ULSAN NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY

# Dual Beam FIB
## (Focused Ion Beam)

### FIB Operation Training Course

# Summary

**Eucentric Position**

- Align the SEM and ION images to face the same place
- Stage 52° Tilt → Stage move (Mouse scroll button)
- Fit using Beam Shift to make the ION image identical to the SEM image

**Deposition**

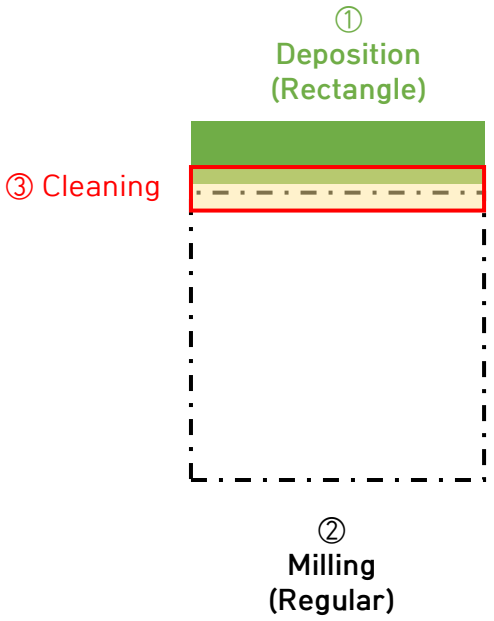
- 0.1 nA → Rectangle → PT dep
- X=10, Y=1, Z=0.5 (um)

**Milling**

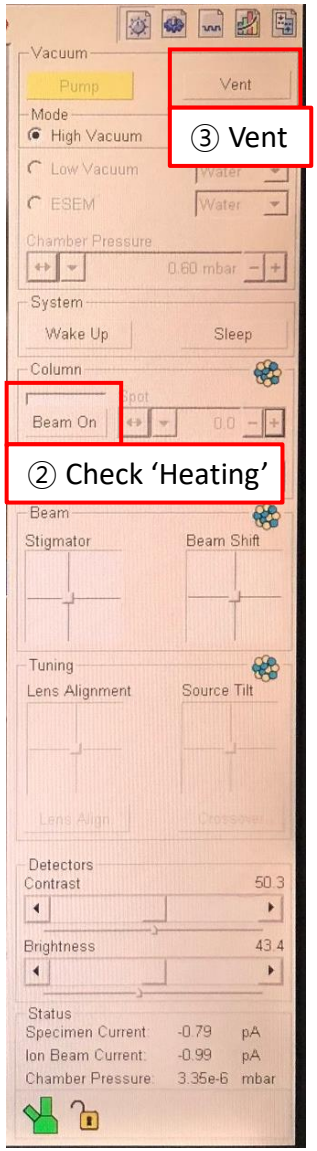
- 3.0 nA or higher
- Regular Closs section
- X=10, Y=8, Z=5 (um)

**Cleaning**

- One level lower than Milling current
- Cleaning Closs section
- Z=5 (um)

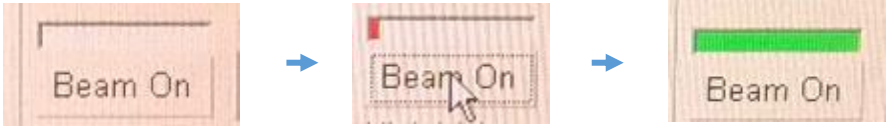


# Check the equipment


## 1) Click 'ION' → Check 'Beam Heating'→ Heating → Click 'Vent'

- White : First user of the day, click on Beam twice (Double click X) → The red bar is full and turns green (takes about 5 minutes)
- Green : A previous user exists. Equipment ready to use

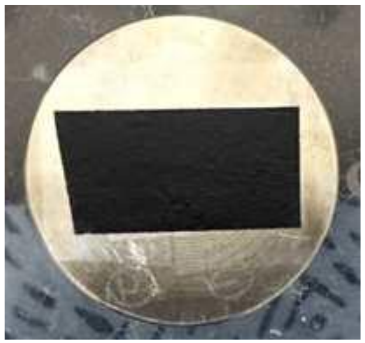



White
Heating required

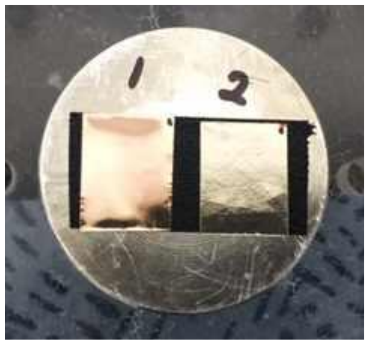
Green
Heating not required

# Sample Loading

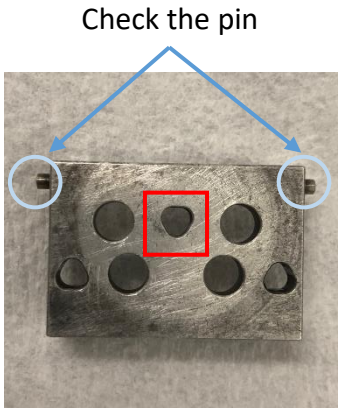
2) **Sample loading** : Requires personal sample holder (Maker's Lab <Jae Hoon Cha> 35,000won 1ea)



Carbon tape attach

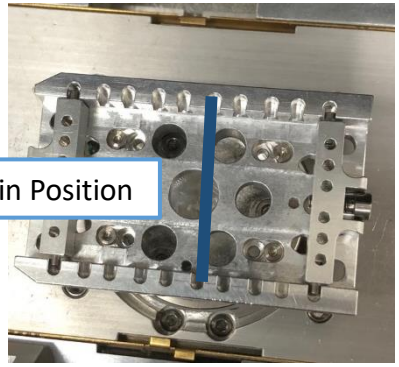


Sample attach



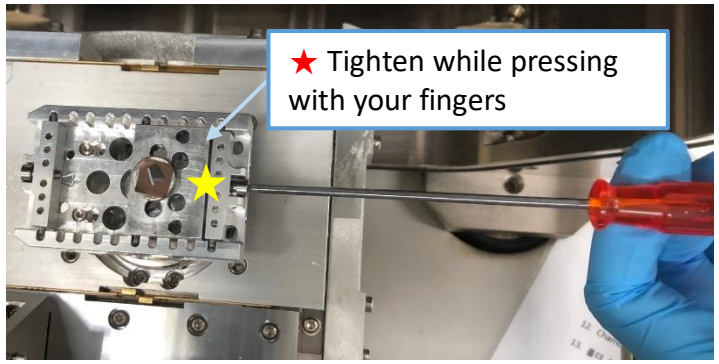

holder fixed position

holder fixed




Check the pin position

Load holder




Screw fastening

# Prepare

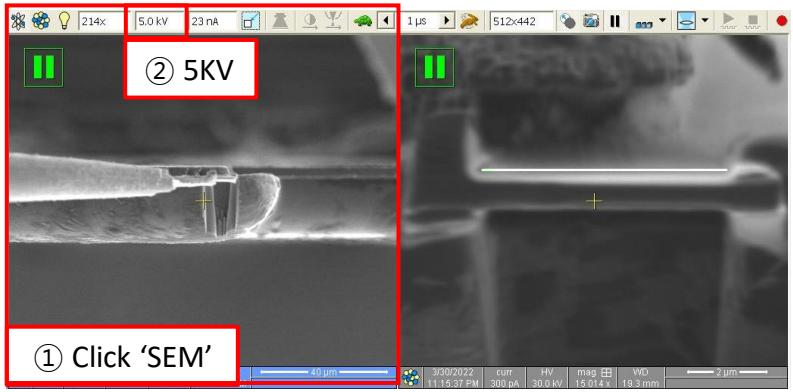
### 3) Click 'PUMP' → Check vacuum

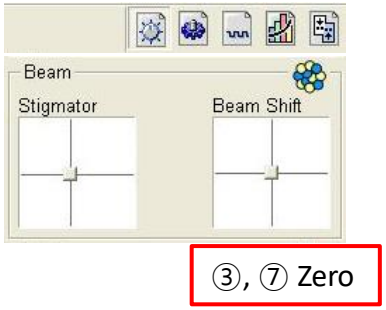
### 4) Check 'Electron Baem'

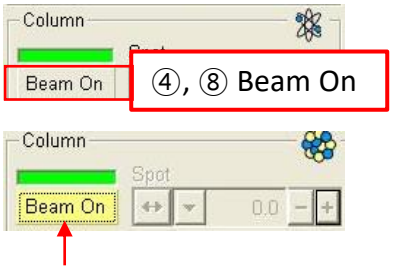
① Click 'SEM screen' → 5 kv, don't change current

② Baem Shift → Click mouse right button → Zero

③ Beam On



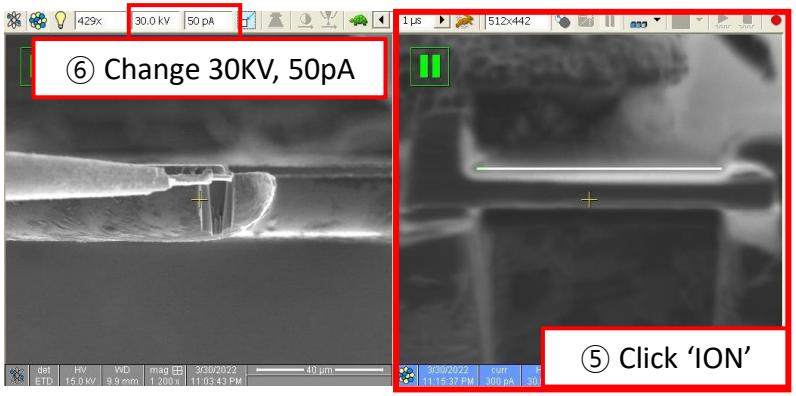




### 5) Check 'Ion Baem'

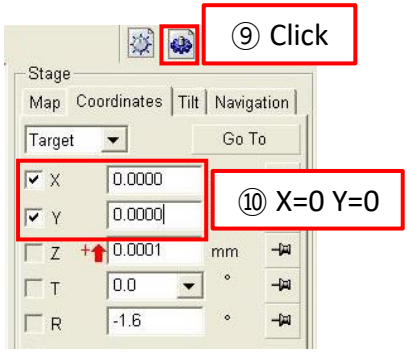
① Click 'Ion screen' → 30kv, 50pA

② Baem Shift → Click mouse right button → Zero

③ Beam On




### 6) Stage position : X = 0, Y = 0 입력 → Enter

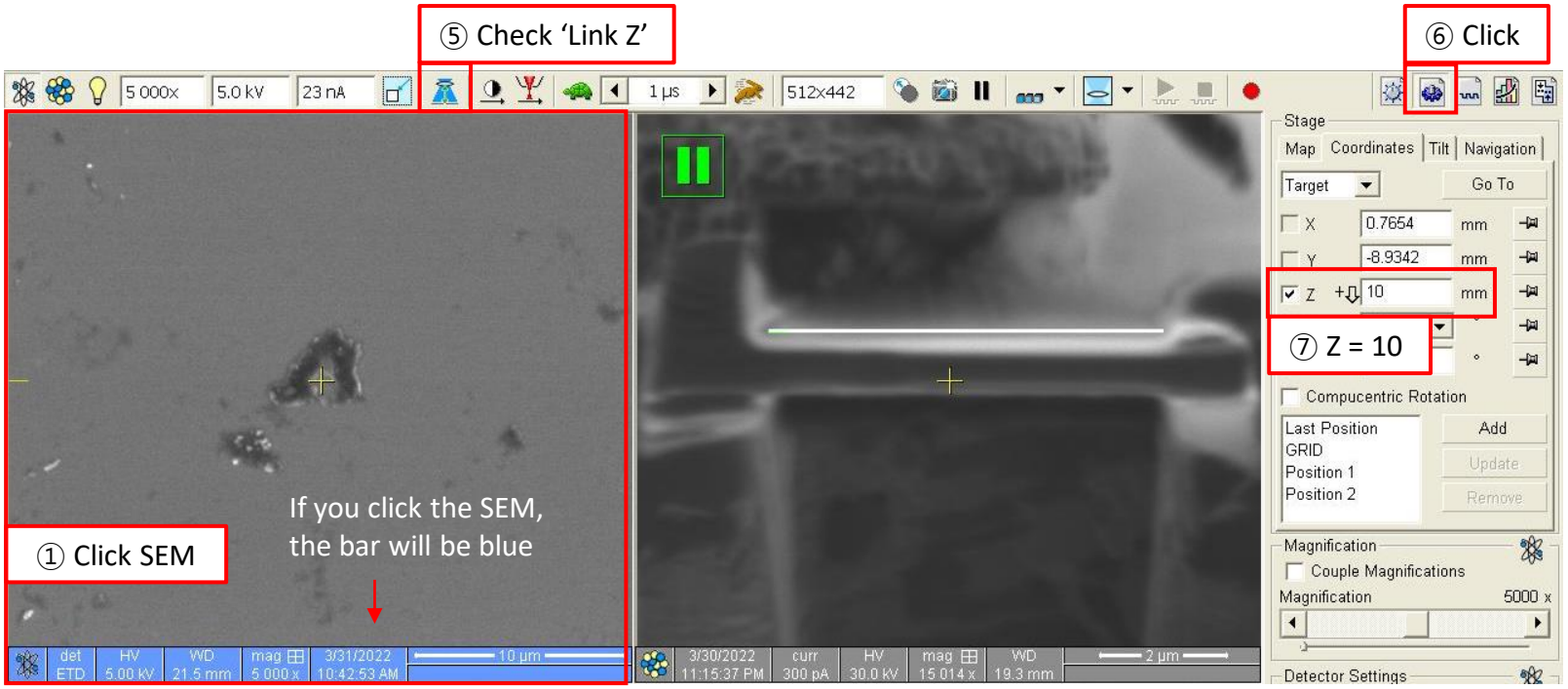


# Eucentric Position

1) Click ‘SEM’ → Click ‘Pause’ → Focusing (1,500 ~ 5,000x)
2) Click ‘Link Z’  → Check ‘Link Z’  → Z = 10 → Enter
3) If focus is bad and Link Z is off, Refocus → Repeat ‘Process 2)’ again

Link Z on 

Link Z off 

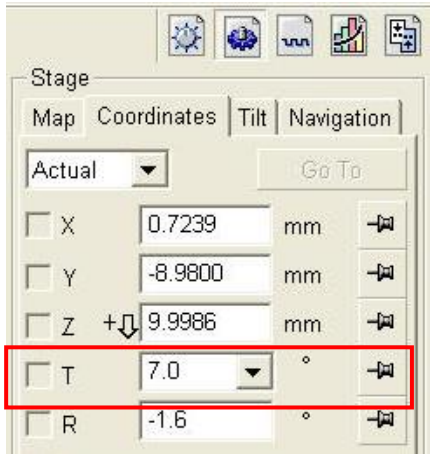



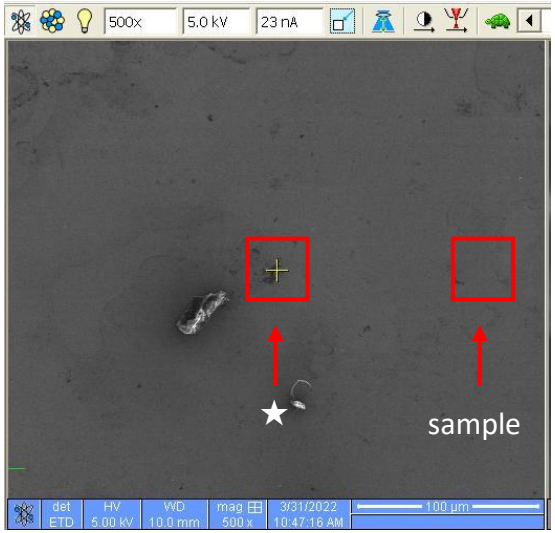
# Eucentric Position

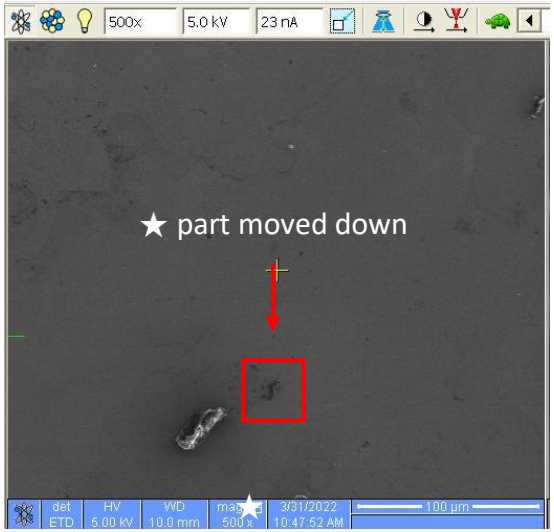
4) Find sample (3,500 ~ 5,000x) → Find specific point in the horizontal direction of the sample (★specific point) → Move the ★ part to the center of the SEM screen → Reduce magnification (500 ~ 2,000x)

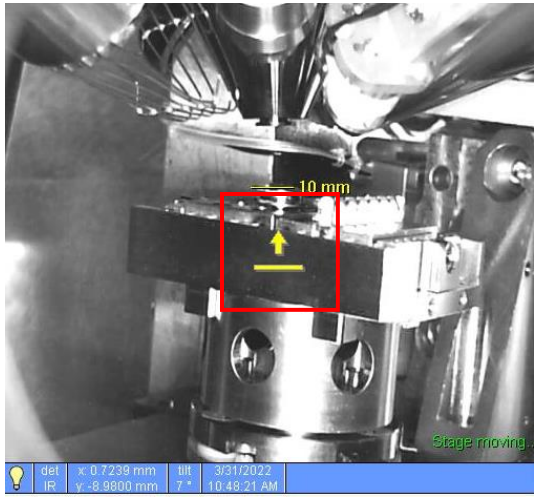
5) Check 'Link Z'  → T = 7 → Enter

6) Press the mouse scroll button in the lower right screen (yellow bar appears) → Move the stage by moving up or down → Re-centering of the ★ point (Same position as before Tilt)



# Eucentric Position

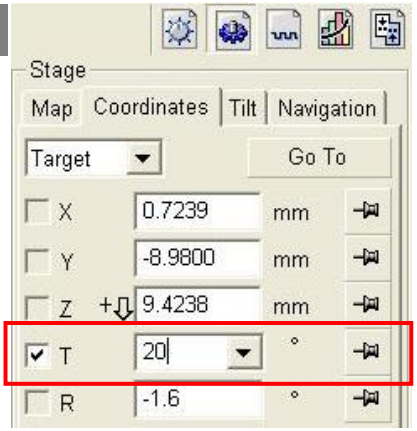
7) T = 20 → Enter

8) Press the mouse scroll button in the lower right screen (showed yellow bar) → Move the stage by moving up or down → Re-centering of the ★ point (Same position as before Tilt)

9) T = 52 → Enter → Re-centering of the ★ point

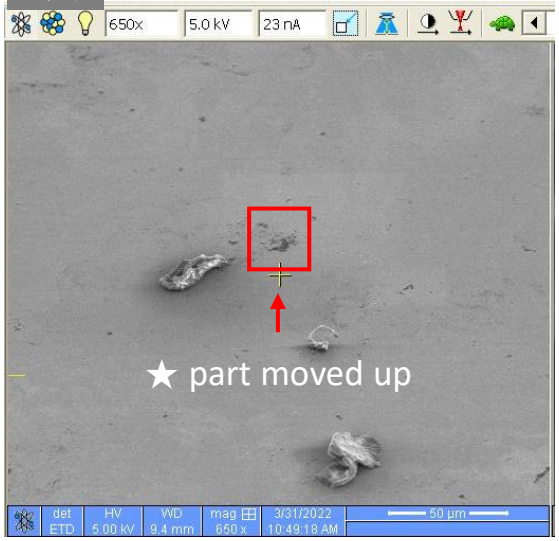
10) Focus the ★ point by magnifying 5000x

7)




6)

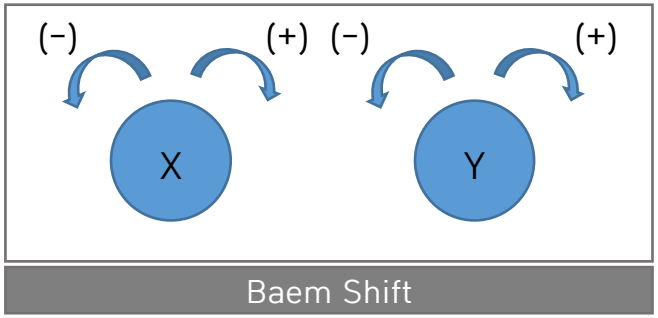

8,9)

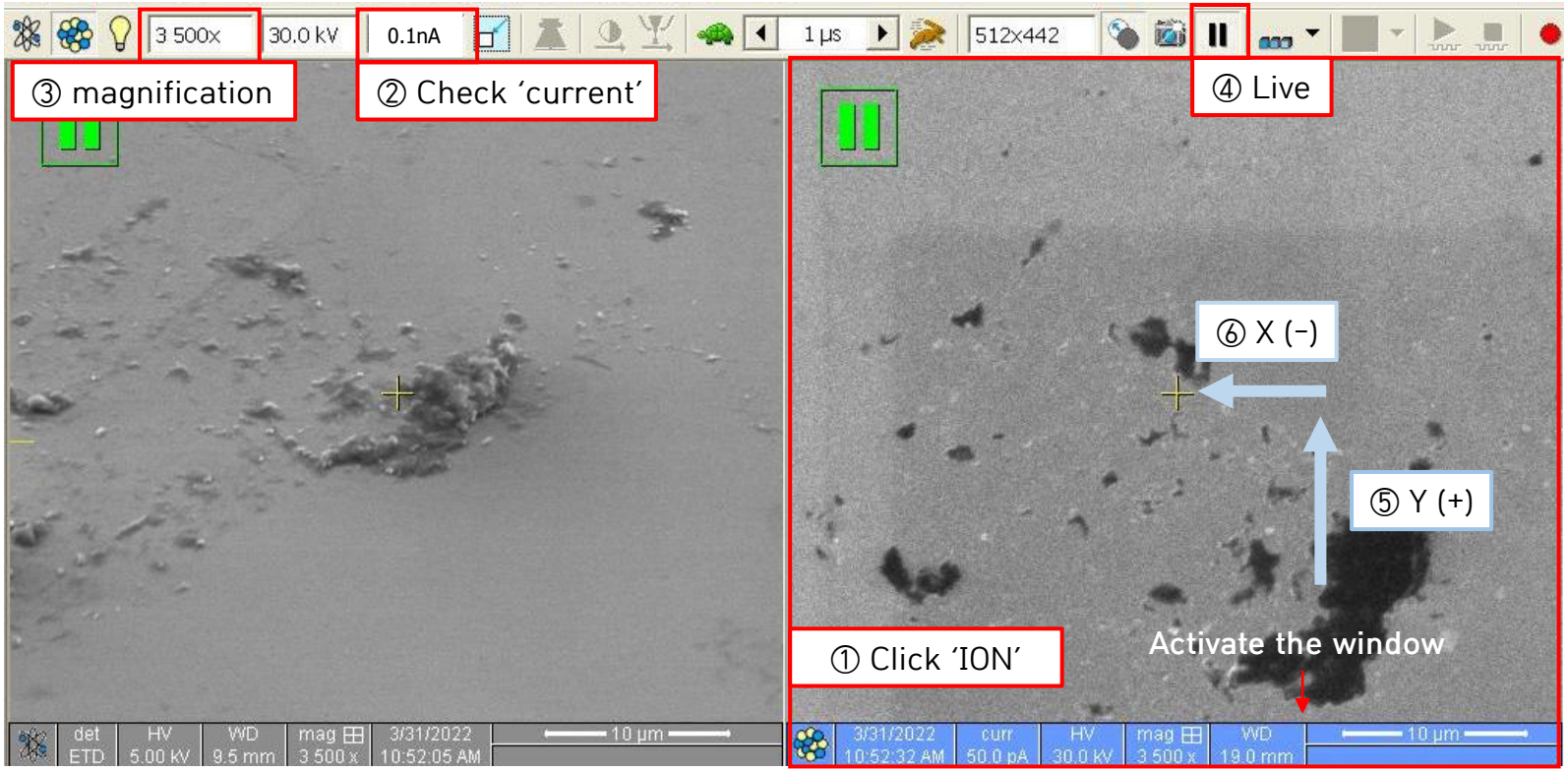



10)

# Eucentric Position

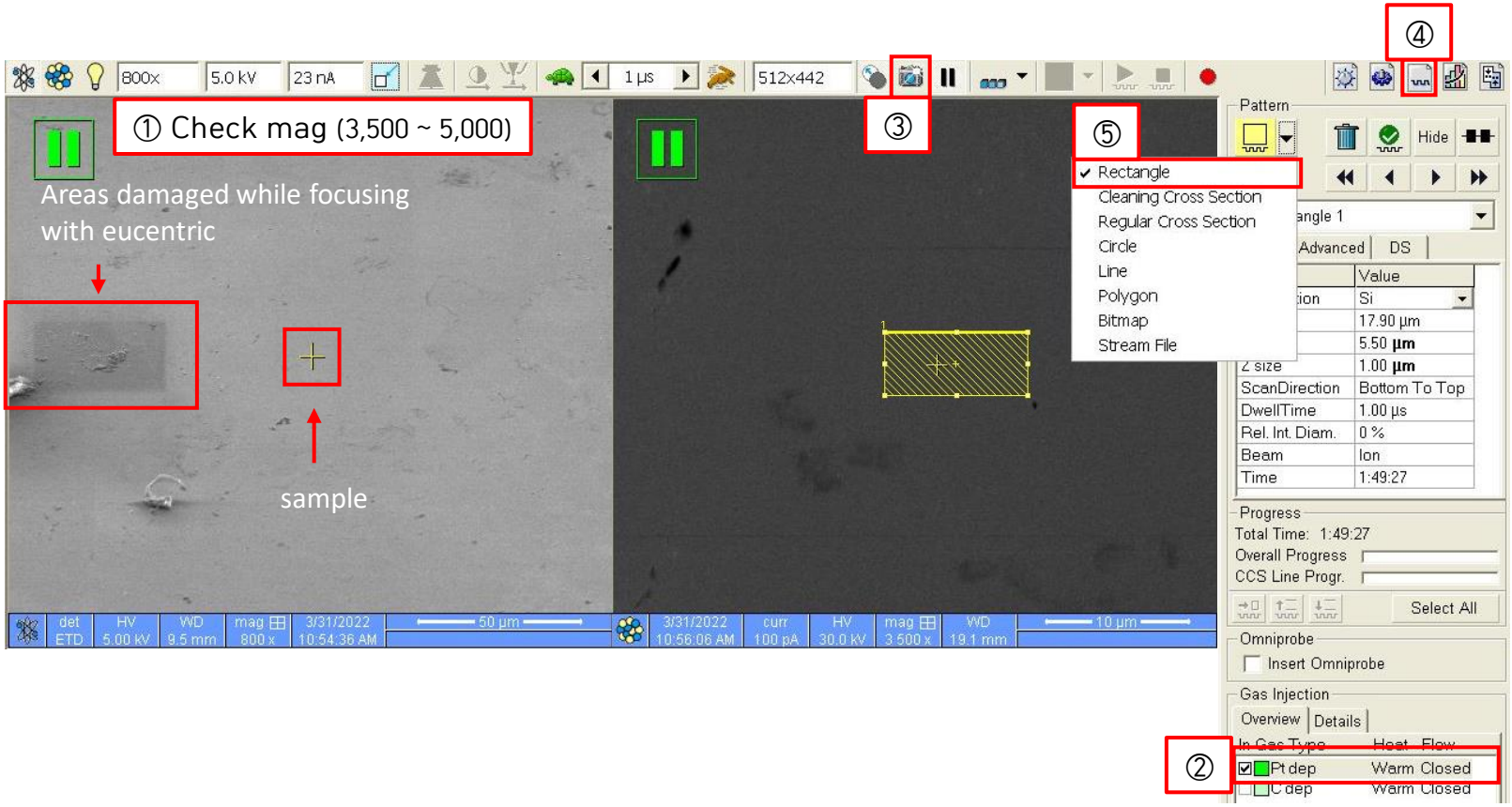
11) Click 'ION'→ 0.1 nA → 3,500 or 5,000x (Same as SEM or one step lower magnification)
12) Live→ Adjust 'Contrast, Focus'
13) Align the SEM and ION images equally with Baem Shift



# Deposition

1) Click 'SEM' → live → Zoom out → move to sample→ 3,500 ~ 5,000x
2) Click 'ION' → Fit to the same magnification as SEM
3) Click 'PT Gas Injection' (If it is cool state, double-click the bar to heat)
4) Insert Pattern → ▼ → Click 'Rectangle' → Drag on the ION screen



# Deposition

5) Pattern property(Basic) : Application = Pt → The pattern turns green

Pattern size : X = 10um, Y = 1um, Z = 0.5um

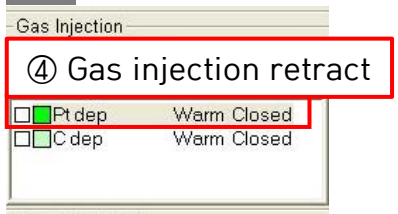
6) Snap shot 'ION' → Move the pattern to the sample position → Play

★ Do not move the stage ★ **If the sample is not visible, retract the gas and re-align the Eucentric Position**

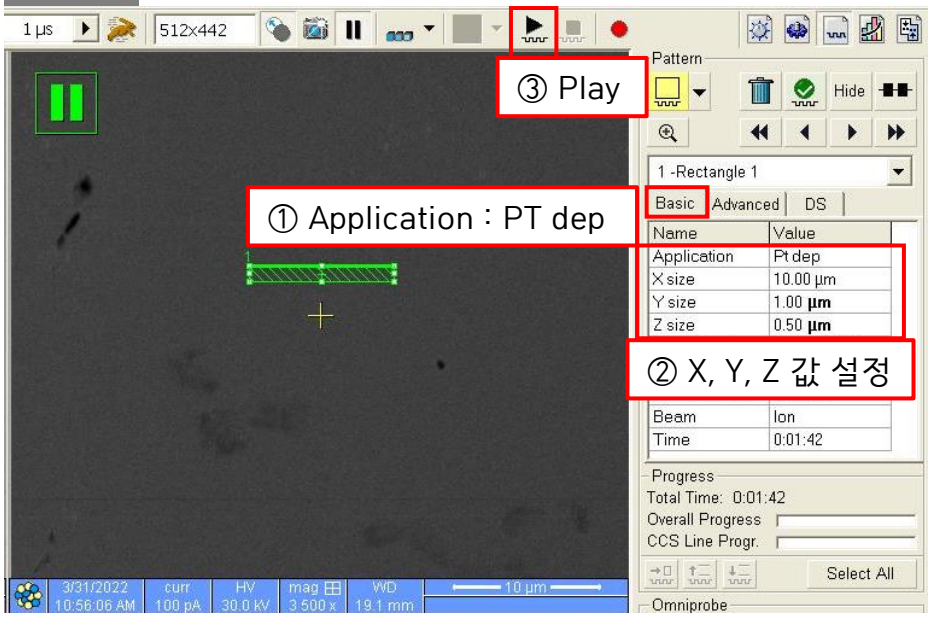
7) Gas injection retract immediately after deposition is completed

8) SEM : Check if the deposition is well with a snap shot (F4)

9)



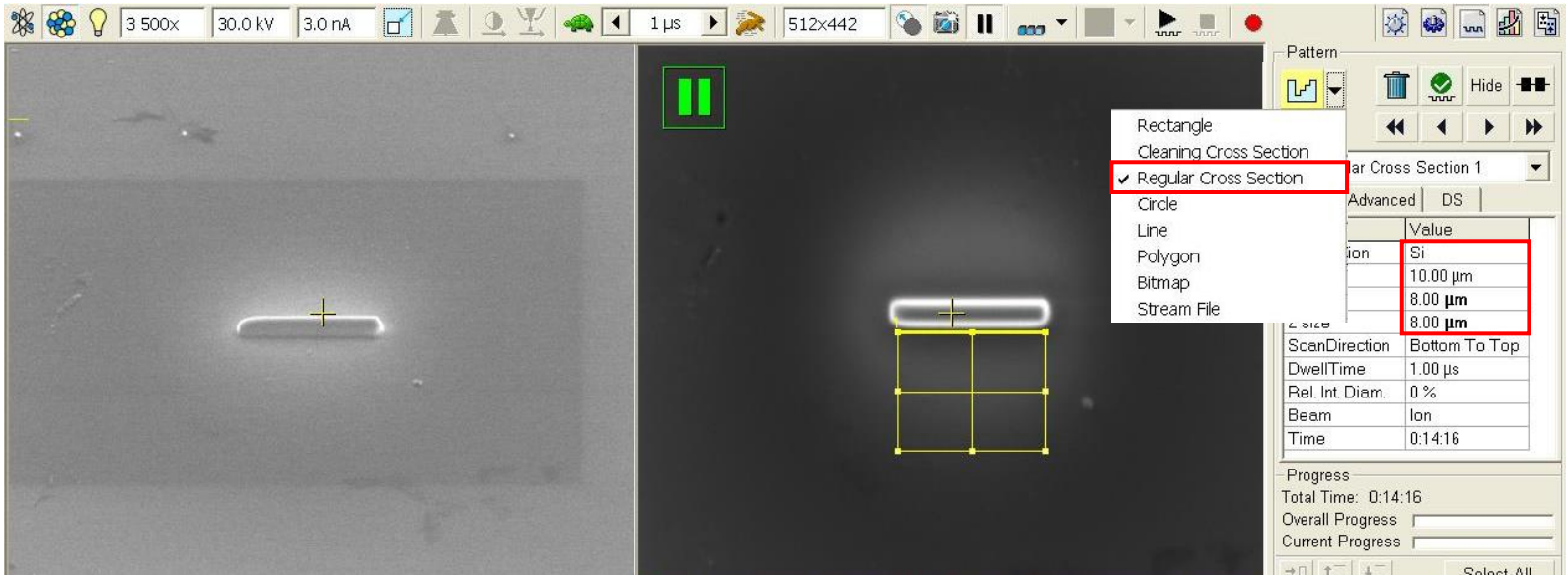

5) ~ 7)




8)

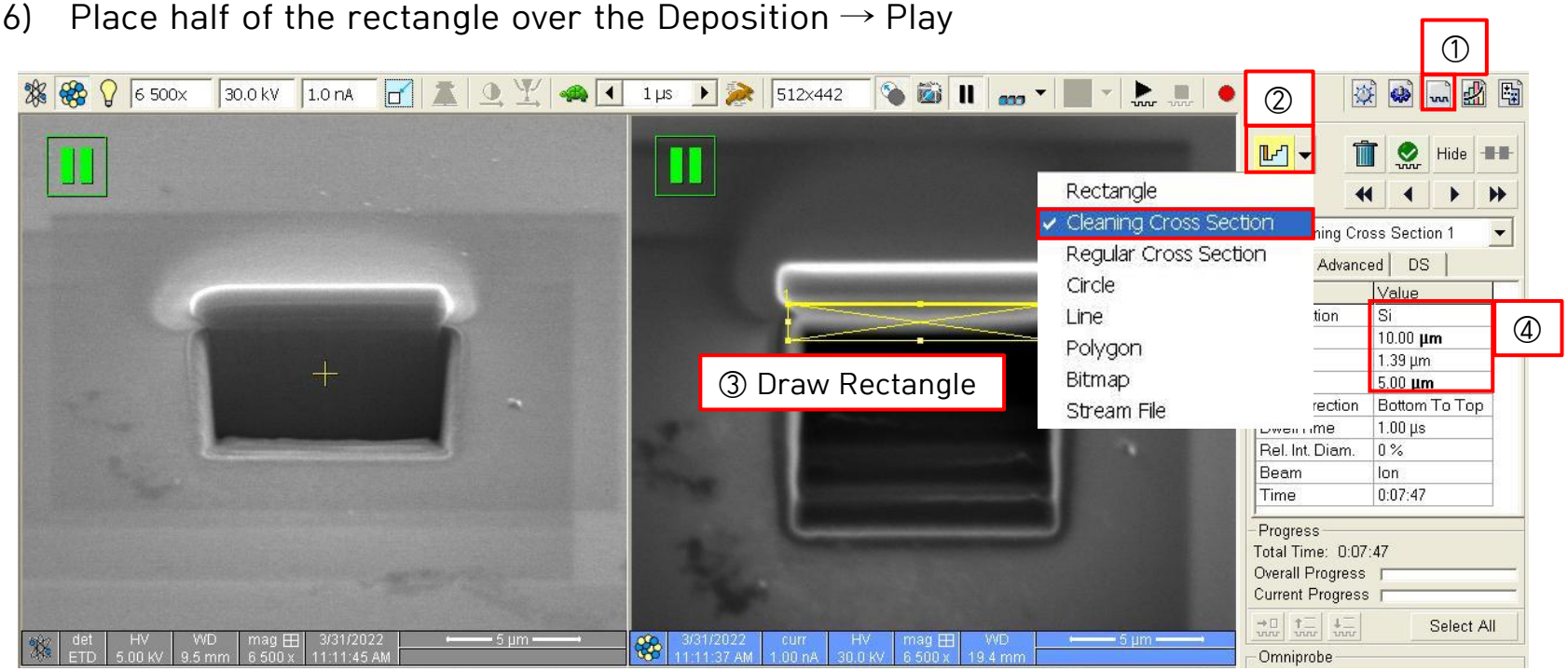
# Milling

1) Change to Current 3.0 nA or higher (Current adjustment according to the hardness of the sample)
2) Click 'SEM' → Live → Zoom out → Move to the eucentric place → Mag 3,500 ~ 5,000
3) Click 'ION' → Same as SEM magnification → Live → Adjust Focus and Contrast → Pause
4) Click 'SEM' → Zoom out → Live → Move to Deposition → Mag 3,500 ~ 5,000
5) Click 'ION' → Same as SEM magnification → Snap Shot
6) Regular cross section → Drag on the ION screen (Align with the Deposition line)
7) Application : Si (Yellow) → X=10, Y=8, Z=5 ~ 8 (Adjust the Z according to the sample size)
8) Snap shot 'ION' → Play → Click 'SEM' → Snap shot → Check the milling area



# Cleaning

1) One level lower than Milling Current.
2) Click 'SEM' → Live → 5,000 ~ 6,500x → focusing
3) Click 'ION' → Adjust to be the same as SEM magnification → snap shot → Check focus and position → snap shot (★ no live, if it is difficult to focus, move to the eucentric place to live))
4) Cleaning cross section → Drag ION screen
5) Application : Si (Yellow sqaure) → X = 10, Z=5 ~ 8 (Adjust the Z value according to the sample size)
6) Place half of the rectangle over the Deposition → Play



# Cleaning

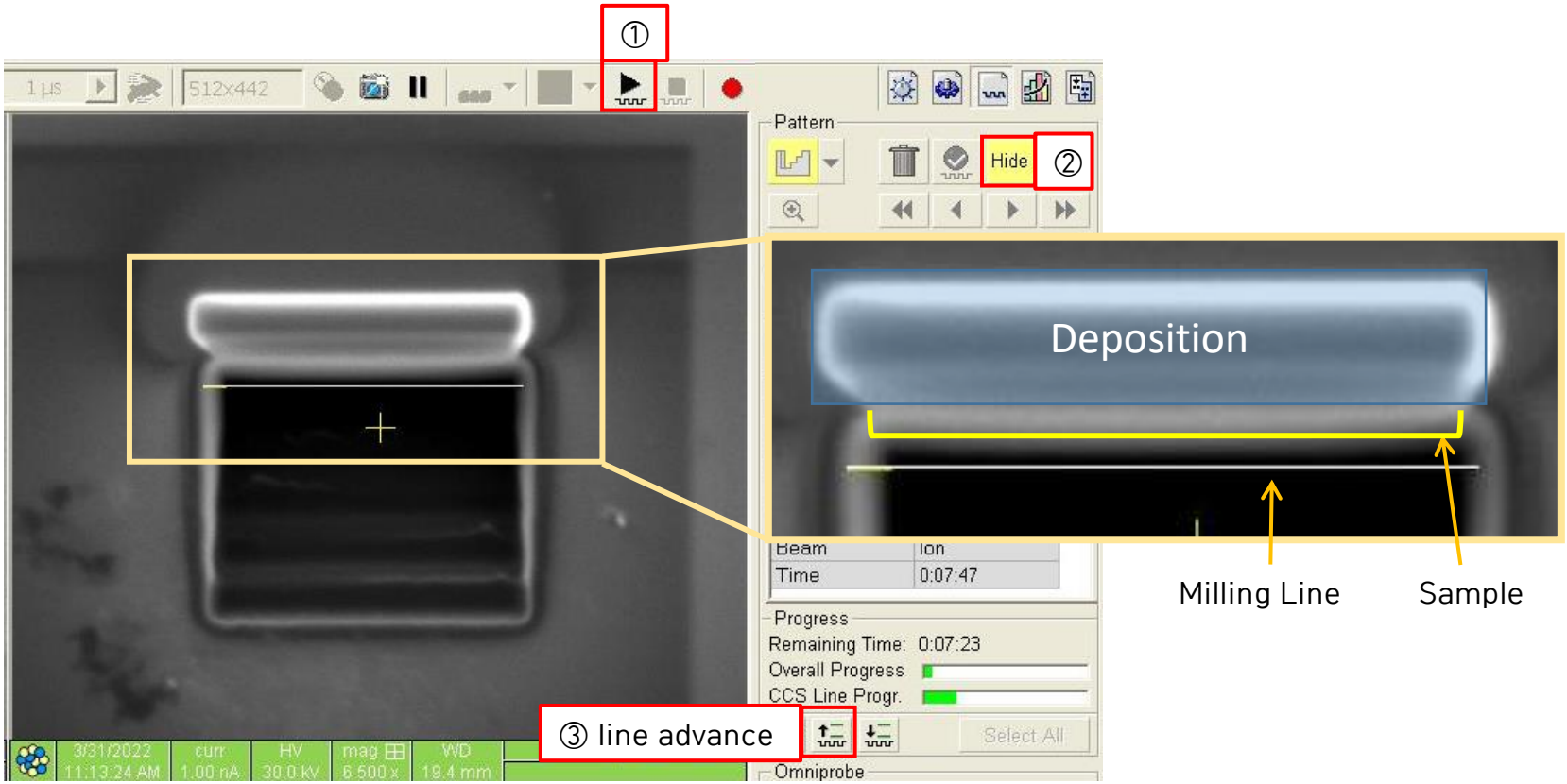
7) Play → Hide Pattern → A single line appears in ION (If you can't see the line, adjust contrast)

8) Click the forward button to start cleaning at the bottom of the real sample → Waiting

9) Check SEM image : Click 'SEM' → snap shot

10) Stop milling and take an image (F2) when the surface is cleared

Ion image : Click 'ION' → 0.1nA / 50 pA → T = 0 → relative → rotation = 180 → Shift + F12 → 180



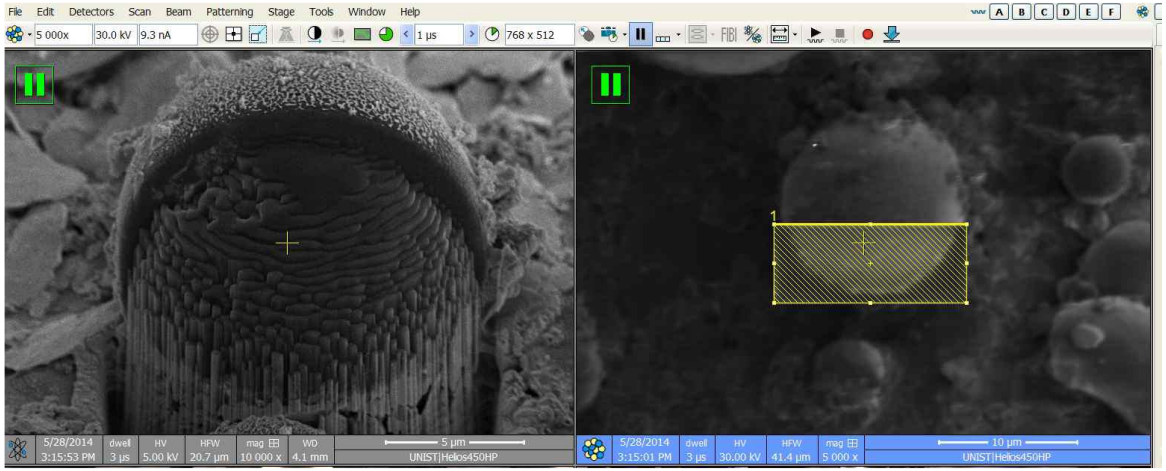
# Example (Powder)

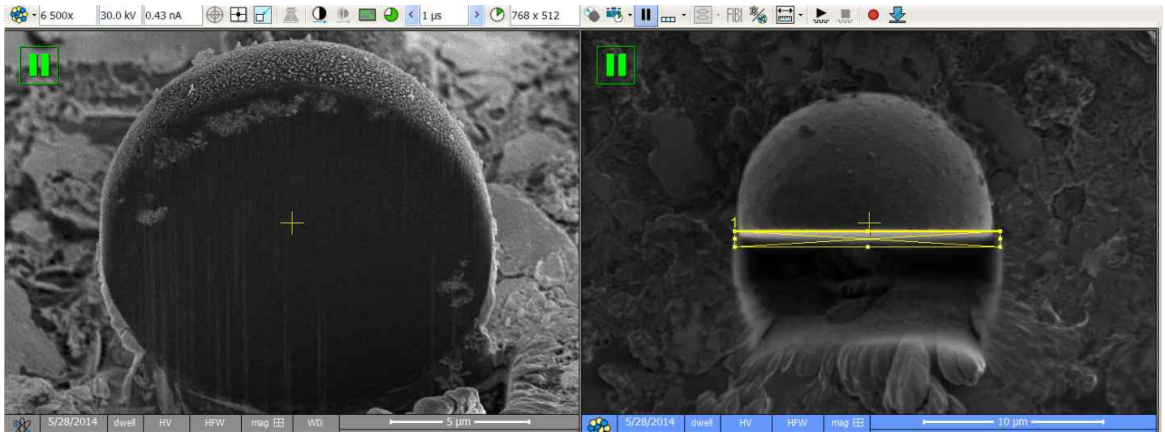
Eucentric Position

Deposition

Milling

Cleaning

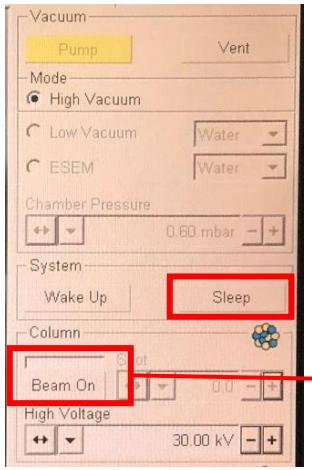


# Final Check

1) T = 0
2) SEM and ION ‘Baem off’ (OFF state when the yellow light of the ‘bean button’ is off)
3) Delete ‘pattern’
4) Beam Shift ‘Zero’
5) X, Y = 0
6) Scan rotation = 0
7) **★ Check a next user ★**

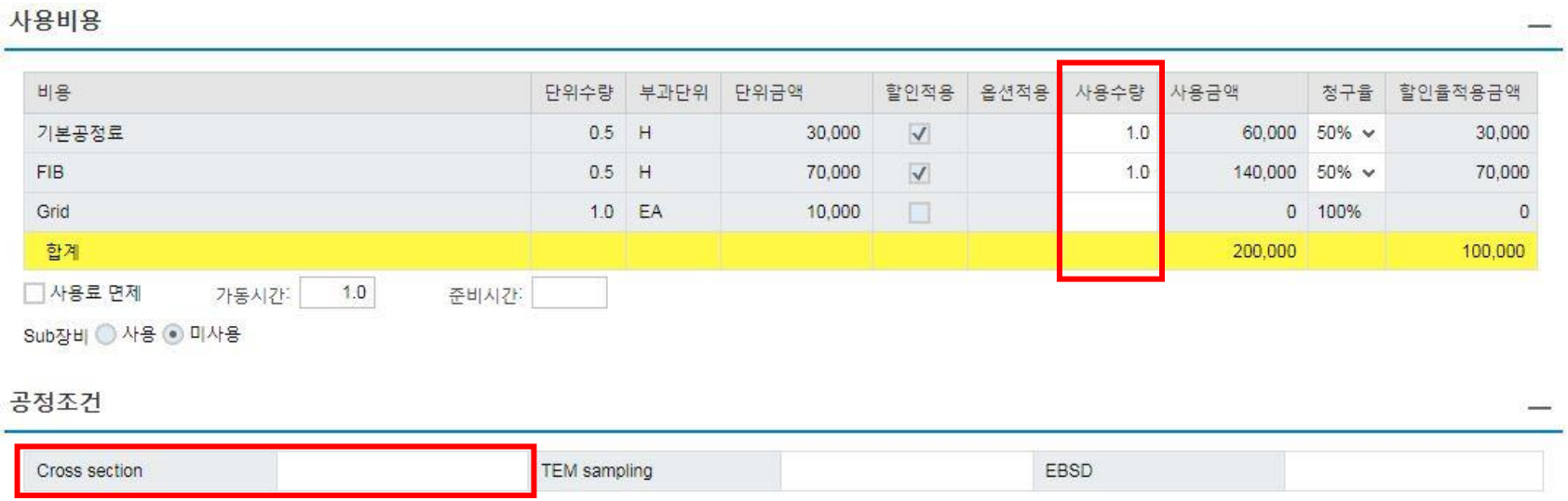
   If you are the last user of the day : Click ‘Sleep’ button




When the Sleep button is pressed, the beam on bar in the Ion window changes to an empty state.

# Approve the result

- Approve the result within 3 days of using the equipment
- Fill in the time spent on the BASIC FEE and the FIB.
- Based on 100% billing rate, 200,000 won per hour
- No change in billing rate
- Fill in the number of samples in the cross section field



사용비용

| 비용 | 단위수량 | 부과단위 | 단위금액 | 할인적용 | 옵션적용 | 사용수량 | 사용금액 | 청구율 | 할인율적용금액 |
|---|---|---|---|---|---|---|---|---|---|
| 기본공정료 | 0.5 | H | 30,000 | ☑ | | 1.0 | 60,000 | 50% | 30,000 |
| FIB | 0.5 | H | 70,000 | ☑ | | 1.0 | 140,000 | 50% | 70,000 |
| Grid | 1.0 | EA | 10,000 | ☐ | | | 0 | 100% | 0 |
| 합계 | | | | | | | 200,000 | | 100,000 |

☐ 사용료 면제 가동시간: 1.0 준비시간:

Sub장비 ○ 사용 ◉ 미사용

공정조건

| Cross section | | TEM sampling | | EBSD | |
|---|---|---|---|---|---|

# 연구실 일상 점검표

| 연구실명 | 3차원나노가공실 | 동/호실 | 102동<br>B108호 | 점검날짜 | |
|---|---|---|---|---|---|

| 구분 | 점검 사항 | 확인 |
|---|---|---|
| 일반 안전 | 연구실(실험실) 정리정돈 및 청결상태 | |
| | 연구실(실험실)내 금연, 음식물 반입 및 섭취여부 | |
| | 안전수칙, 안전표지, 개인보호구, 구급약품 등 실험장비(흄 후드 등) 관리상태 | |
| | 사전유해인자위험분석 보고서게시 | |
| | 위험표지 및 안전, 경과 표지 부착여부 | |
| 전기 안전 | 사용하지 않는 전기기구의 전원투입상태확인 및 무분별한 문어발식 콘센트 사용여부 | |
| | 접지형 콘센트를 사용, 전기배선의 절연피복 손상 및 배선 정리 상태 | |
| | 기기의 외함 접지 또는 정전기 장애방지를 위한 접지실시상태 | |
| 소방 안전 | 소화기표지, 적정 소화기비치 및 정기적인 소화기 점검상태 | |
| | 비상구, 피난통로확보 및 통로 상 장애물 적재여부 | |
| | 소화전, 소화기 주변 이물질 적재금지 상태여부 | |
| 가스 안전 | 배관 표시사항 부착, 가스 사용시설 경계/경고표시 부착, 조정기 및 밸브 등 작동상태 | |
| 화공 안전 | 유해인자별 취급 및 관리대장, MSDS의 비치 | |
| | 소량을 덜어서 사용하는 통, 화학물질의 보관함. 보관용기에 경고표시부착여부 | |
| 장비 안전 | Chamber pressure 값의 적정여부 | |

| 일상점검확인 | 점검자 서명 | (인) |
|---|---|---|
| | 연구실책임자 서명 | (인) |