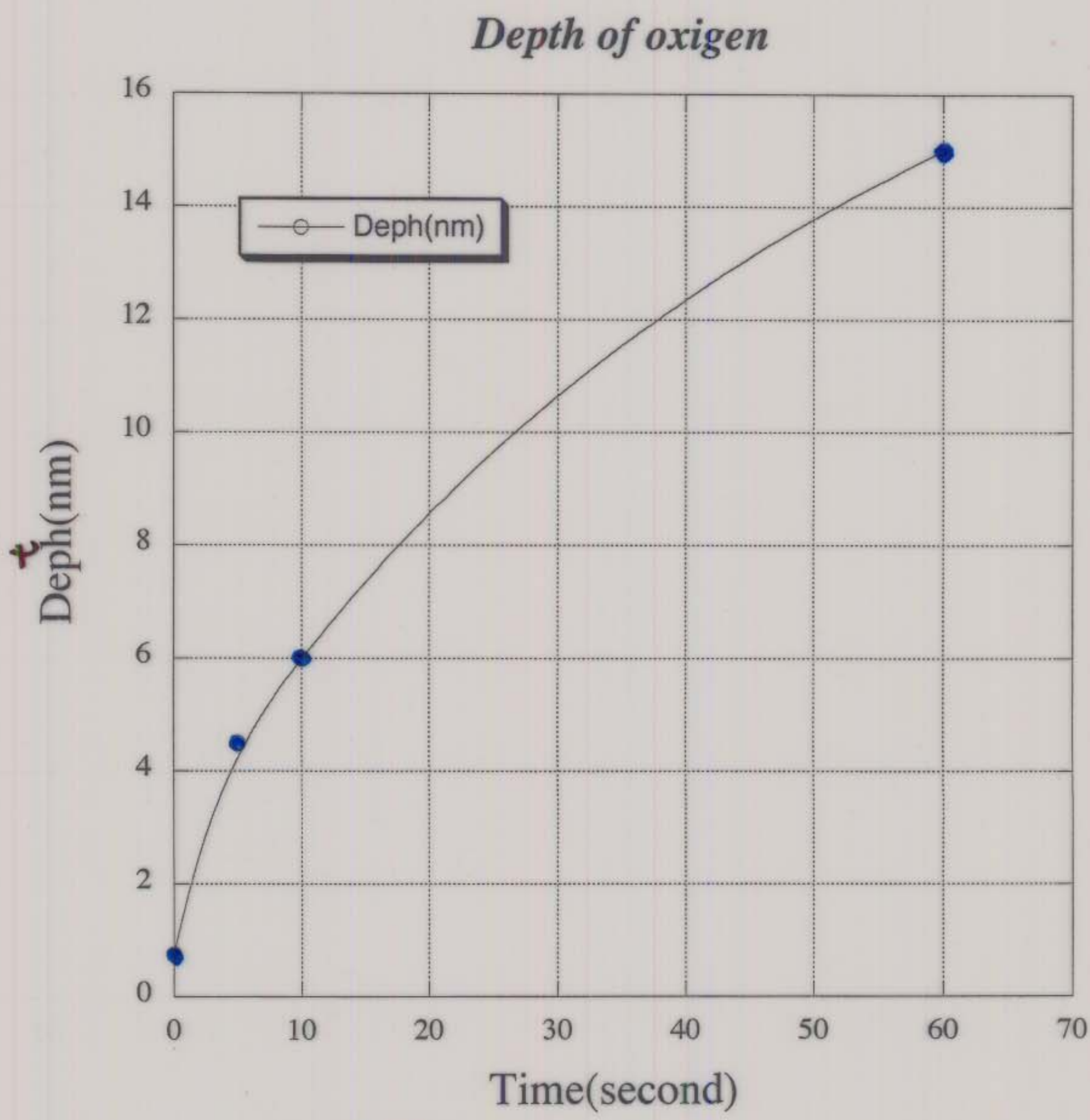
sulubility of hydrogen at various temperature




elevated temperature diffusion
coefficient of H2 to copper
Duffusion coefficient
duffusion coefficient (m2/sec)
10-9
10-11
10-13
10-15
10-17
0
200
400
600
800
1000
1200
1400
temperature (K)



Diffusion length of H2 through copper
plotted versus length, time
duffsion length(mm)at 1000deg
duffsion length(mm) at 1000deg
Time(min) at 1000deg
35
30
25
20
15
10
5
0
50
100
150
200



Depth of oxigen
Deph(nm)
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
Time(second)
ETCH TIME

せず、工業用によく用いられている真空炉が 10^{-5} Pa であることや、精密加工したディスク面をあわせた時のギャップのもつコンダクタンスが非常に小さくて実効的にギャップ間の真空が更に悪いことを考えると、真空中での表面酸化層の酸素解離による銅同士の直接接合は困難であることがわかる．図１５には何らかの方法で銅の表面に付着した Cu_2Oを取り除いた時の酸化反応を示すが、銅は簡単に酸化し、表面にCu_2Oを生成することが判る．そうすると、前節で述べた単純な拡散が支配的でなくなることが充分考えられ、接合がブロックされる可能性がある．

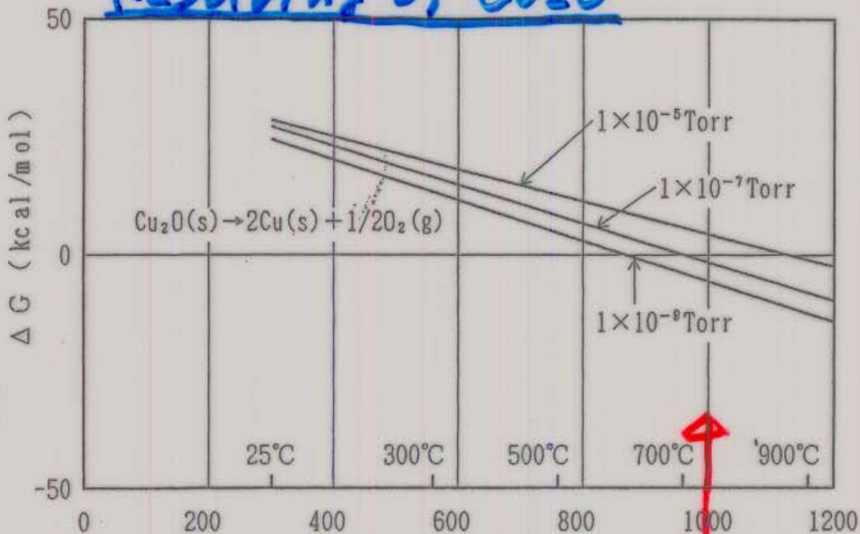


図１４　Cu_2Oの分解

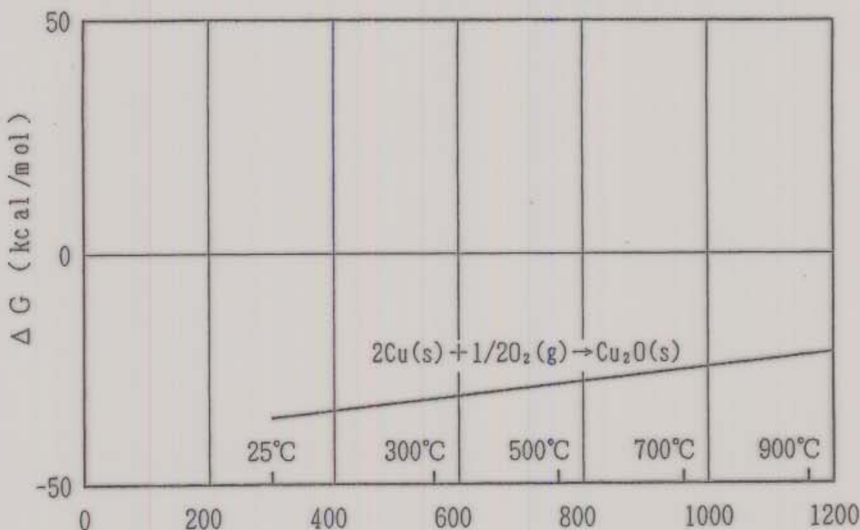
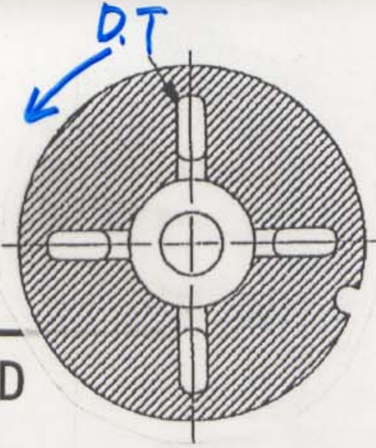


図１５　銅の酸化

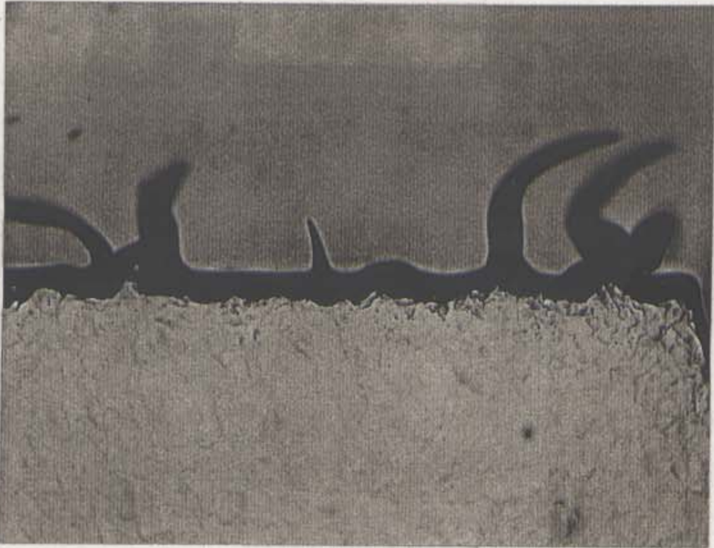
Observation of etched and H.P rinsed surface
Of the DDS1, 2 disk (HOM slots edge) 1994



(Material) MITSUBISHI, (Cutting tool) facing: S.C.DT, Milling: A.D

50μm

EP(1min)



CP(4min etch fluid: Cu-8)

H.P rinse (1min)

Tentative Speculative Summary

* Reasons to speculate that D.T+15 sec etching is worth a try.
* Burs of the coupler iris were removed by 1 min etching.
* Burs of the HOM slots edge were removed by H.P H_2O rinsing.
* H.P H_2O rinsing results.
    - @ Particle removal was proved.
    - @ Rinsing parameters are to be optimized.
    - @ Carbon contamination due to SEM was removed.
    - @ Stains were removed.