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株式会社アイテス

MEMS製品の構造解析技術

アイテス
品質技術部

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MEMS製品の構造解析技術

- アウトライン
  - アイテス紹介
  - MEMS構造解析
    - X線観察
    - 赤外線透過観察
    - パッケージ開封
    - 機械研磨（平面研磨、断面研磨）
    - FIBによる断面SEM観察
    - 結晶粒の断面SEM観察
  - 最後に

品質技術の特長

プロファイル

- 日本IBMの信頼性評価部門、解析・分析部門を母体として平成5年、分社・独立
- 30年以上にわたって培ってきた技術力
- 豊富にとりそろえた信頼性試験装置、解析・分析装置

Quality ・高品質のアウトプット

Delivery・短納期/即応性

Value ・お客様にとって価値ある結果を提出する

MEMS製品の構造解析技術

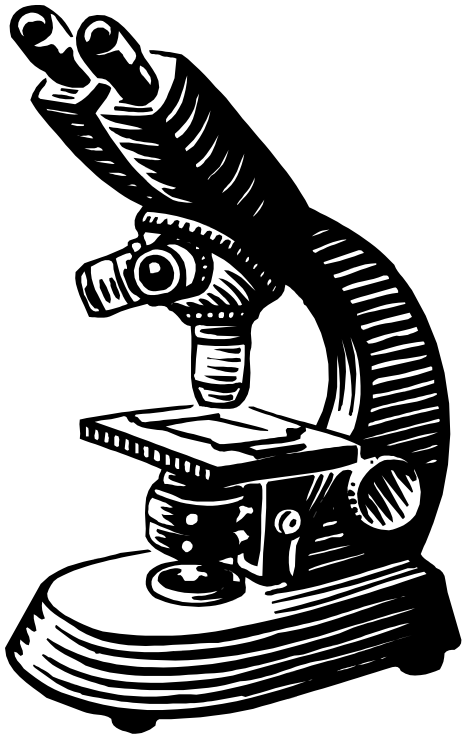
- X線観察
- 赤外線透過観察
- パッケージ開封
- 機械研磨（平面研磨、断面研磨）
- FIBによる断面SEM観察
- 結晶粒の断面SEM観察

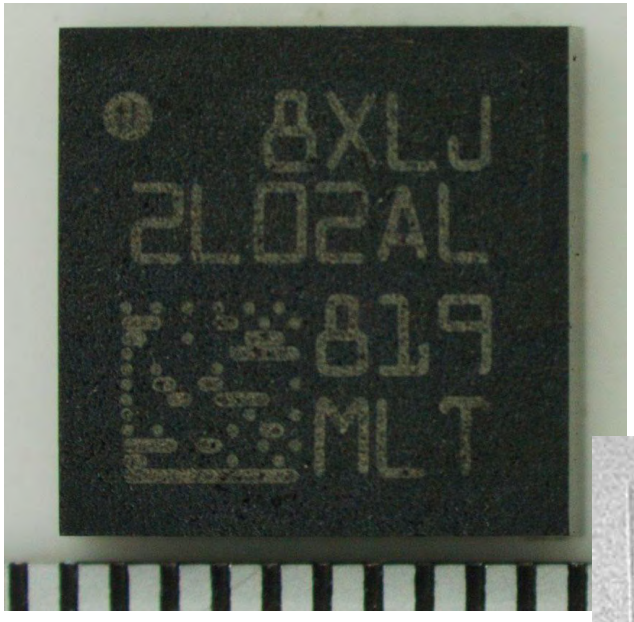
MEMS製品の構造解析技術

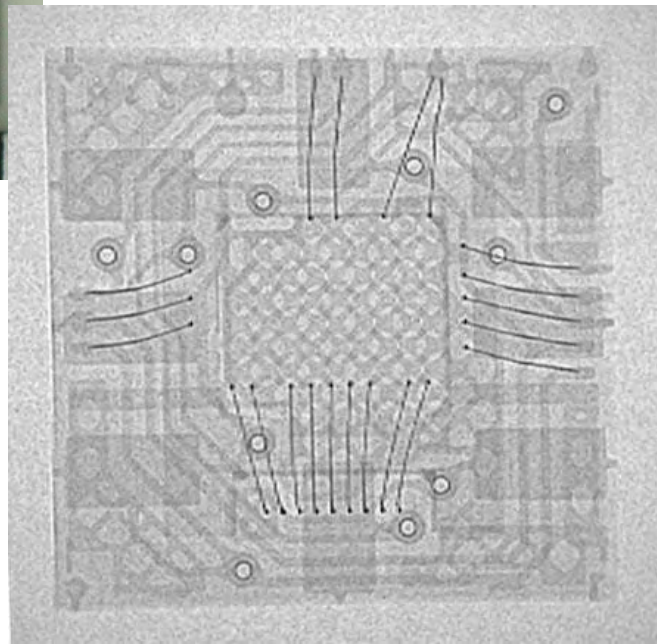
- X線観察
  - ワイヤ、チップ、基板、
    積層構造など 非破壊での
    内部構造の 立体的な把握

MEMS製品の構造解析技術

- X線観察

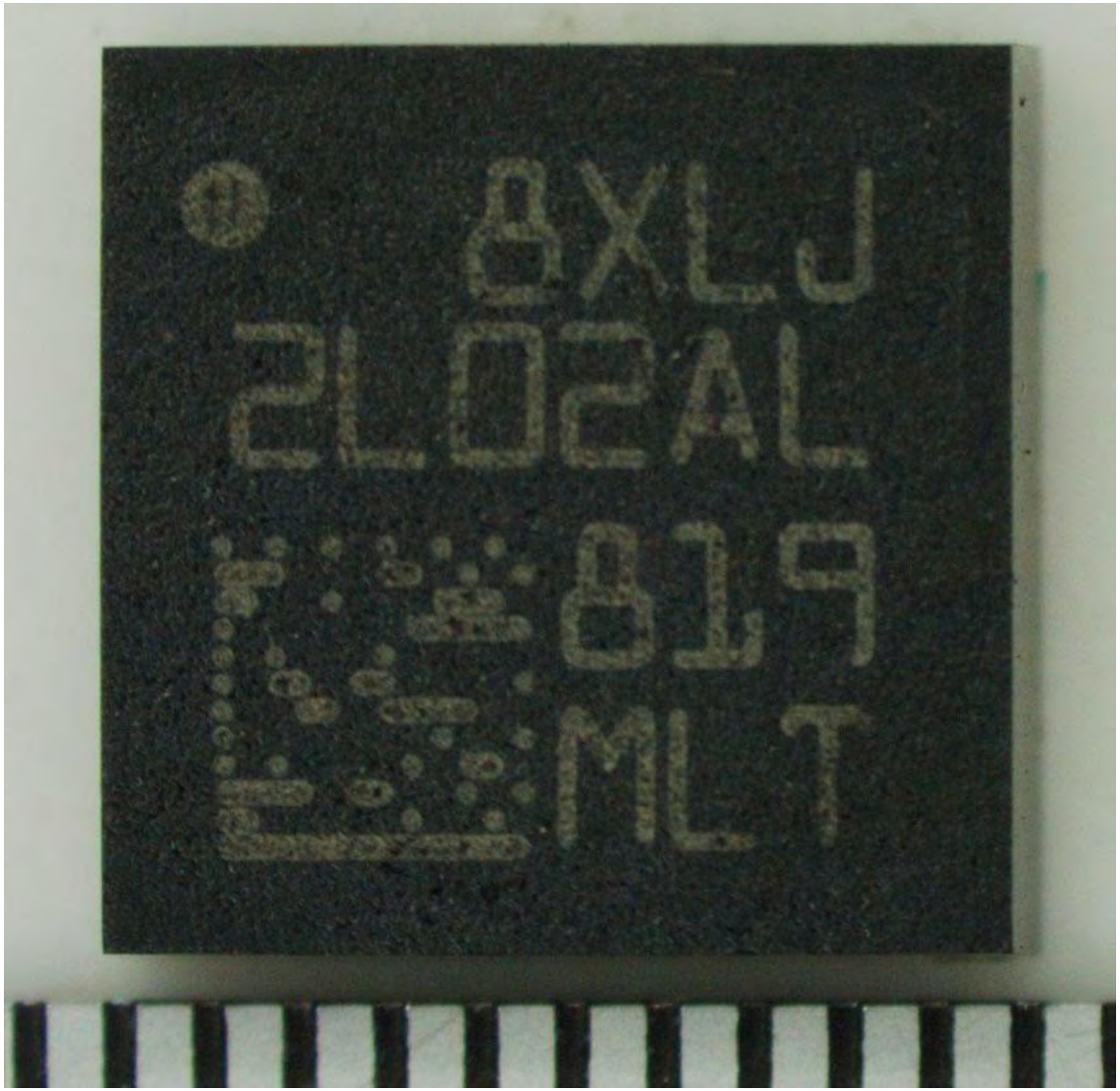




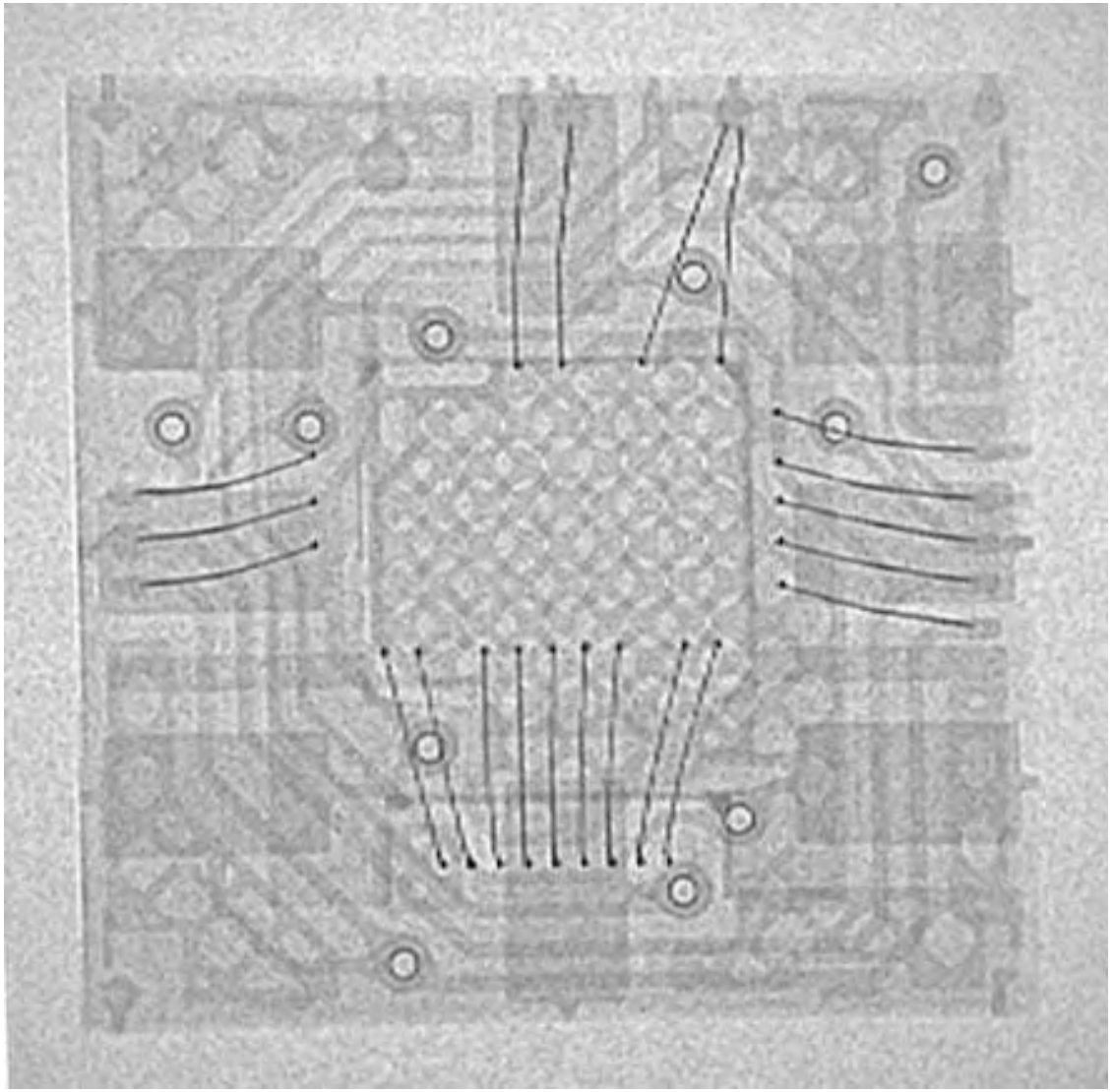


外観、内部構造の把握

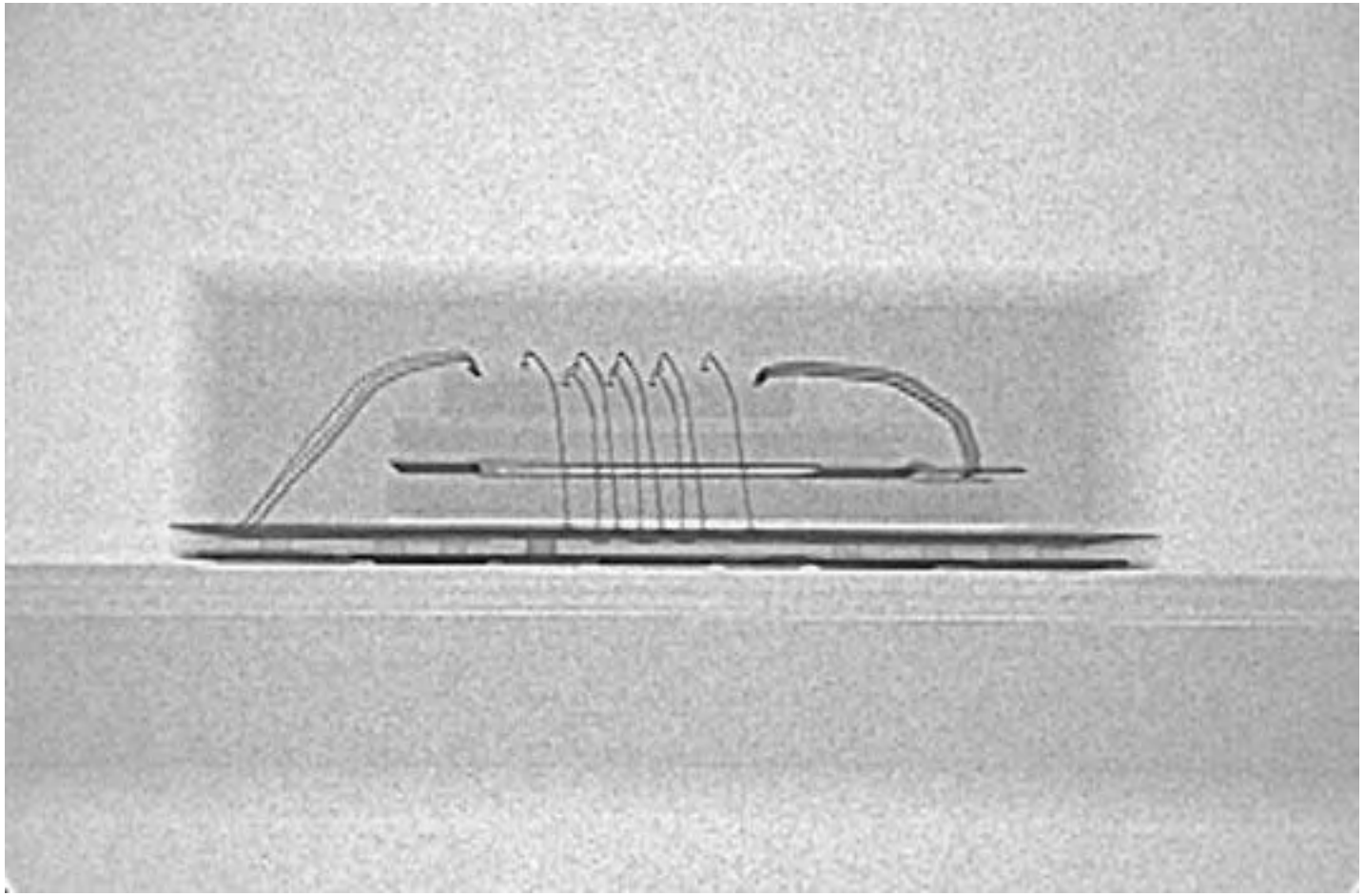
パッケージ外観観察



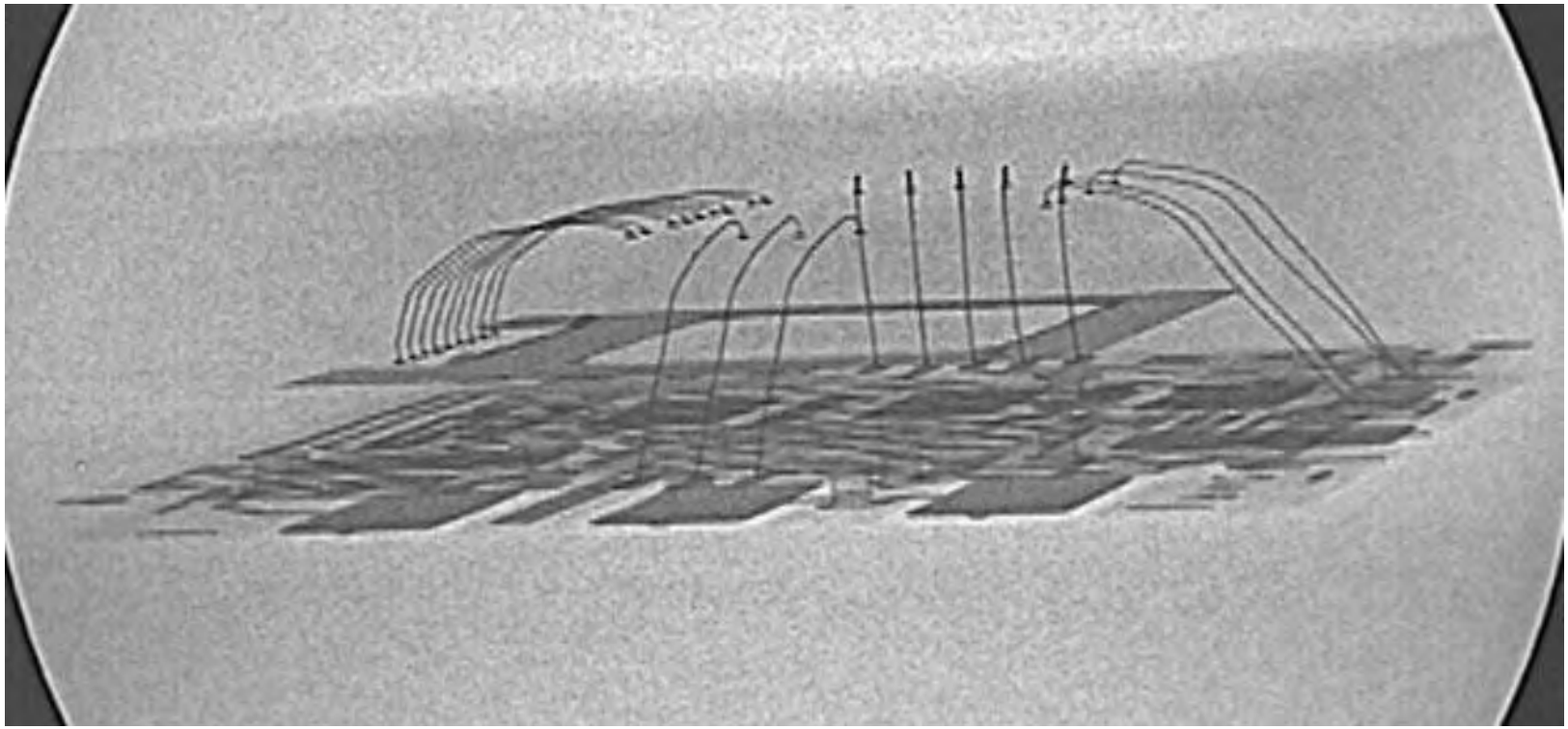
X線観察(平面)



X線観察（側面）



X線観察(傾斜)

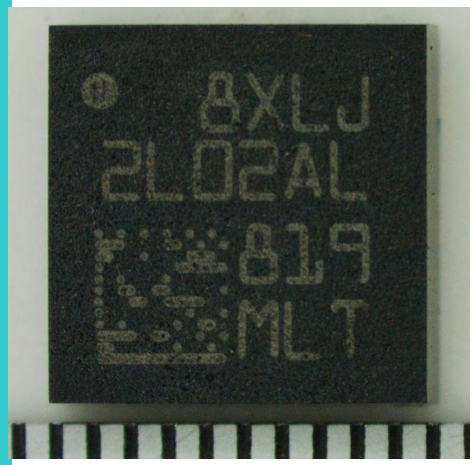


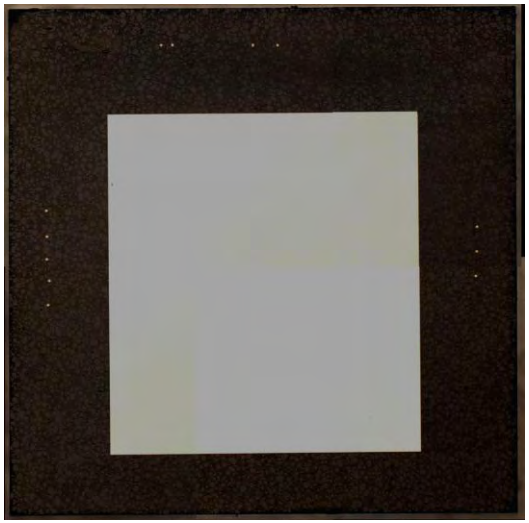
MEMS製品の構造解析技術

- 赤外線透過観察
  - Siチップ内配線パターン
  - Si接着樹脂の平面形状

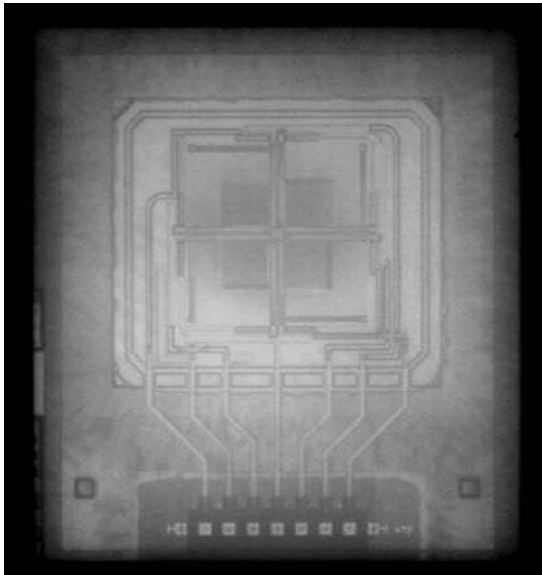
MEMS製品の構造解析技術

- 赤外線透過観察

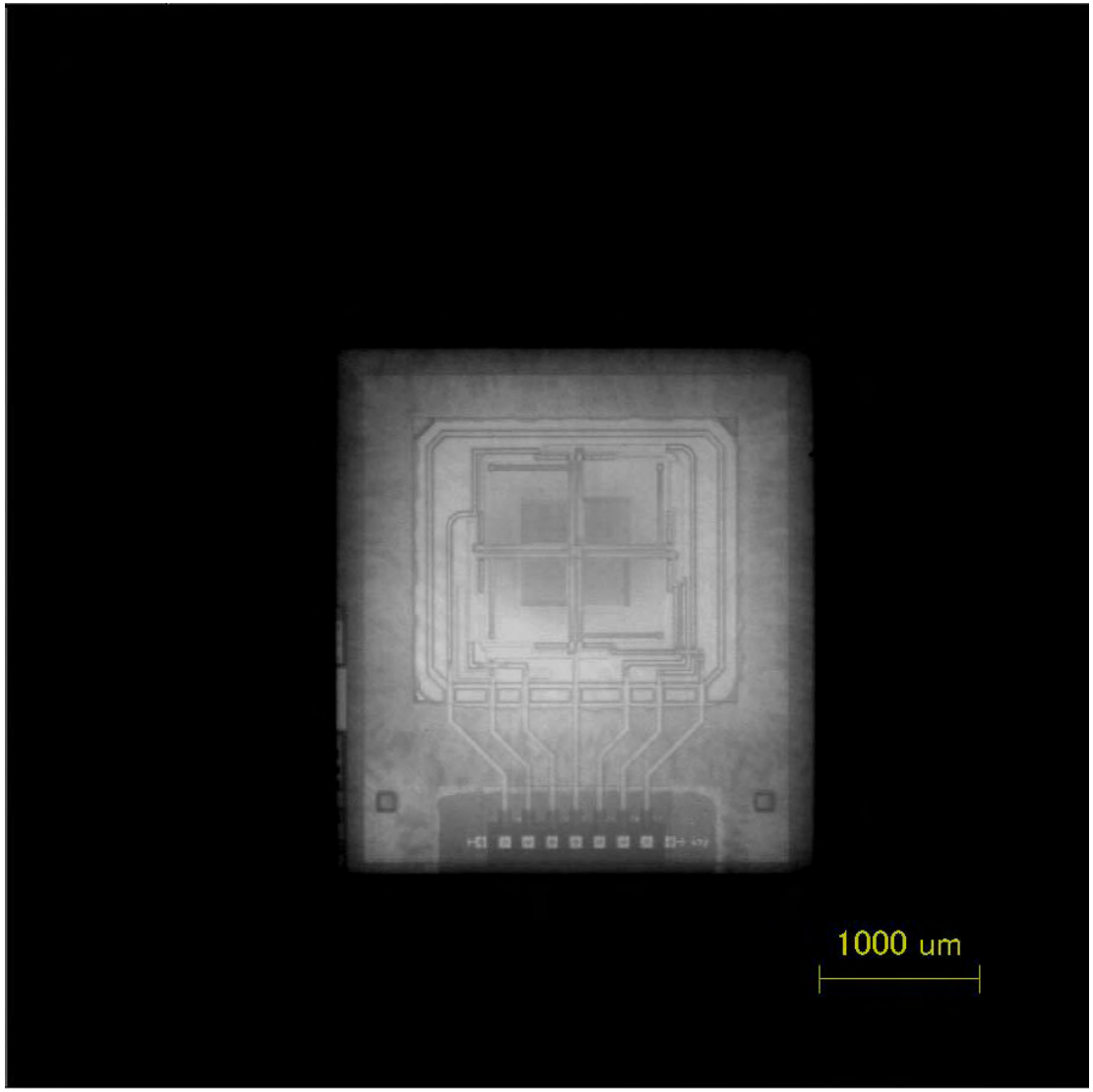




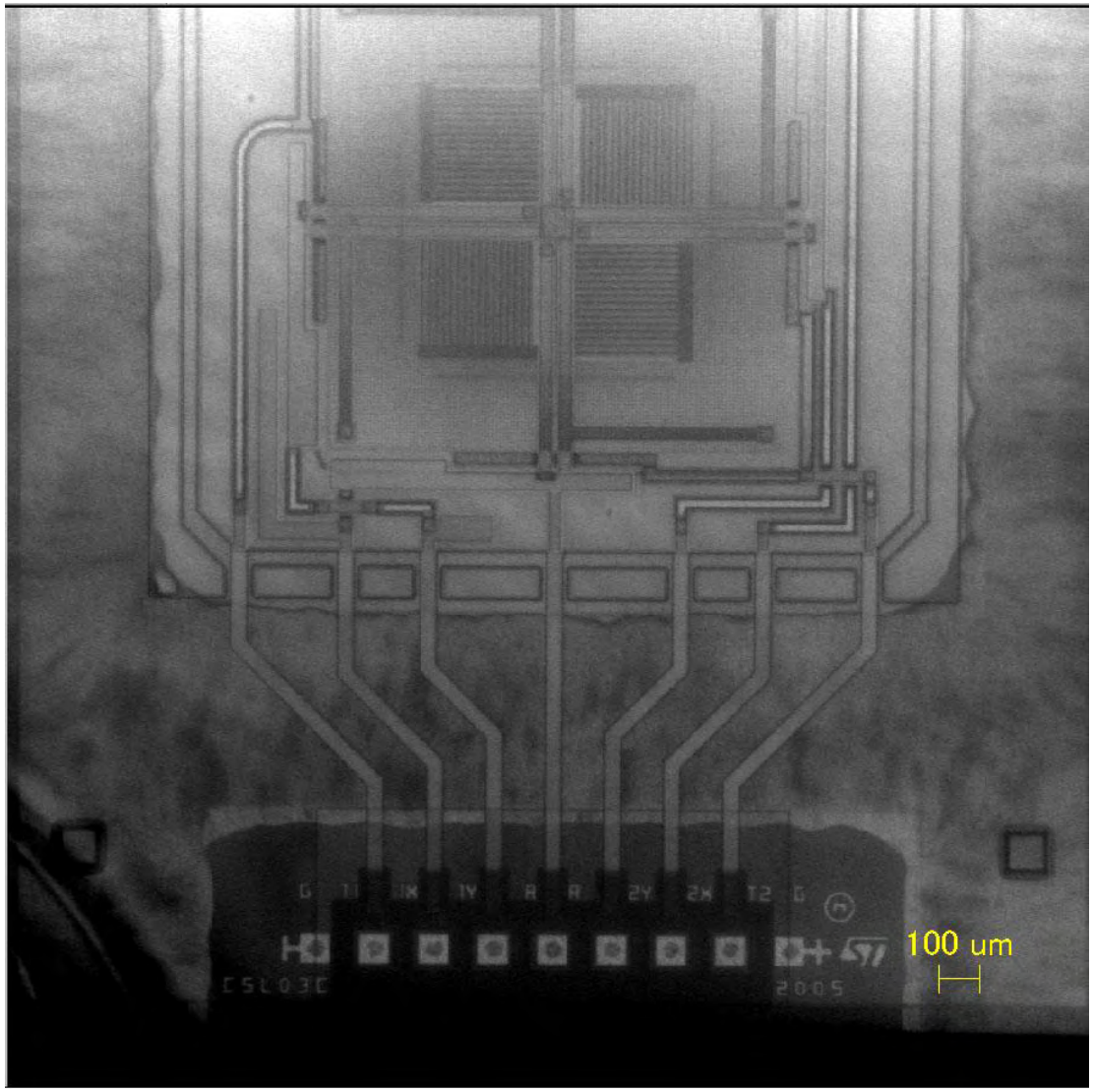
裏面研磨



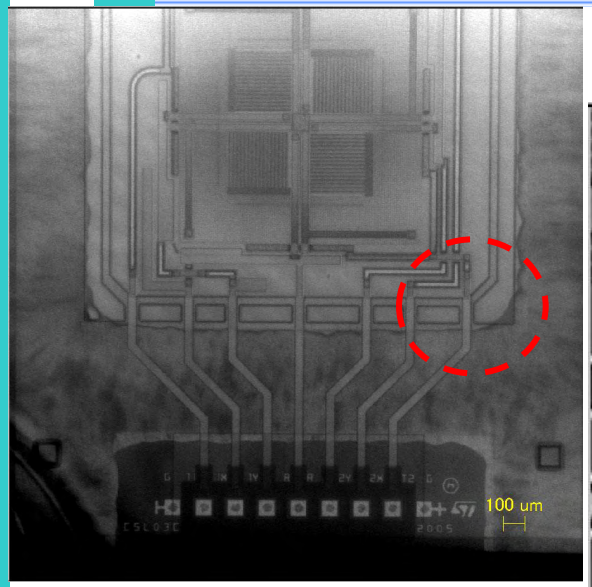
赤外線透過観察(低倍)

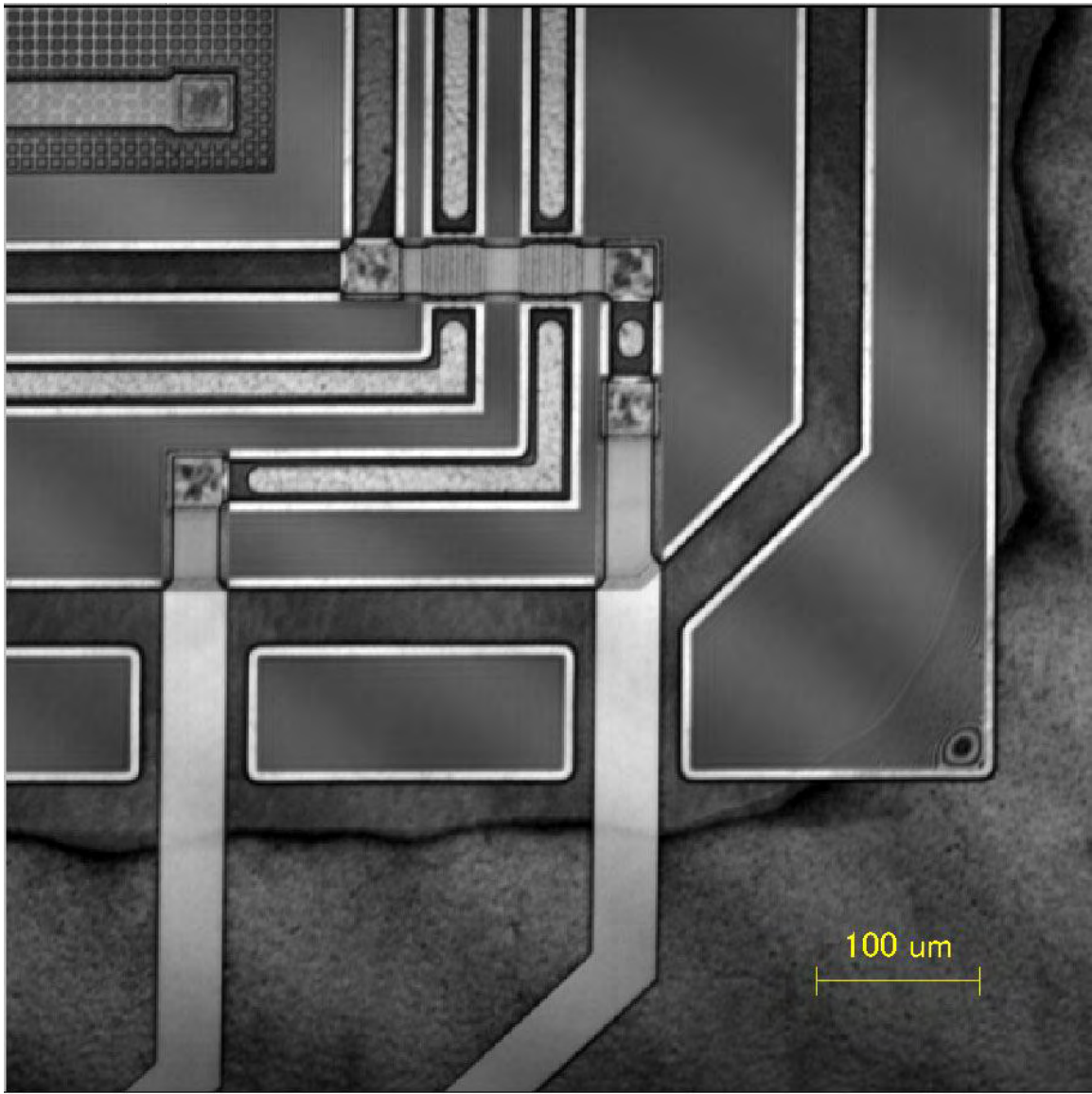


赤外線透過観察(中倍)

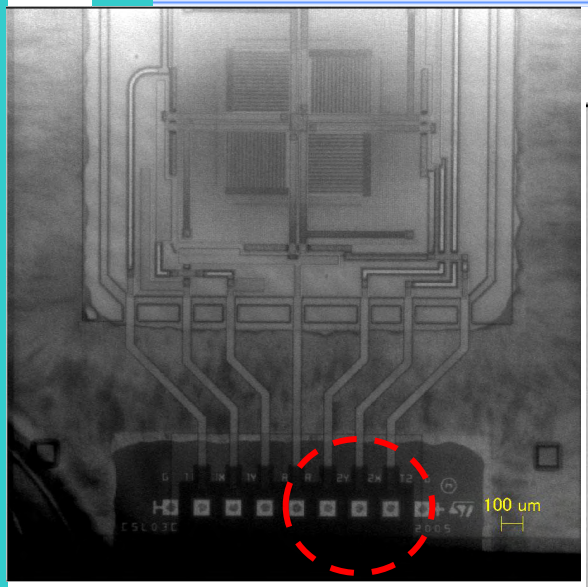


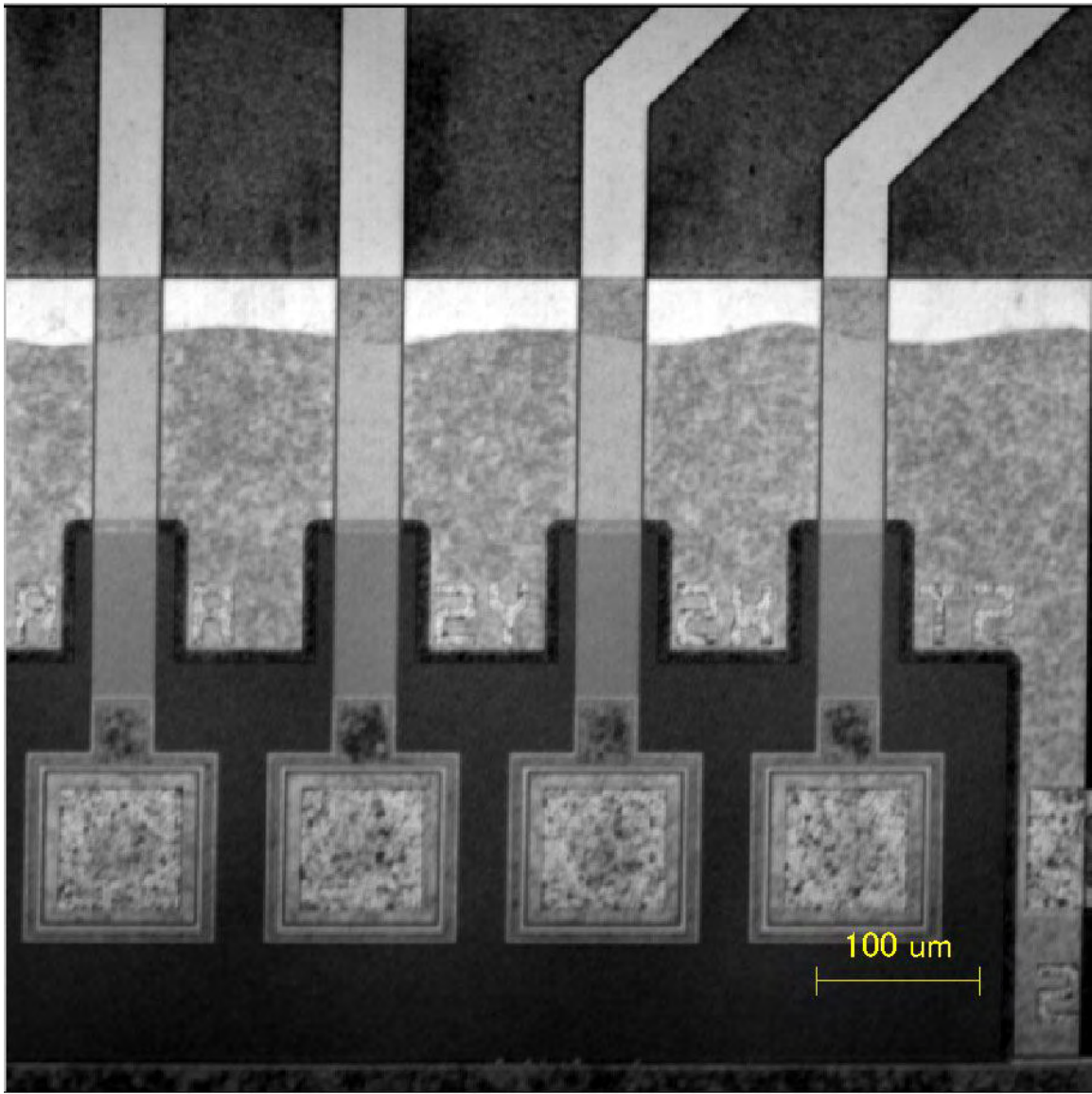
赤外線透過観察(高倍)



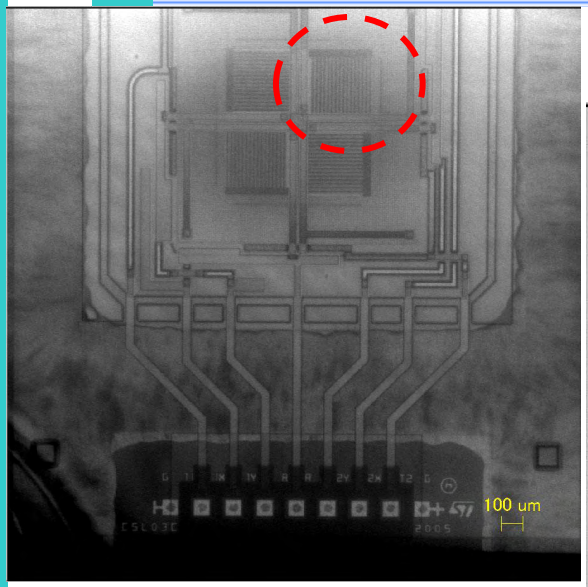


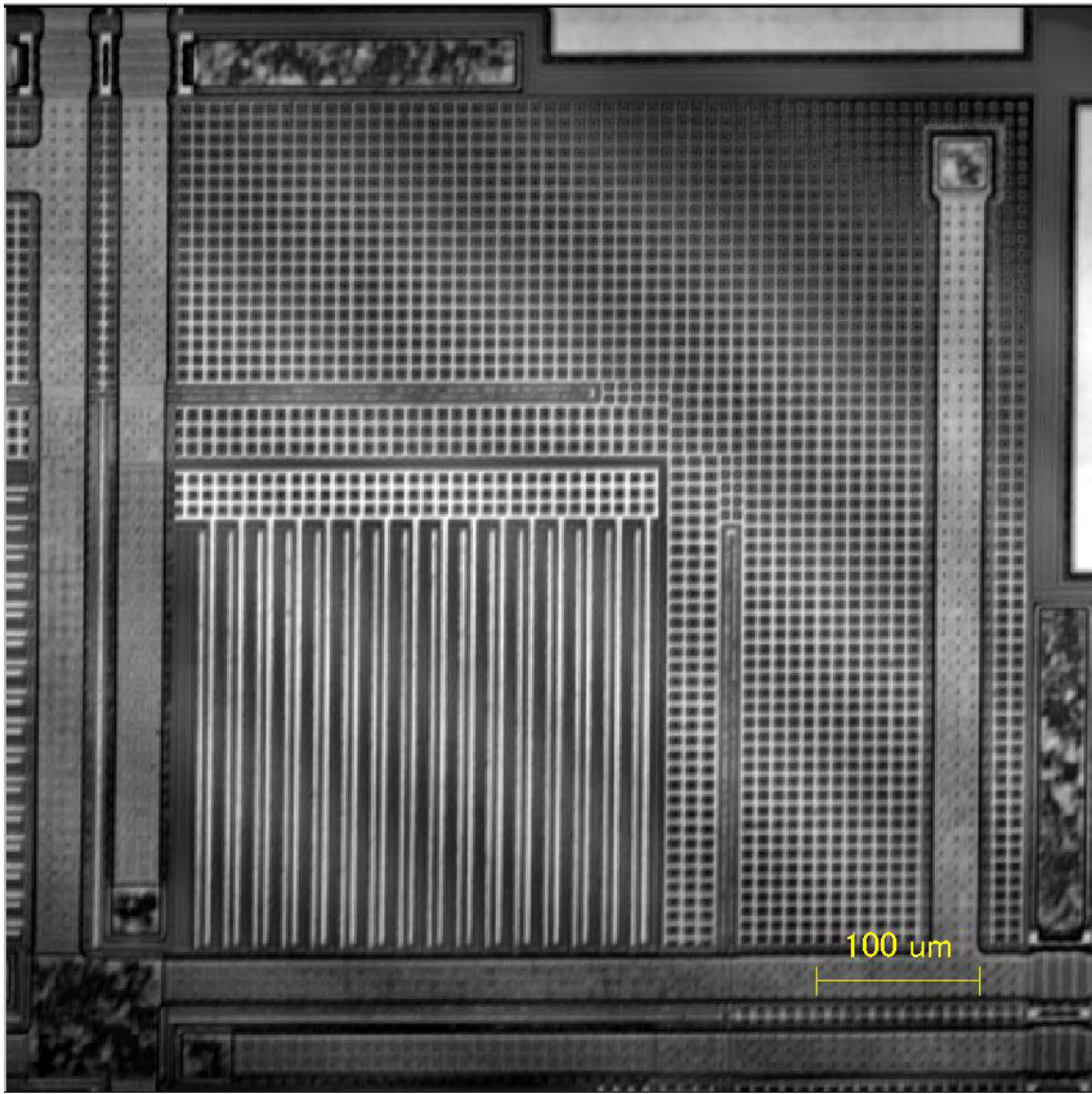
赤外線透過観察(高倍)



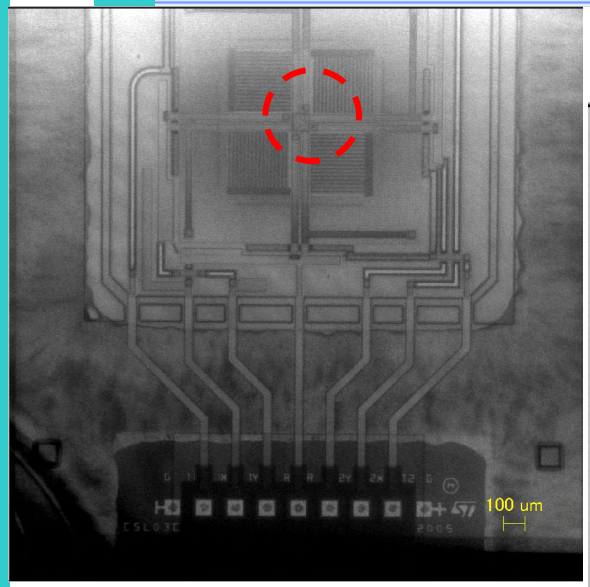


赤外線透過観察(高倍)





赤外線透過観察(高倍)

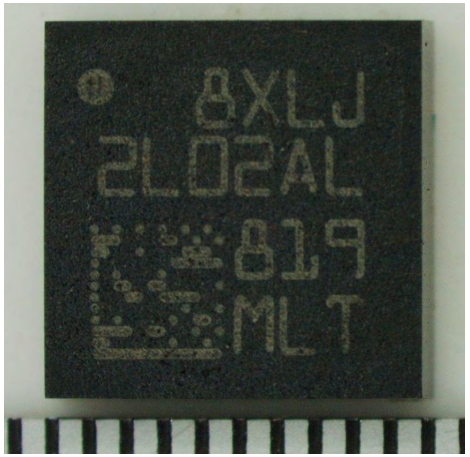


MEMS製品の構造解析技術

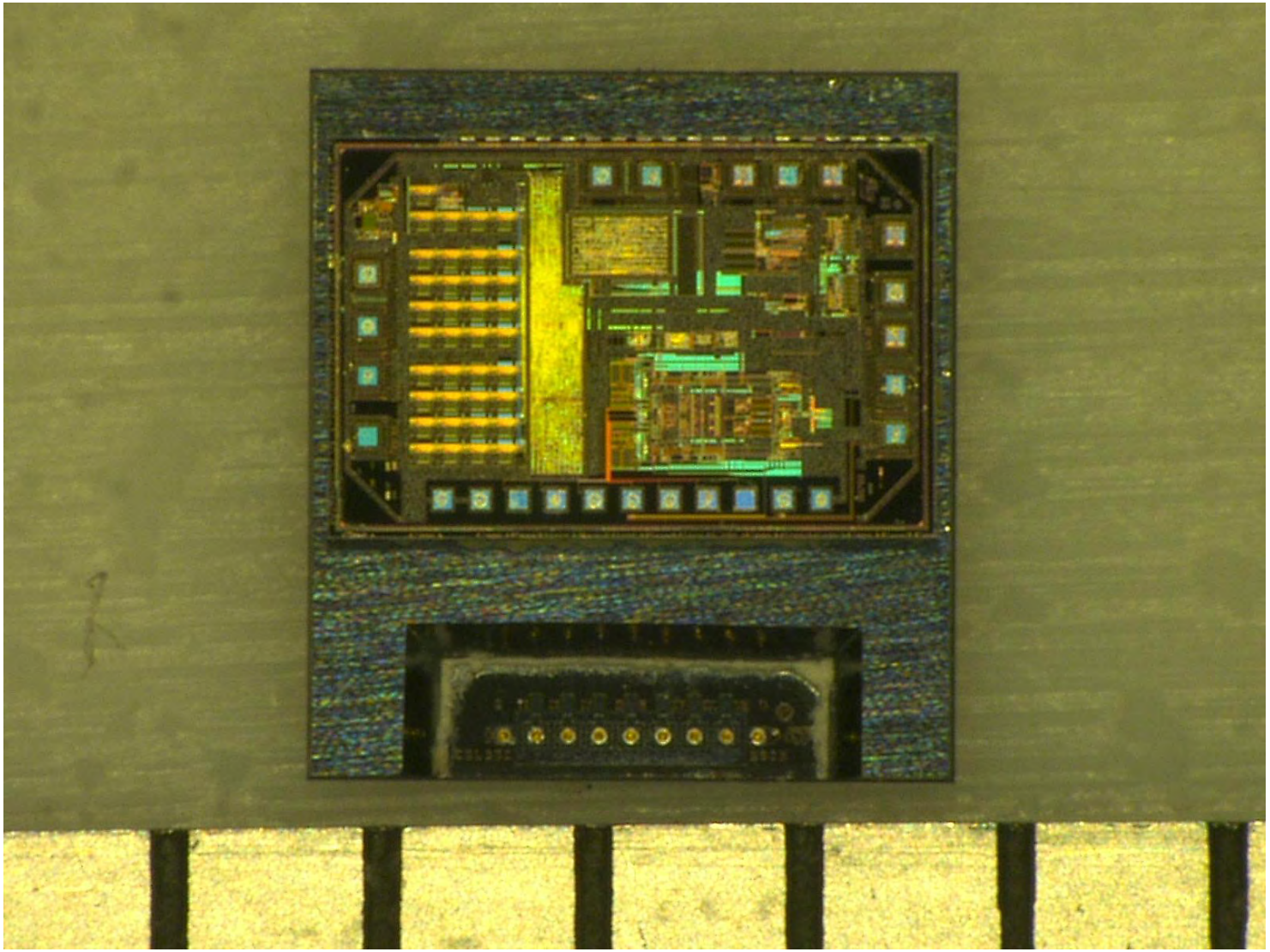
- パッケージ開封
  - チップの表面情報、形状

MEMS製品の構造解析技術

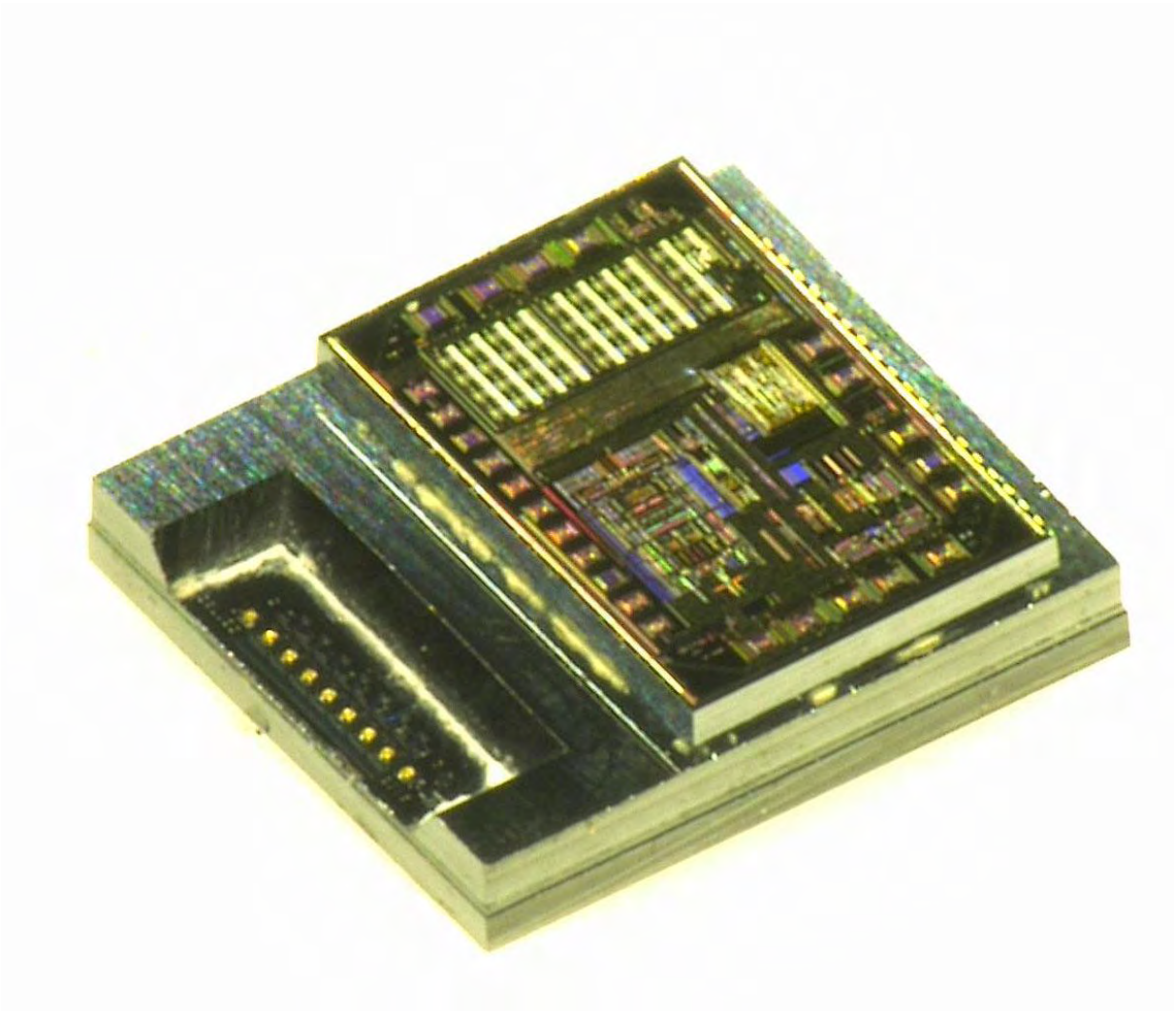
- パッケージ開封



光学顕微鏡観察



光学顕微鏡観察

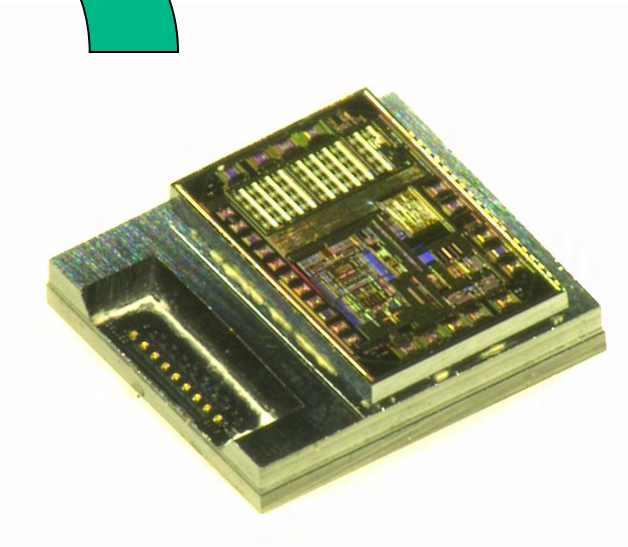


MEMS製品の構造解析技術

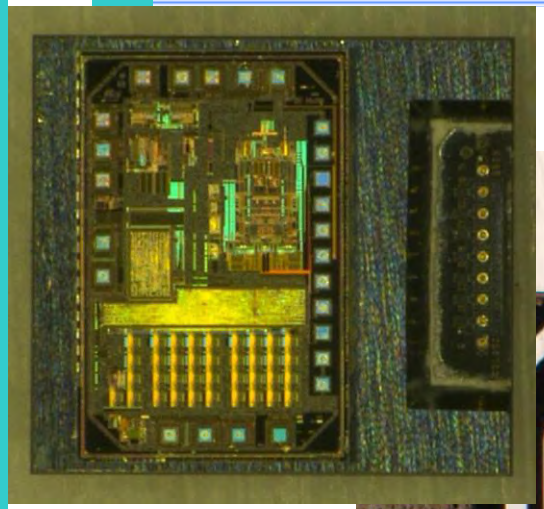
- 機械研磨（平面研磨、断面研磨）
  - 各層毎の配線パターン
  - センサー部 断面構造
  - 配線層断面構造
  - 接着樹脂断面構造
  - 内部空洞断面形状
  - 構成元素分析

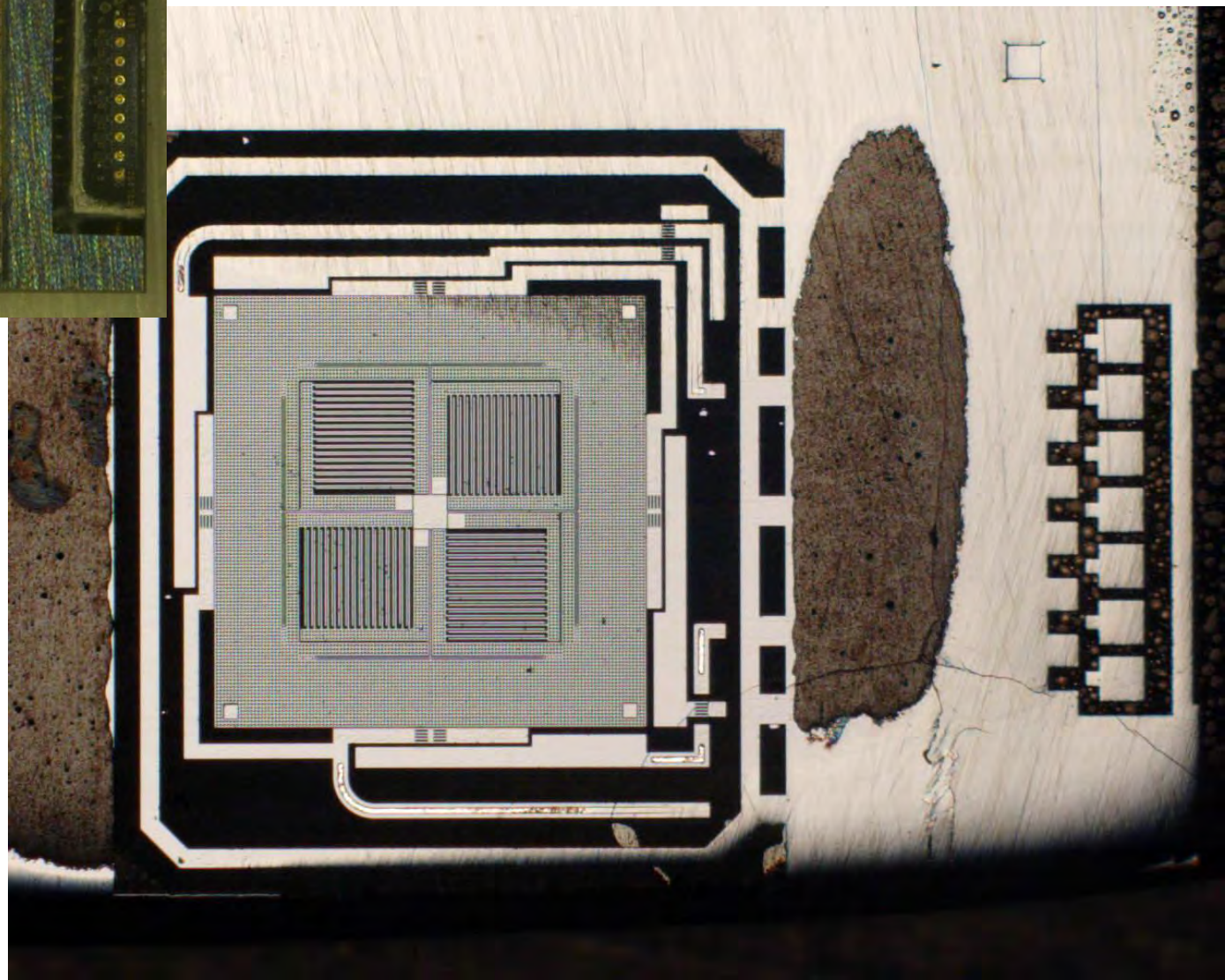
MEMS製品の構造解析技術

- 平面研磨・断面研磨

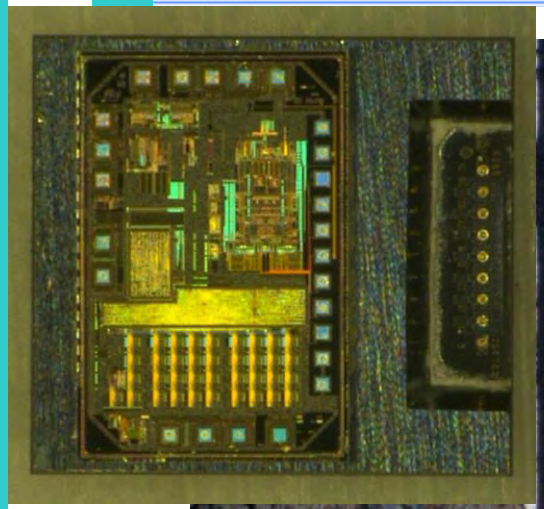


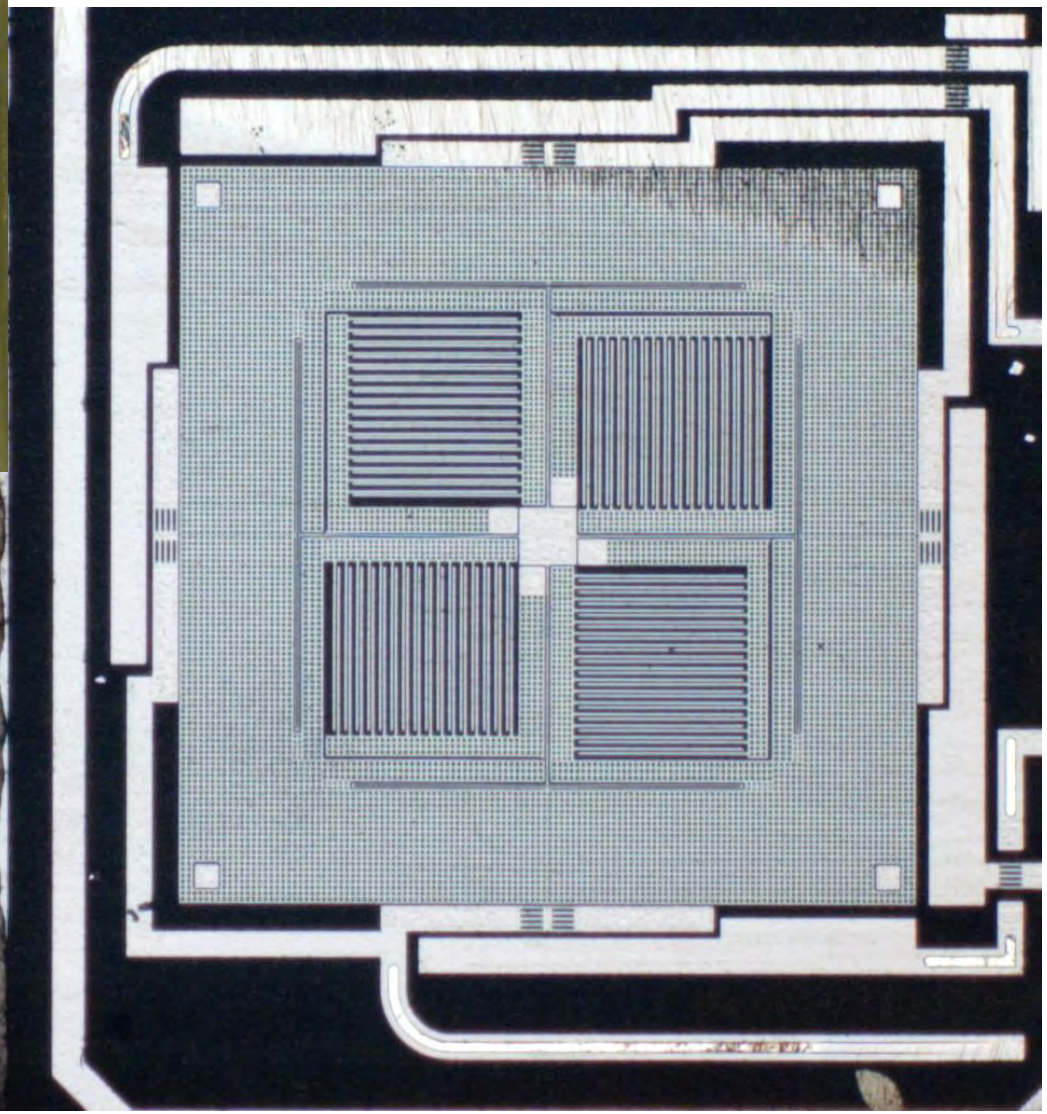
平面研磨(光学観察)



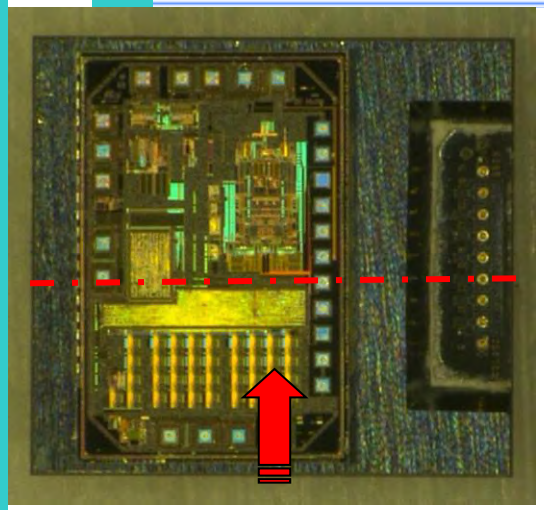


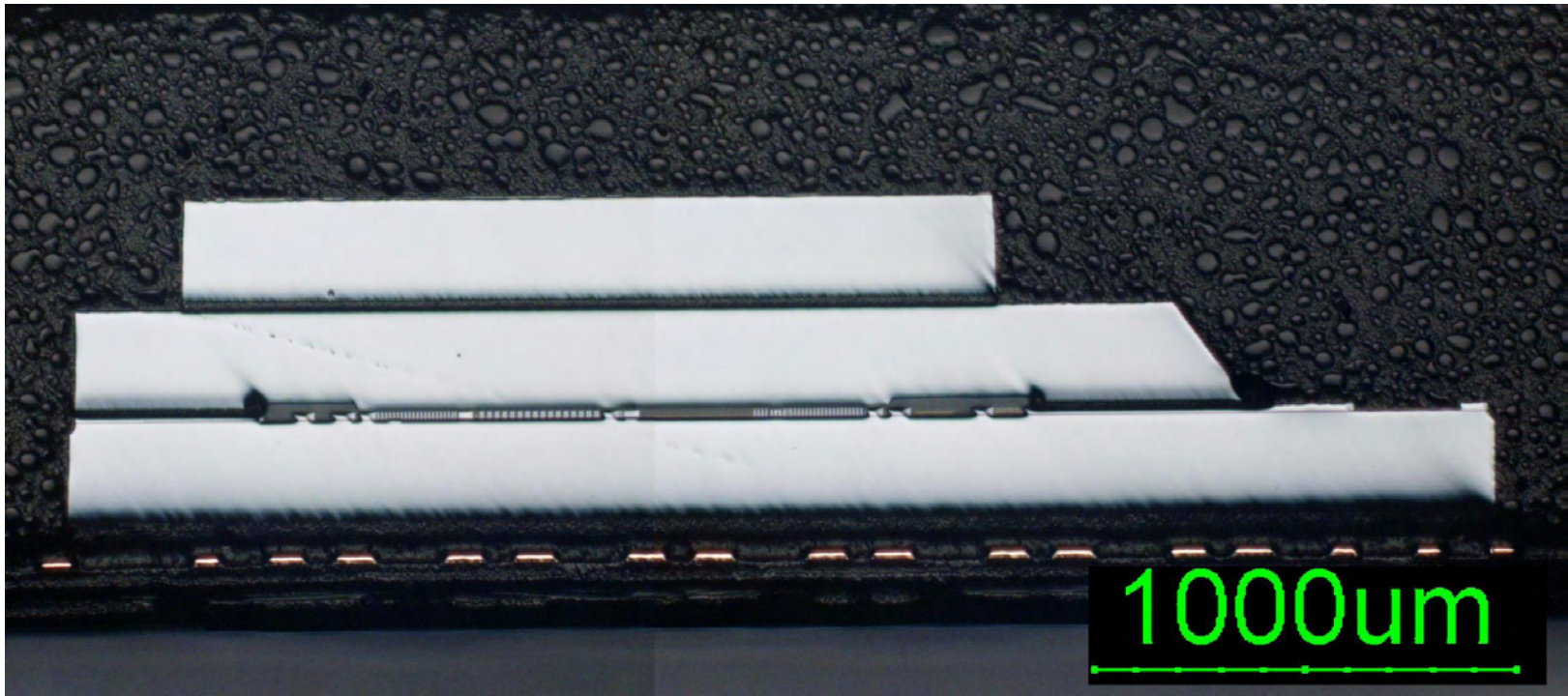
平面研磨(光学観察)



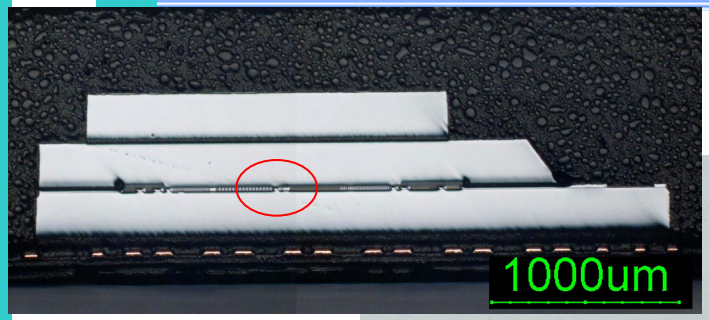


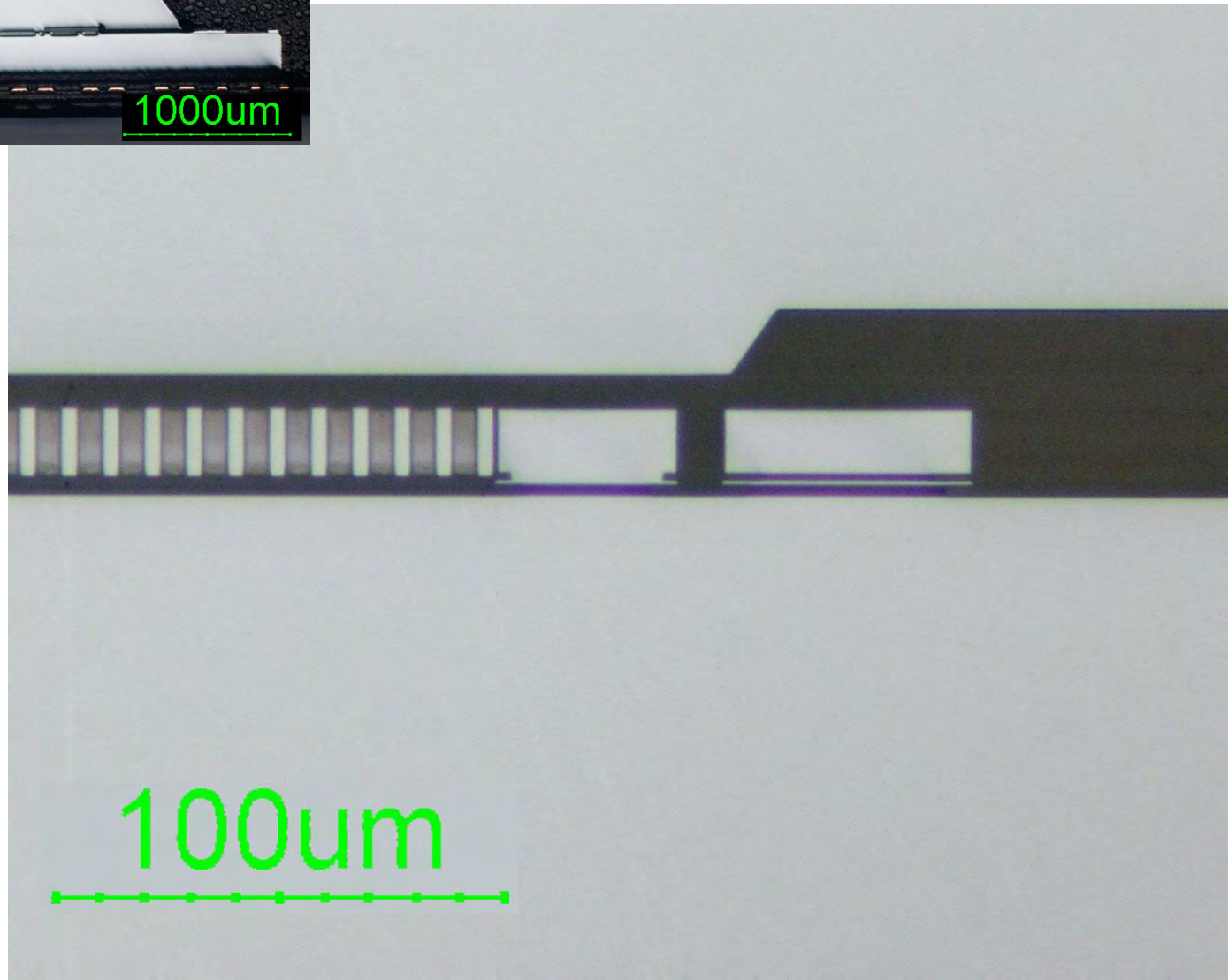
断面研磨(光学観察)



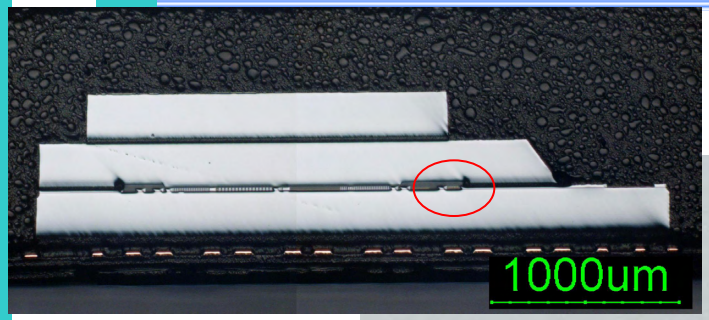


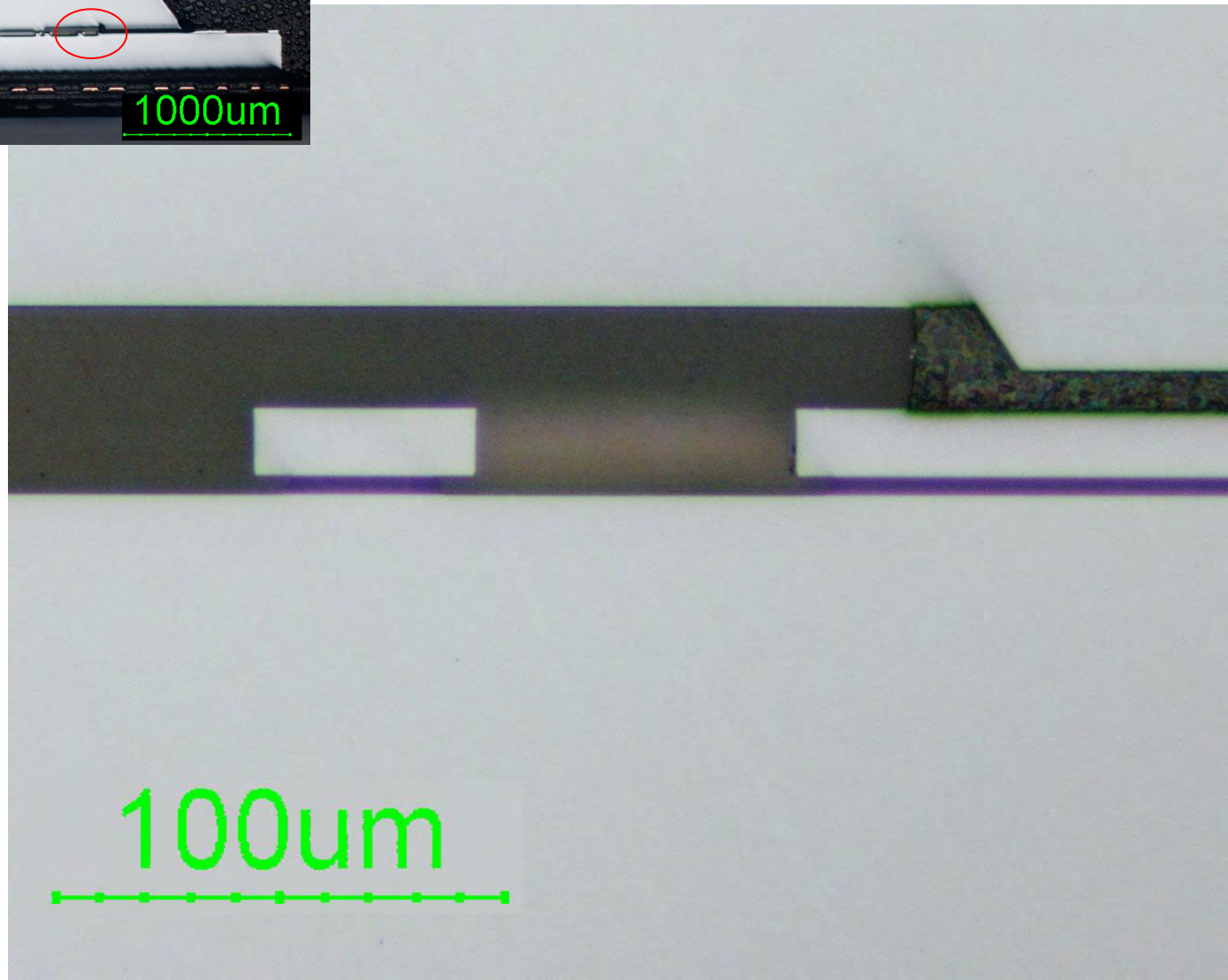
断面研磨(光学観察)



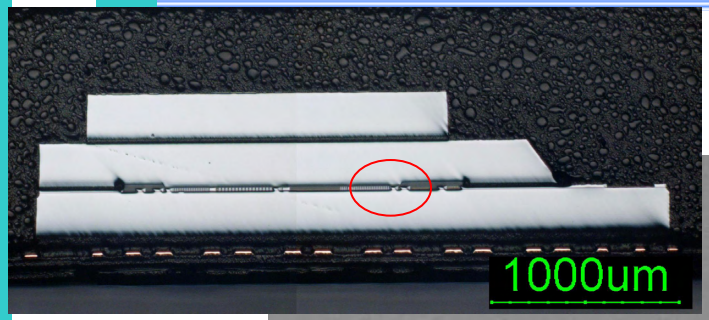


断面研磨(光学観察)



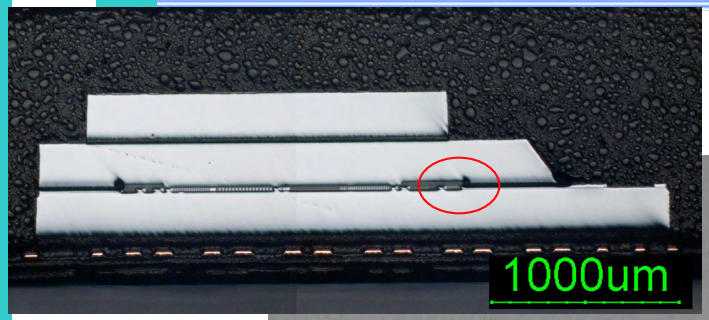


断面研磨（SEM観察）


1000um


10 µm
EHT = 3.00 kV
WD = 4 mm
Mag = 450 X
Signal A = SE2
ESB Grid is = 792 V

断面研磨（SEM観察）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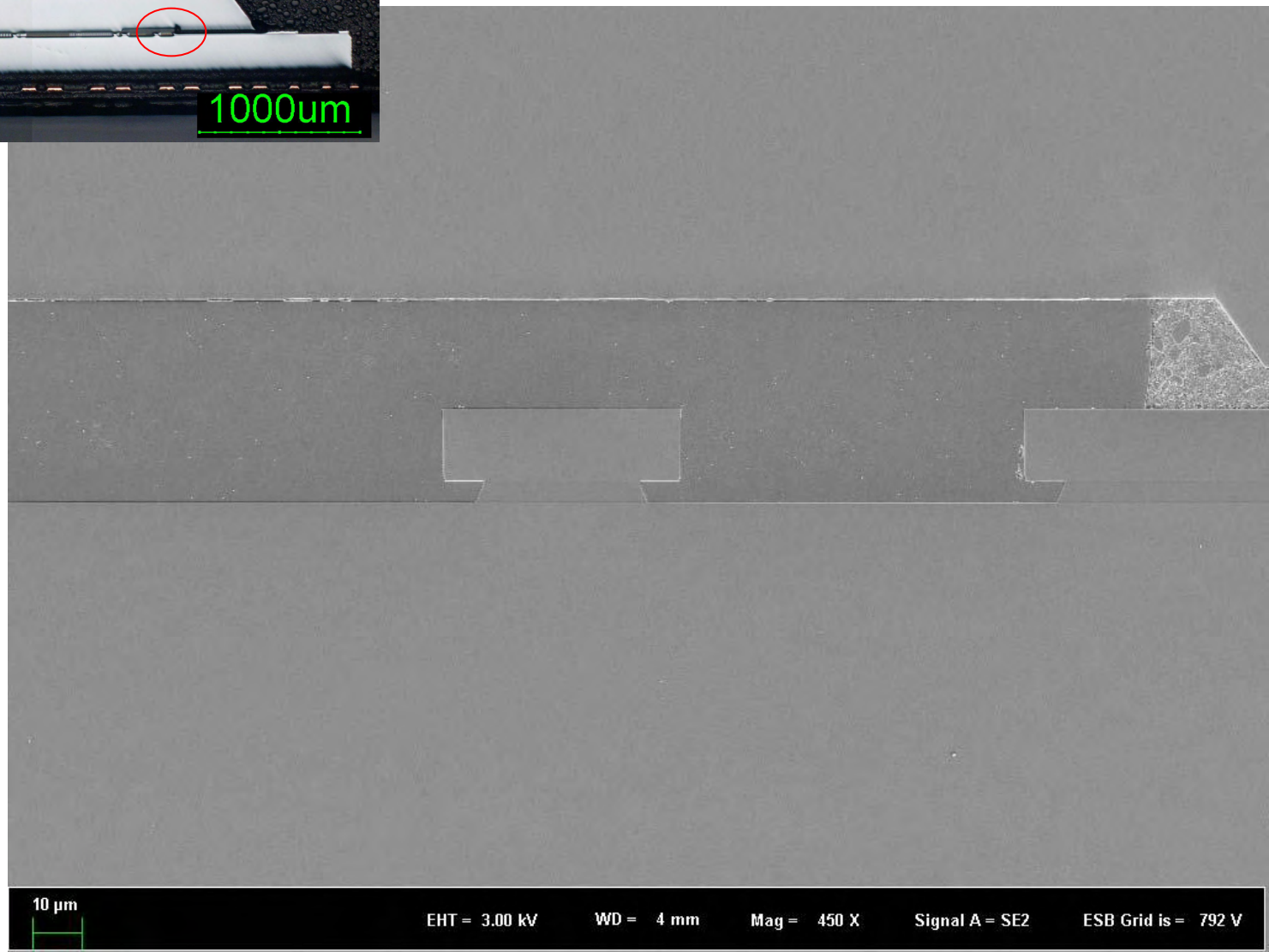
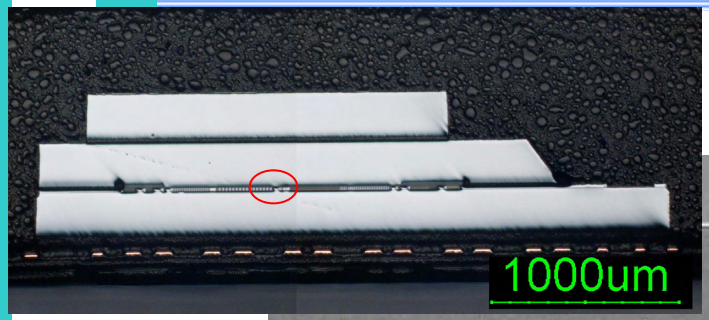
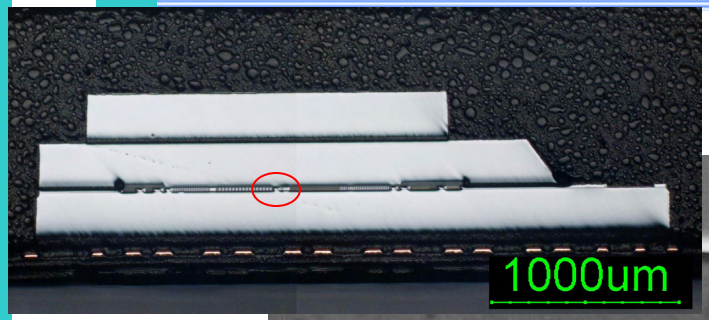

10 µm
EHT = 3.00 kV
WD = 4 mm
Mag = 450 X
Signal A = SE2
ESB Grid is = 792 V

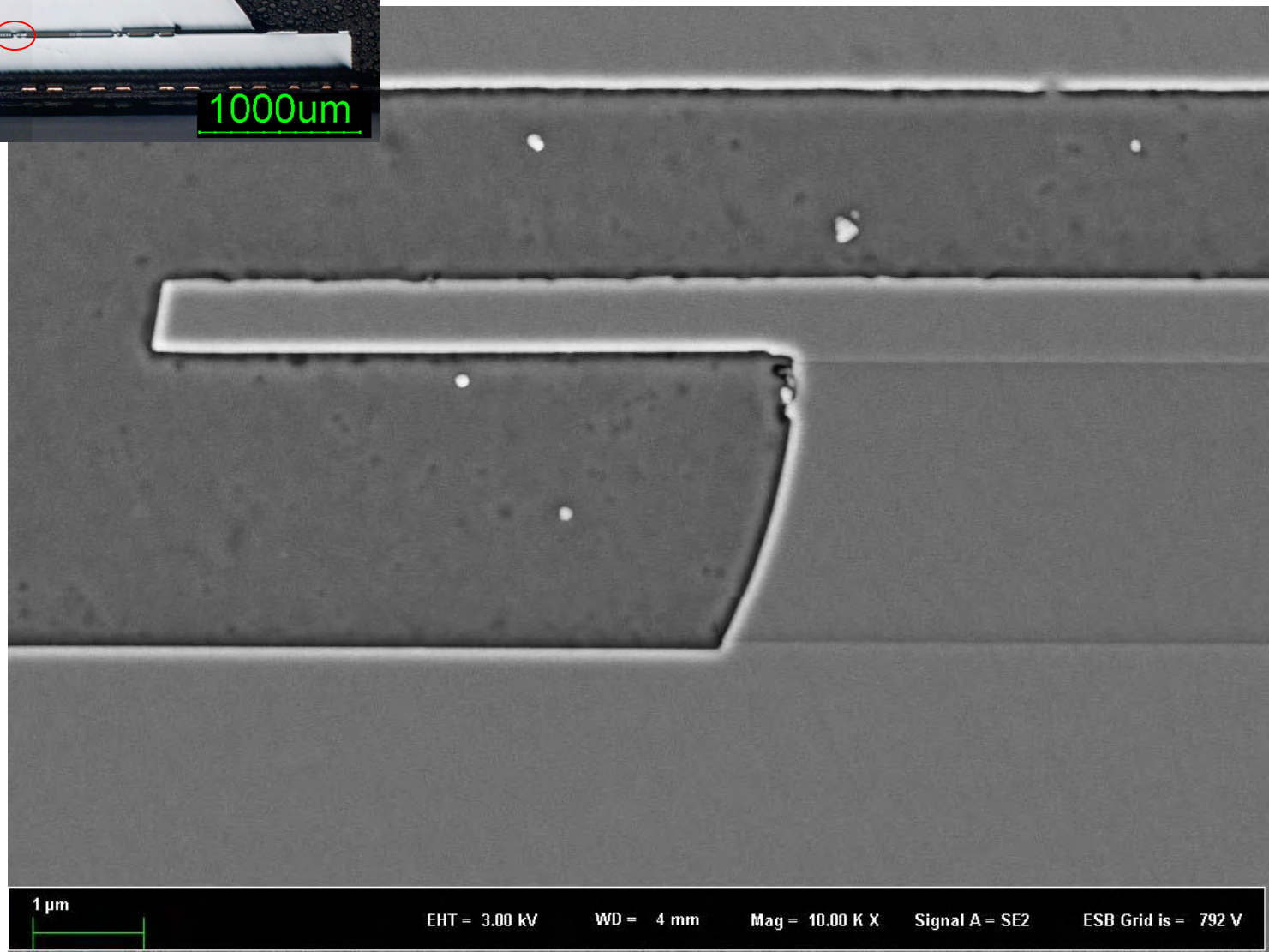
断面研磨（SEM観察）


1000um

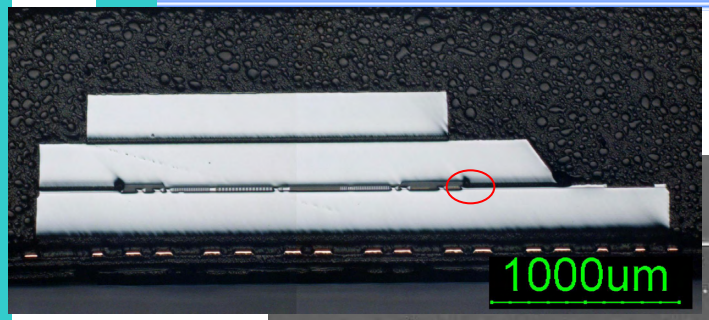

10 µm
EHT = 3.00 kV
WD = 4 mm
Mag = 2.00 K X
Signal A = SE2
ESB Grid is = 792 V

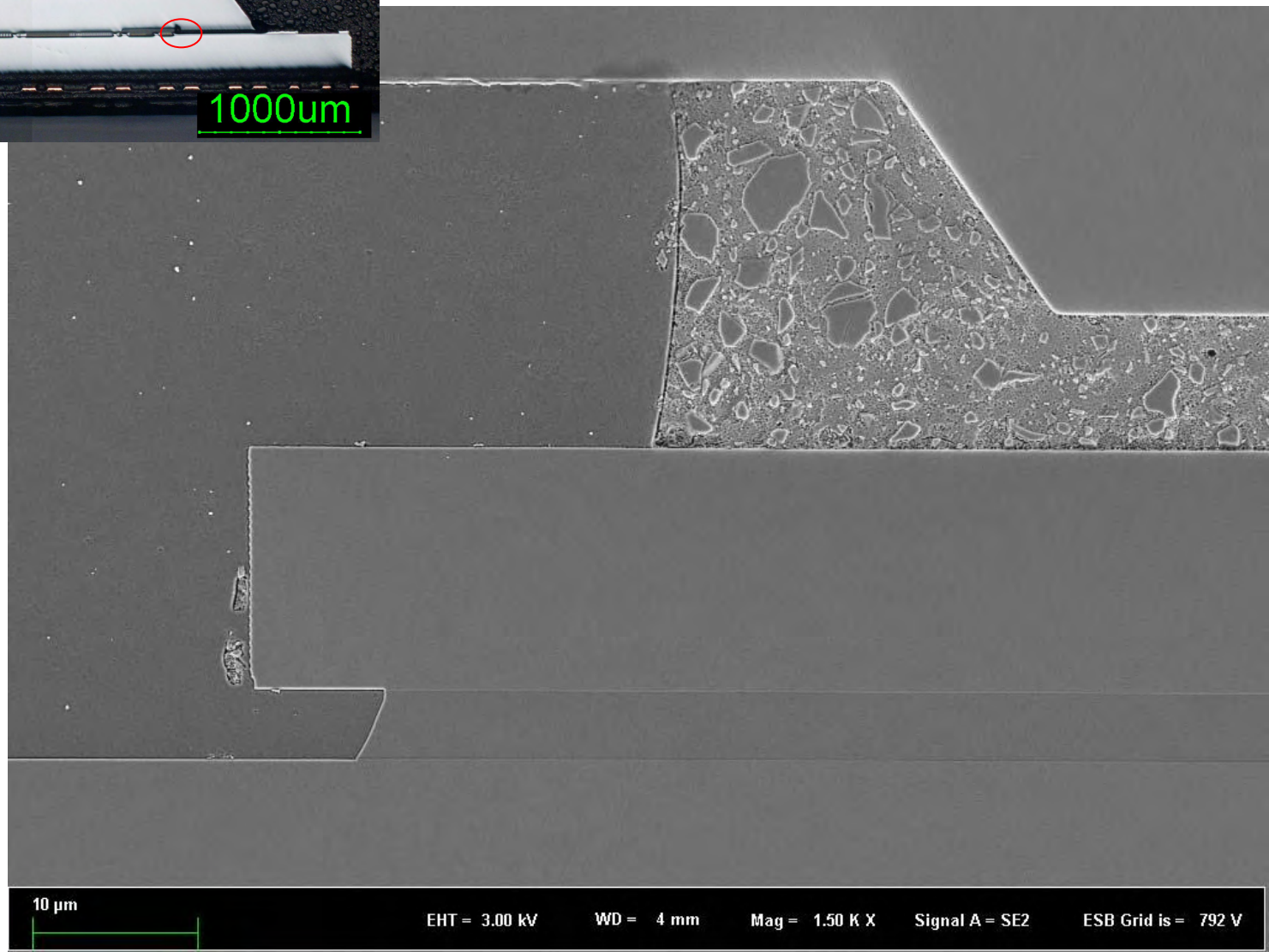
断面研磨（SEM観察）


1000um


1 µm
EHT = 3.00 kV
WD = 4 mm
Mag = 10.00 K X
Signal A = SE2
ESB Grid is = 792 V

断面研磨（SEM観察）


1000um


10 µm
EHT = 3.00 kV
WD = 4 mm
Mag = 1.50 K X
Signal A = SE2
ESB Grid is = 792 V

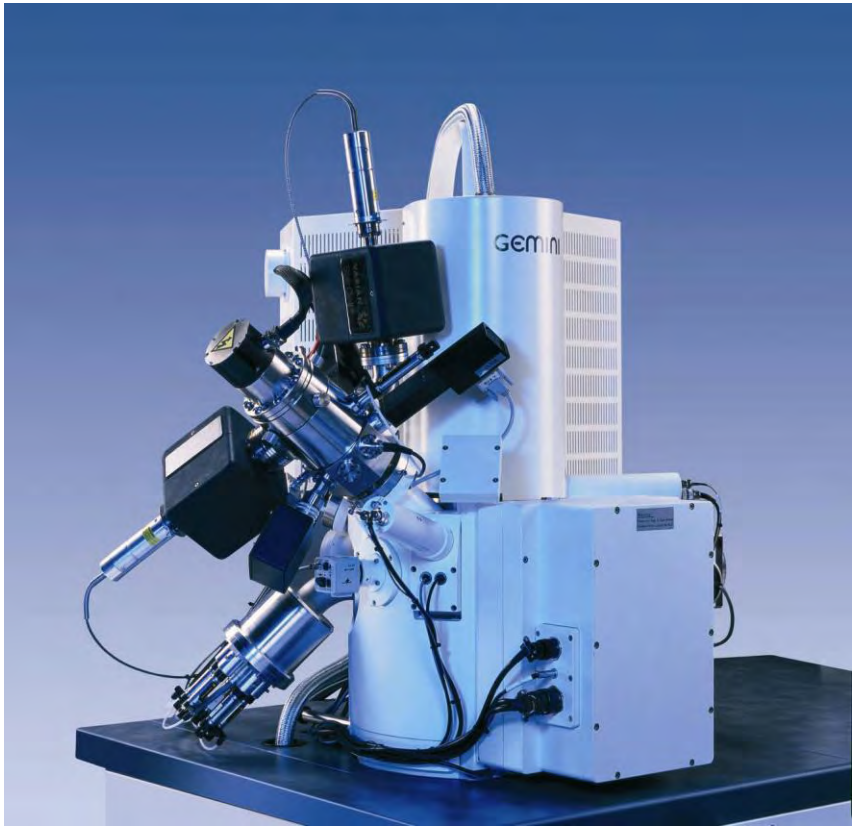
MEMS製品の構造解析技術

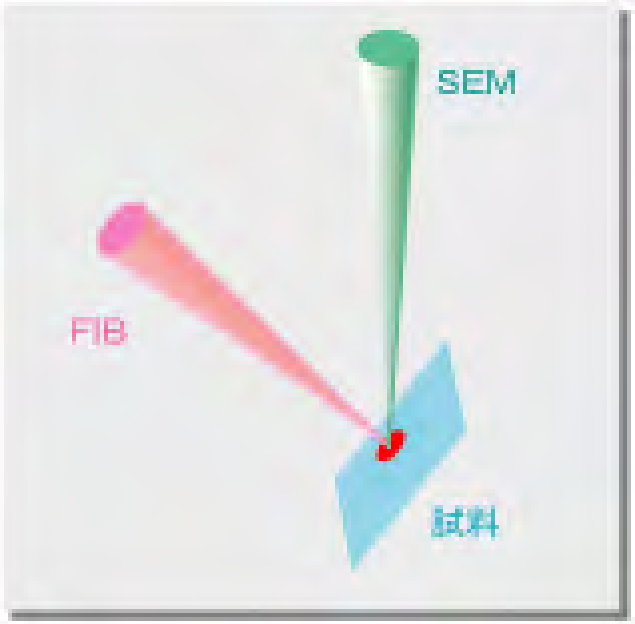
- FIBによる断面SEM観察
  - ピンポイントでの加工観察
  - 空洞部など各形状の観察
  - ダイヤフラムなど薄膜部の微細断面構造観察

MEMS製品の構造解析技術

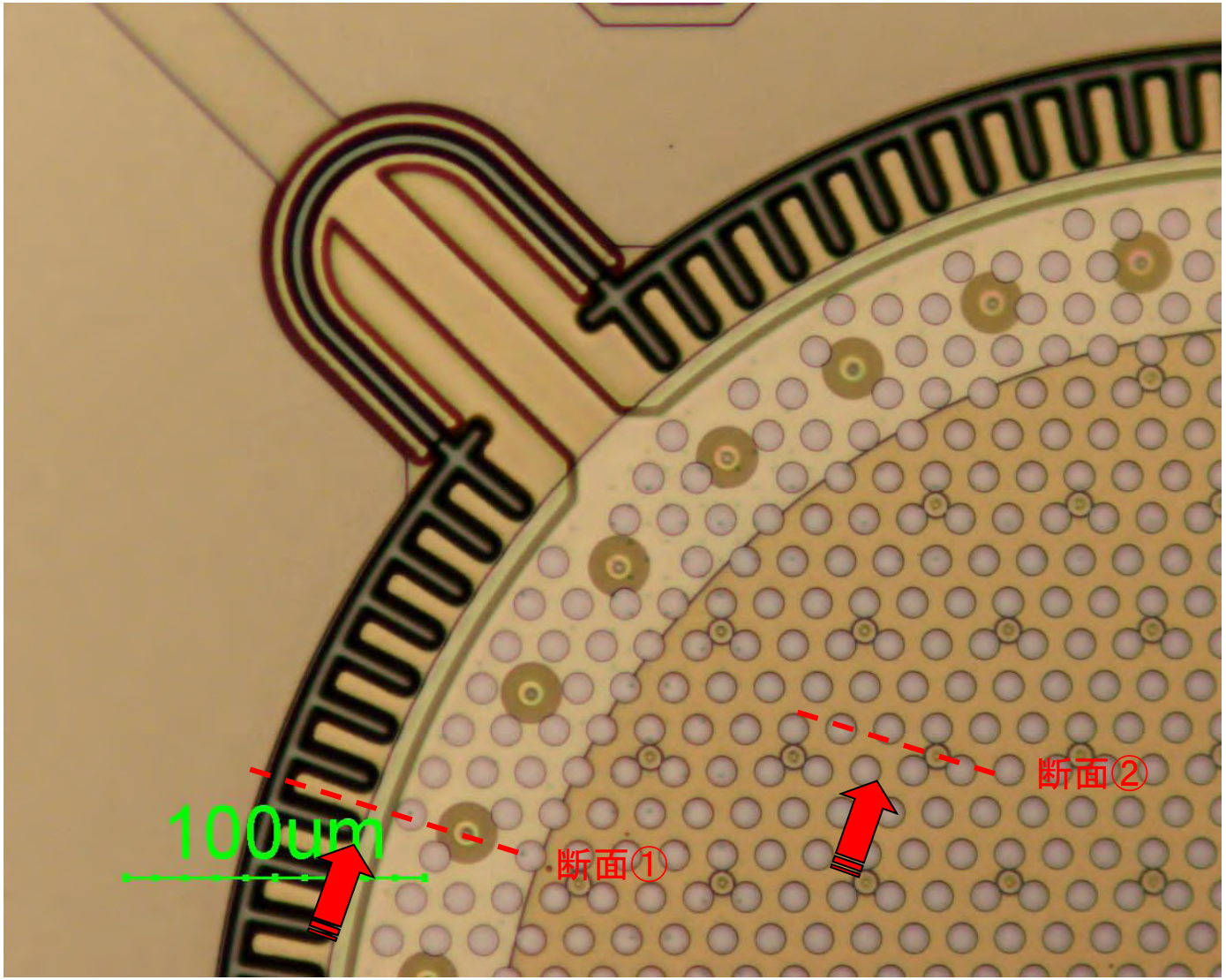
- **FIB加工・断面SEM観察**

加工中の断面をリアルタイムでSEM観察

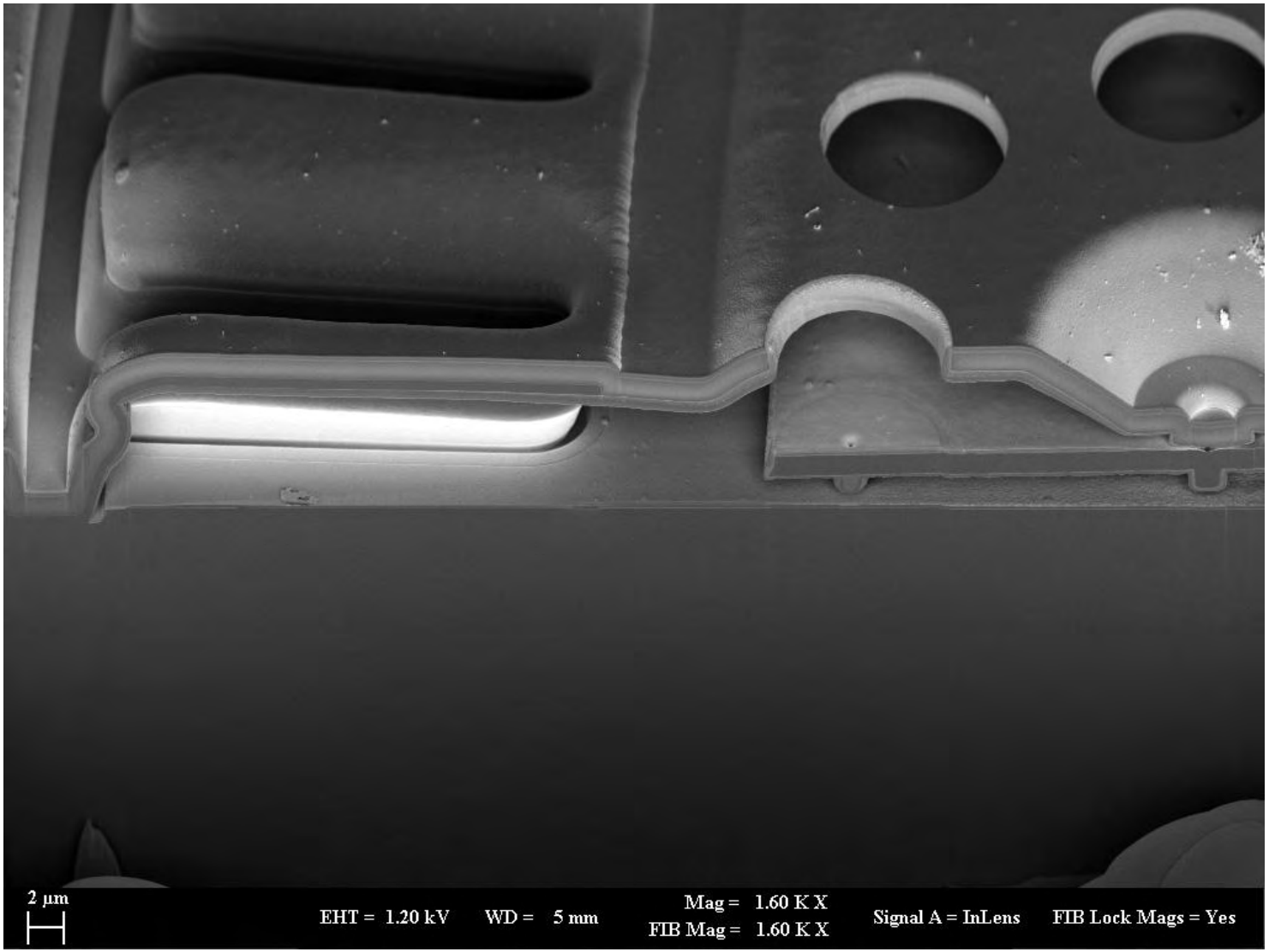




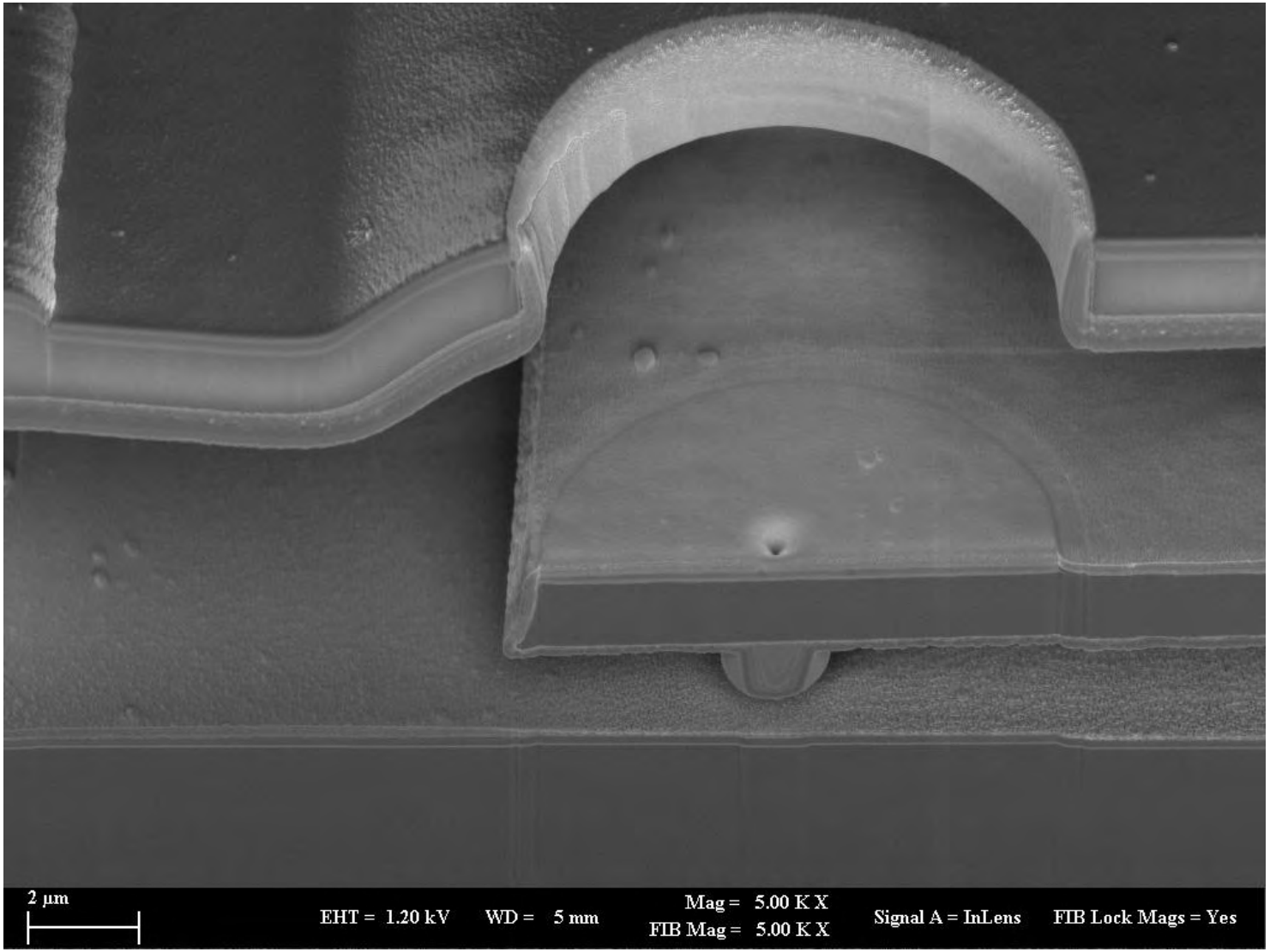
FIBによる断面SEM観察



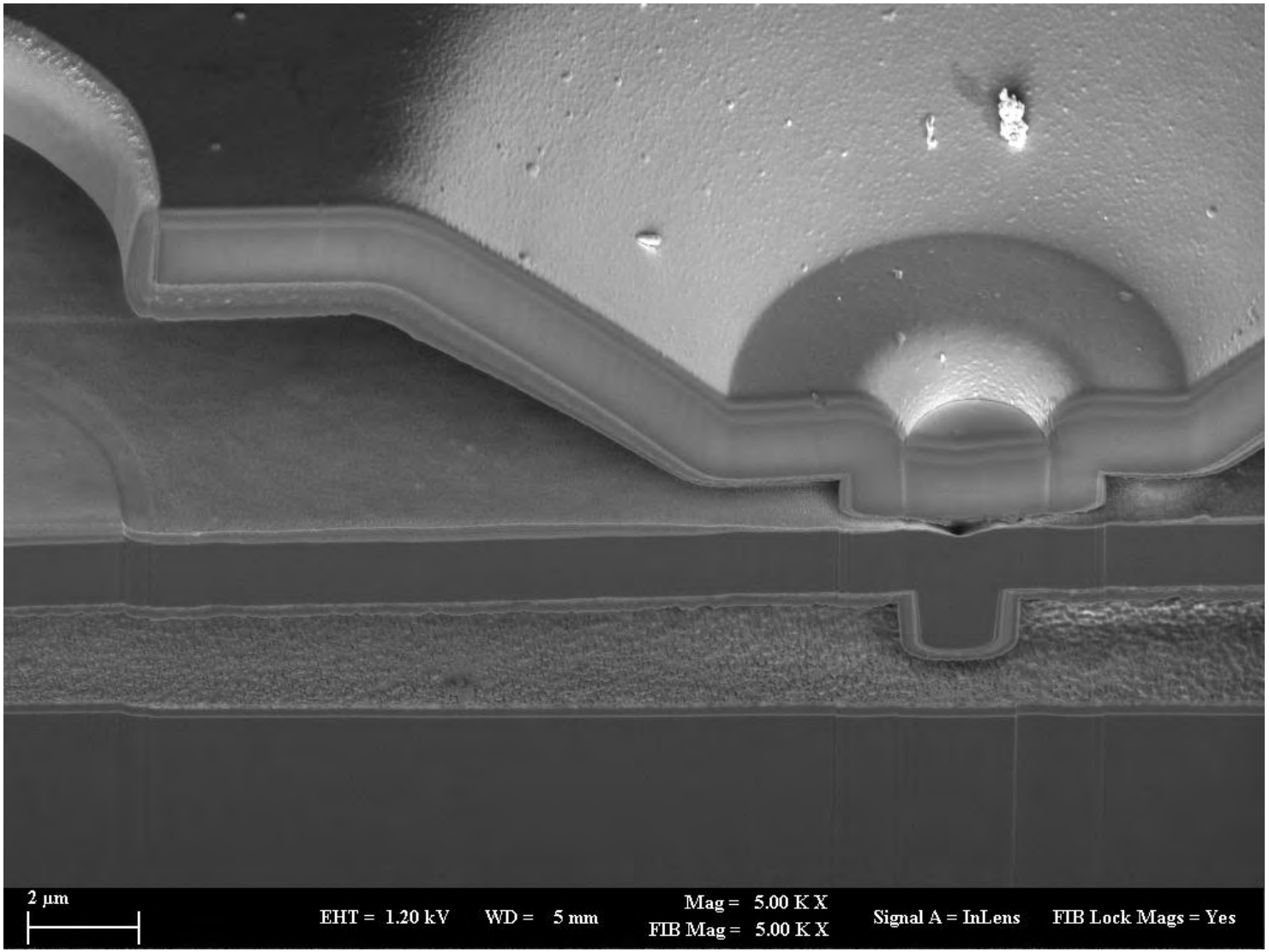
断面①


2 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 1.60 K X
FIB Mag = 1.60 K X
Signal A = InLens
FIB Lock Mags = Yes

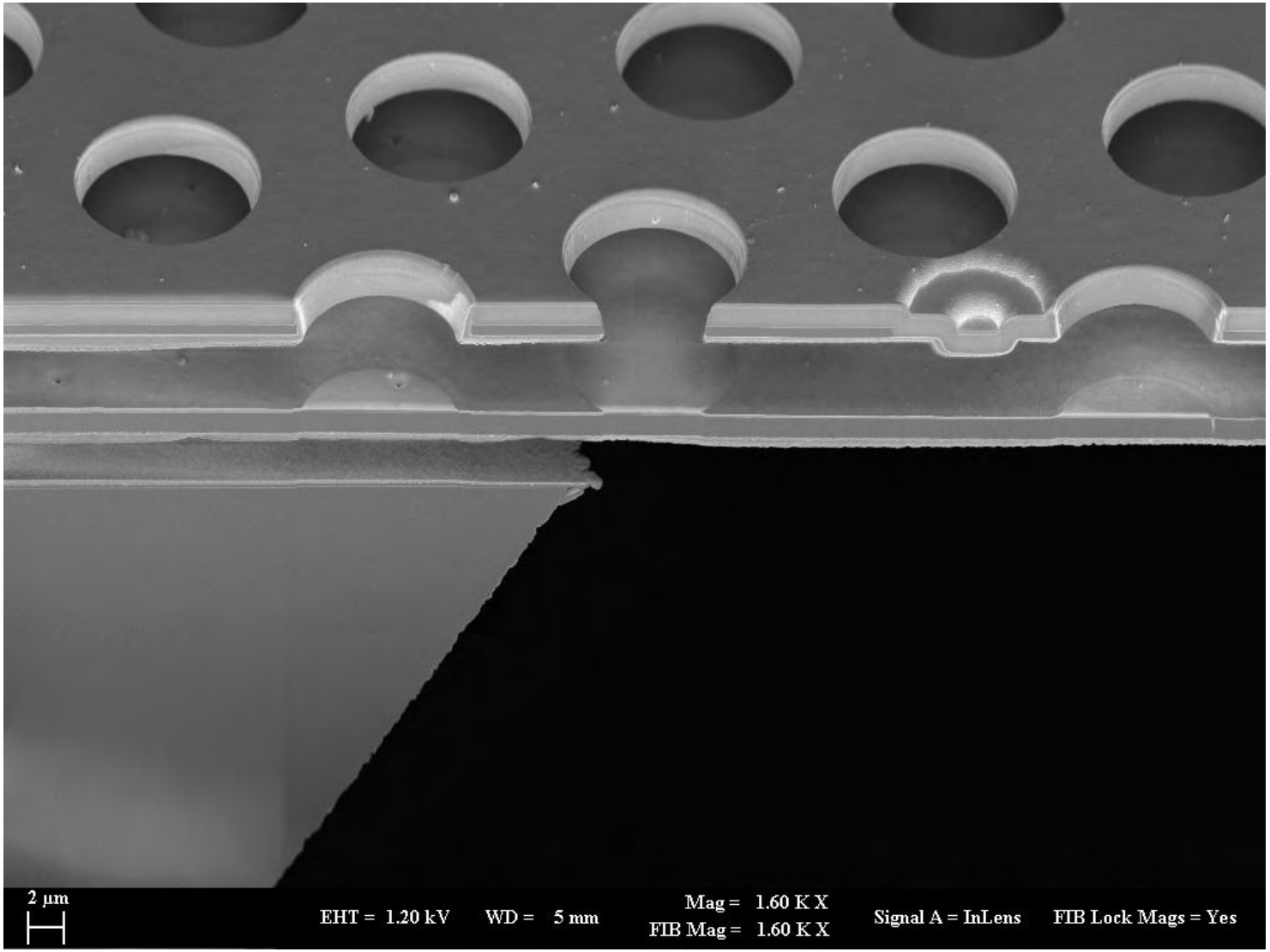
断面①


2 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 5.00 K X
FIB Mag = 5.00 K X
Signal A = InLens
FIB Lock Mags = Yes

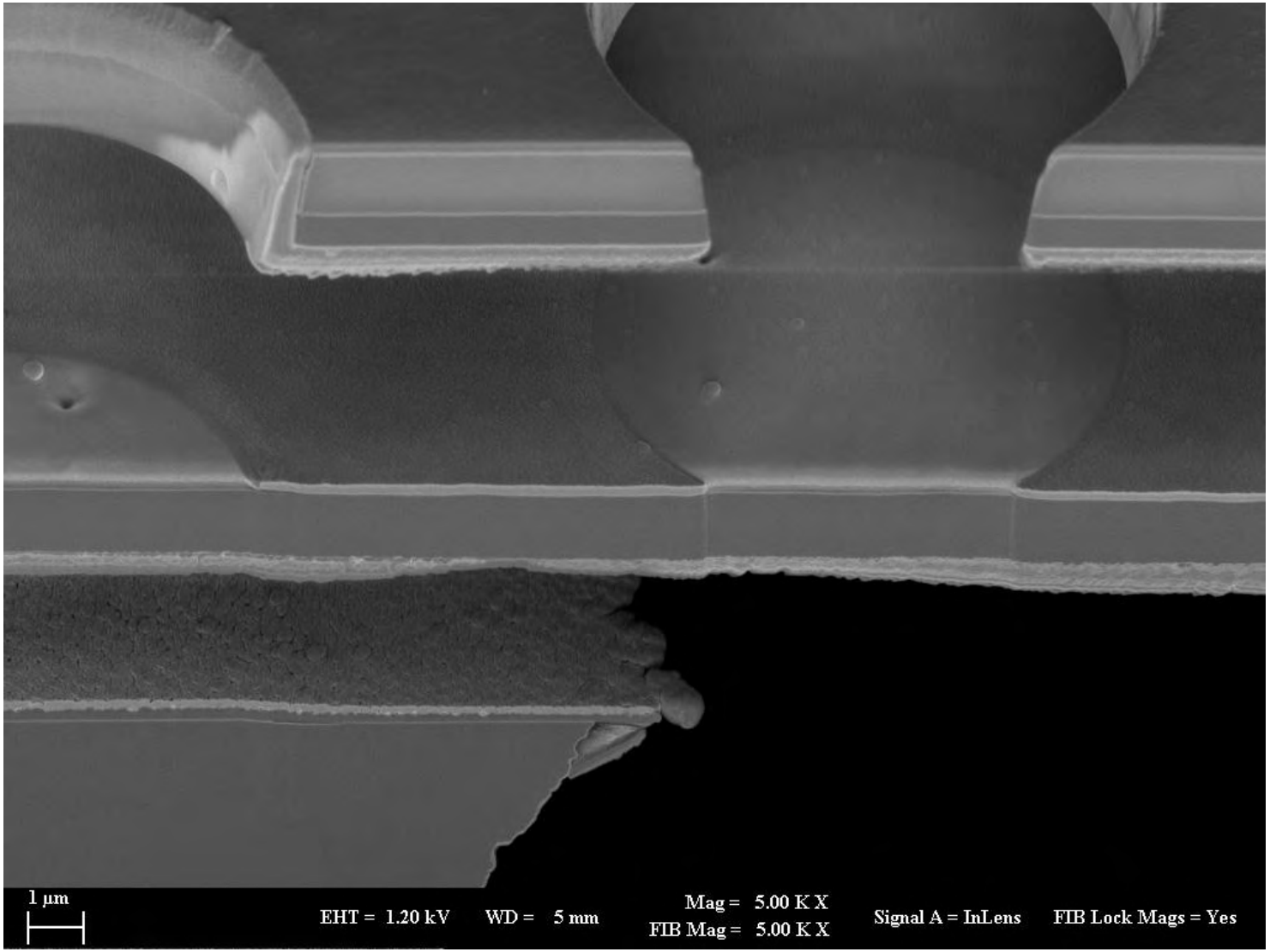
断面①


2 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 5.00 K X
FIB Mag = 5.00 K X
Signal A = InLens
FIB Lock Mags = Yes

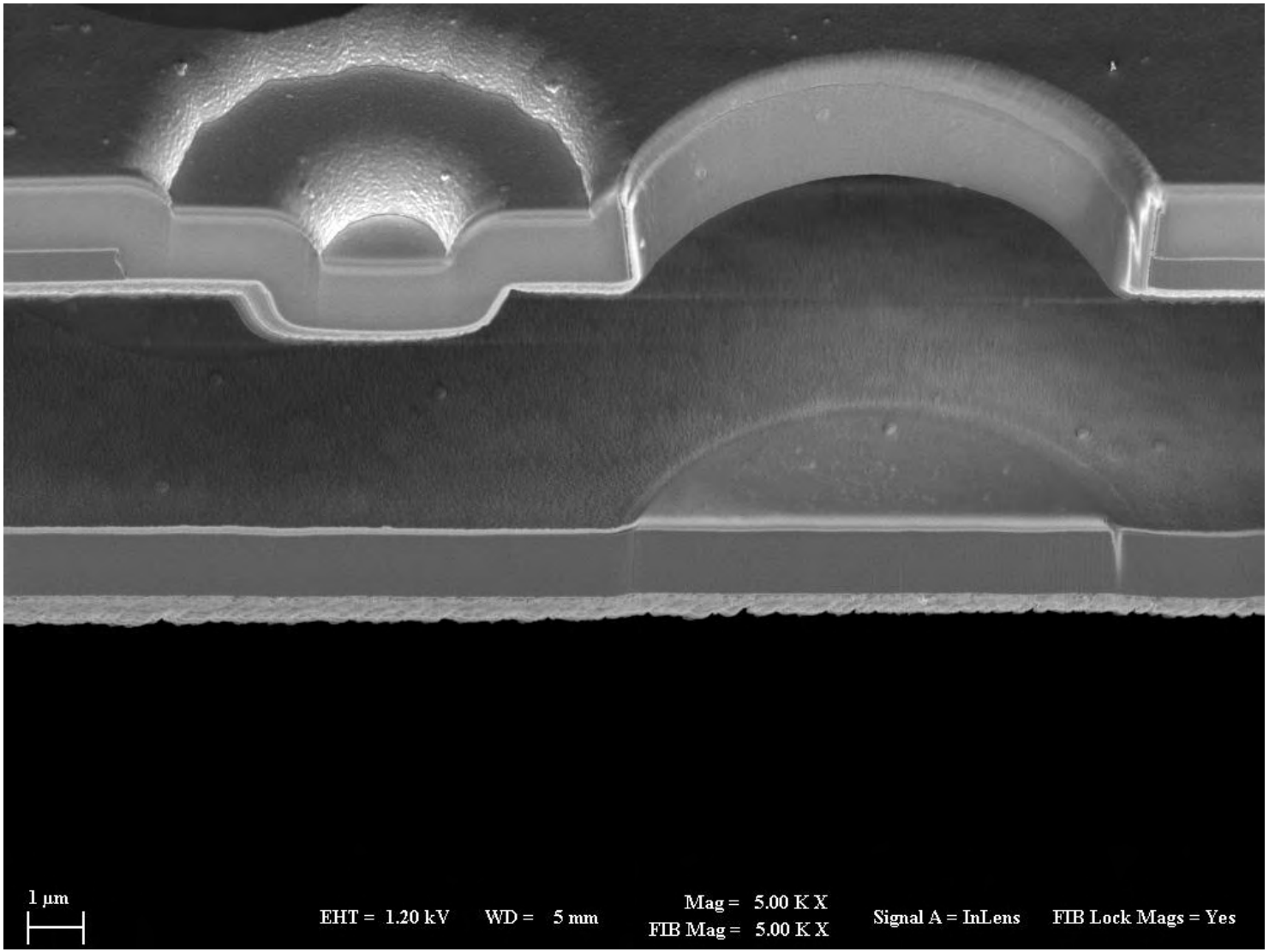
断面②


2 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 1.60 K X
FIB Mag = 1.60 K X
Signal A = InLens
FIB Lock Mags = Yes

断面②


1 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 5.00 K X
FIB Mag = 5.00 K X
Signal A = InLens
FIB Lock Mags = Yes

断面②


1 µm
EHT = 1.20 kV
WD = 5 mm
Mag = 5.00 K X
FIB Mag = 5.00 K X
Signal A = InLens
FIB Lock Mags = Yes

MEMS製品の構造解析技術

- 結晶粒の断面SEM観察
  - 広範囲に観察
  - 接合部の詳細な観察
    （グレイン、空洞、合金層、
    有機層）

Al の結晶粒観察

- 極低加速電圧SEM

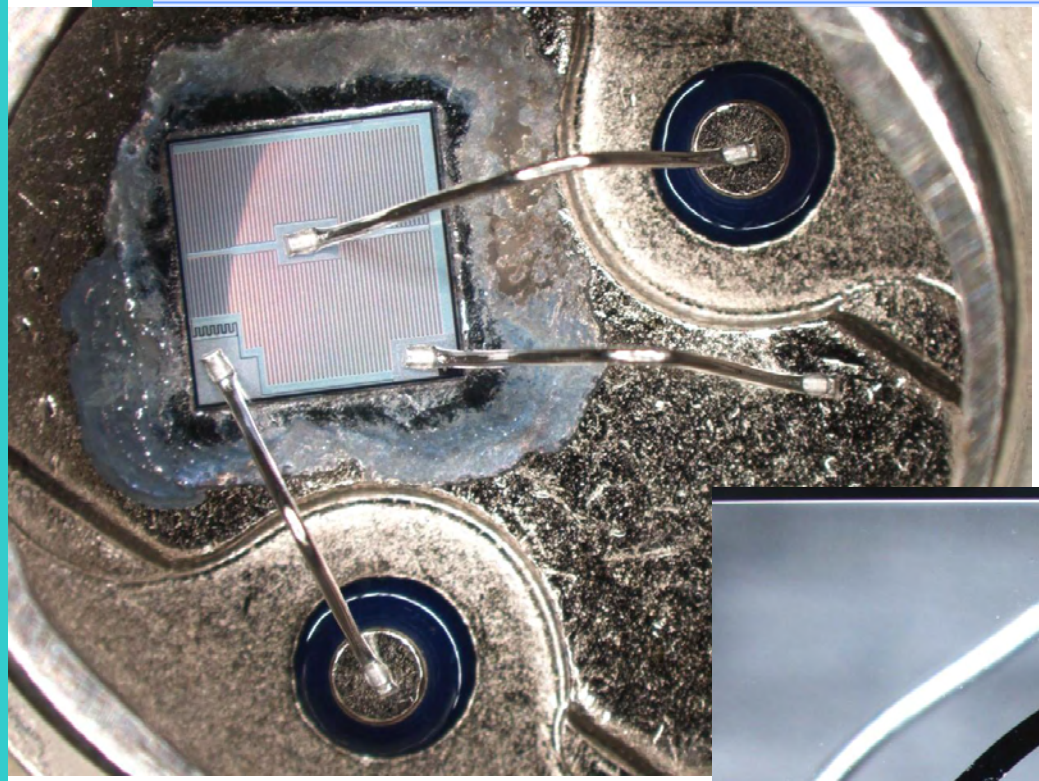
In-Lens SE像：

表面・物質の状態が良く分かる

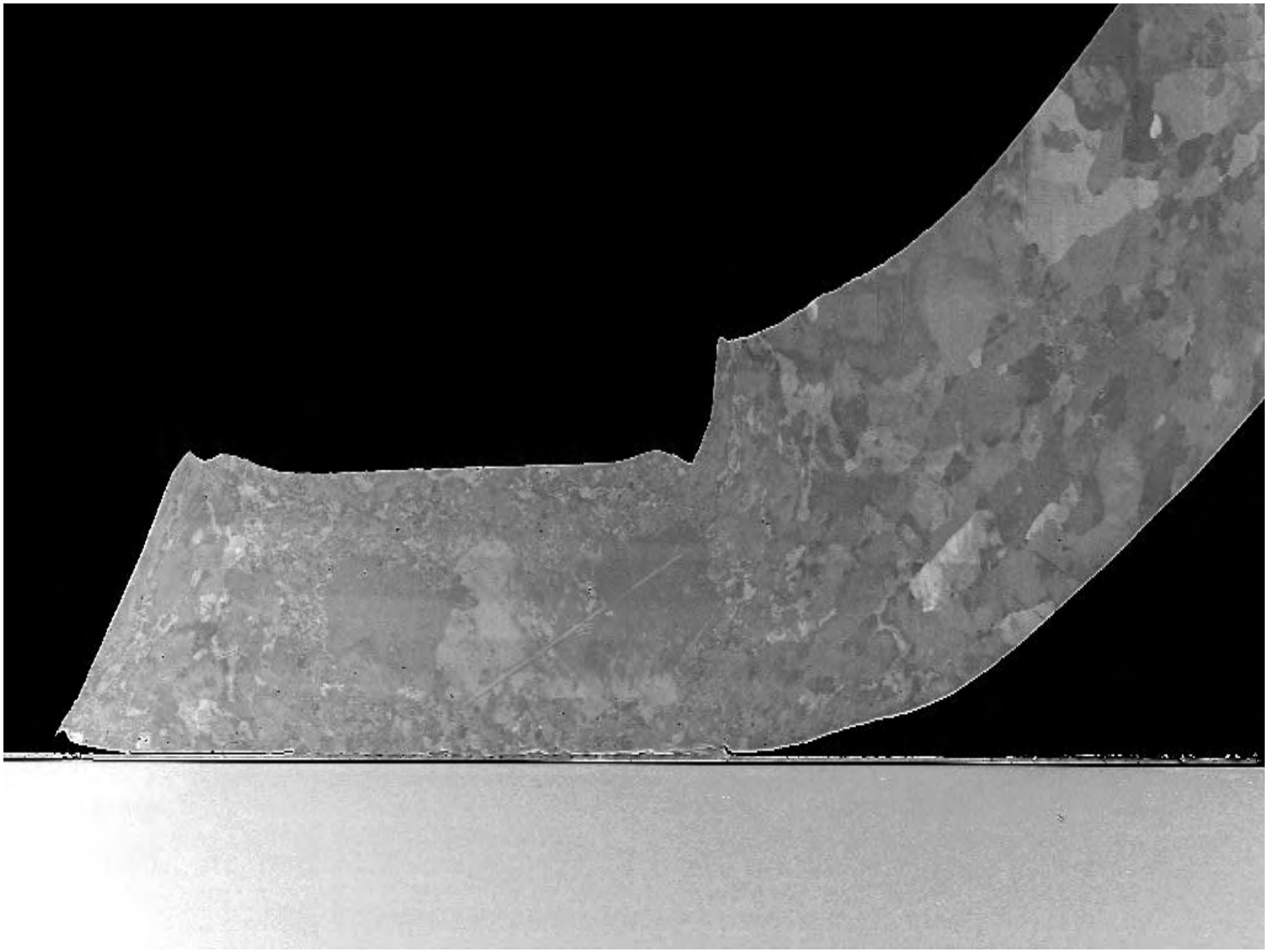
BSE像：

高組成コントラストで二次電子像に匹敵する分解能を持つ

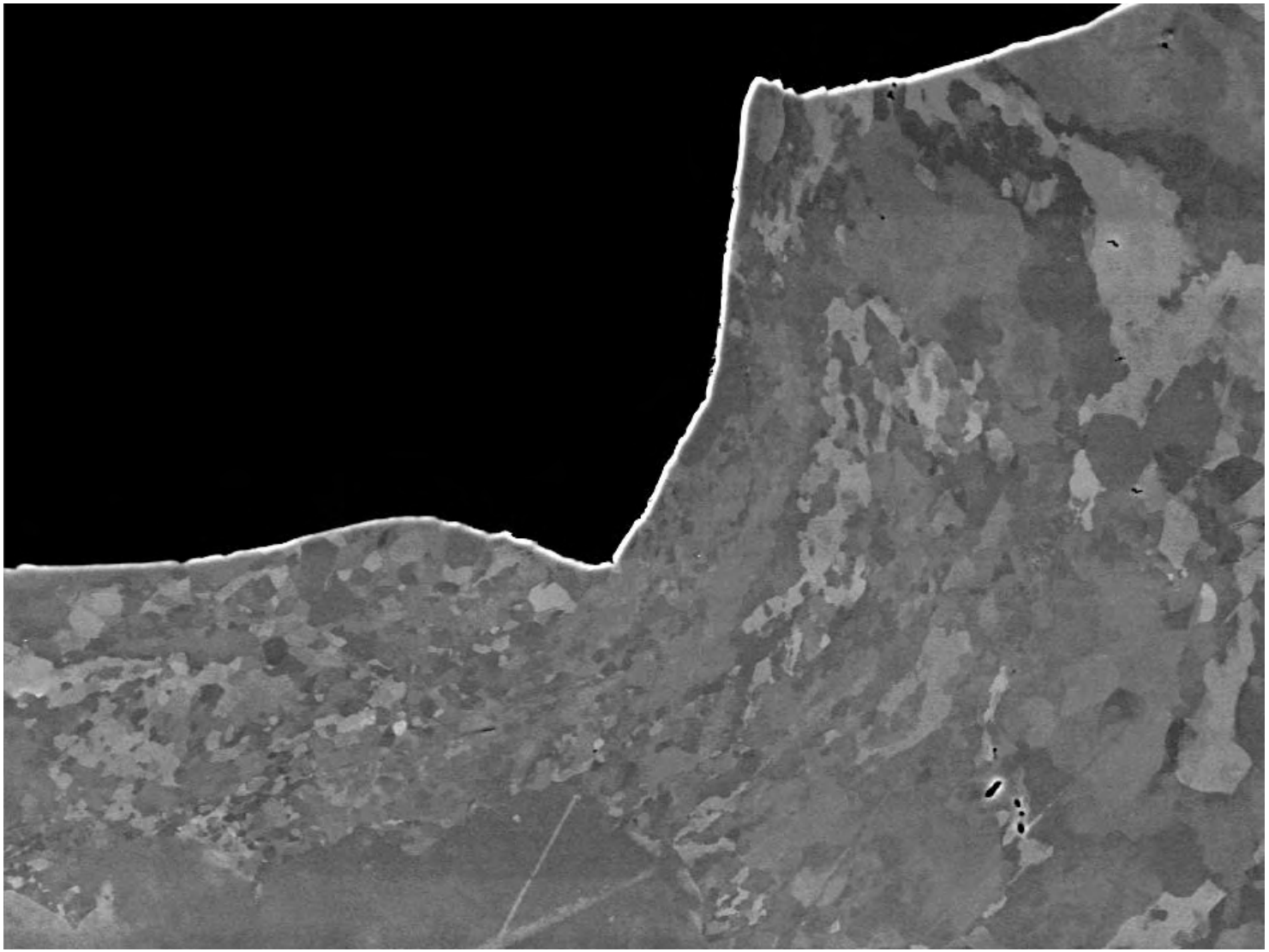
Al の結晶粒観察



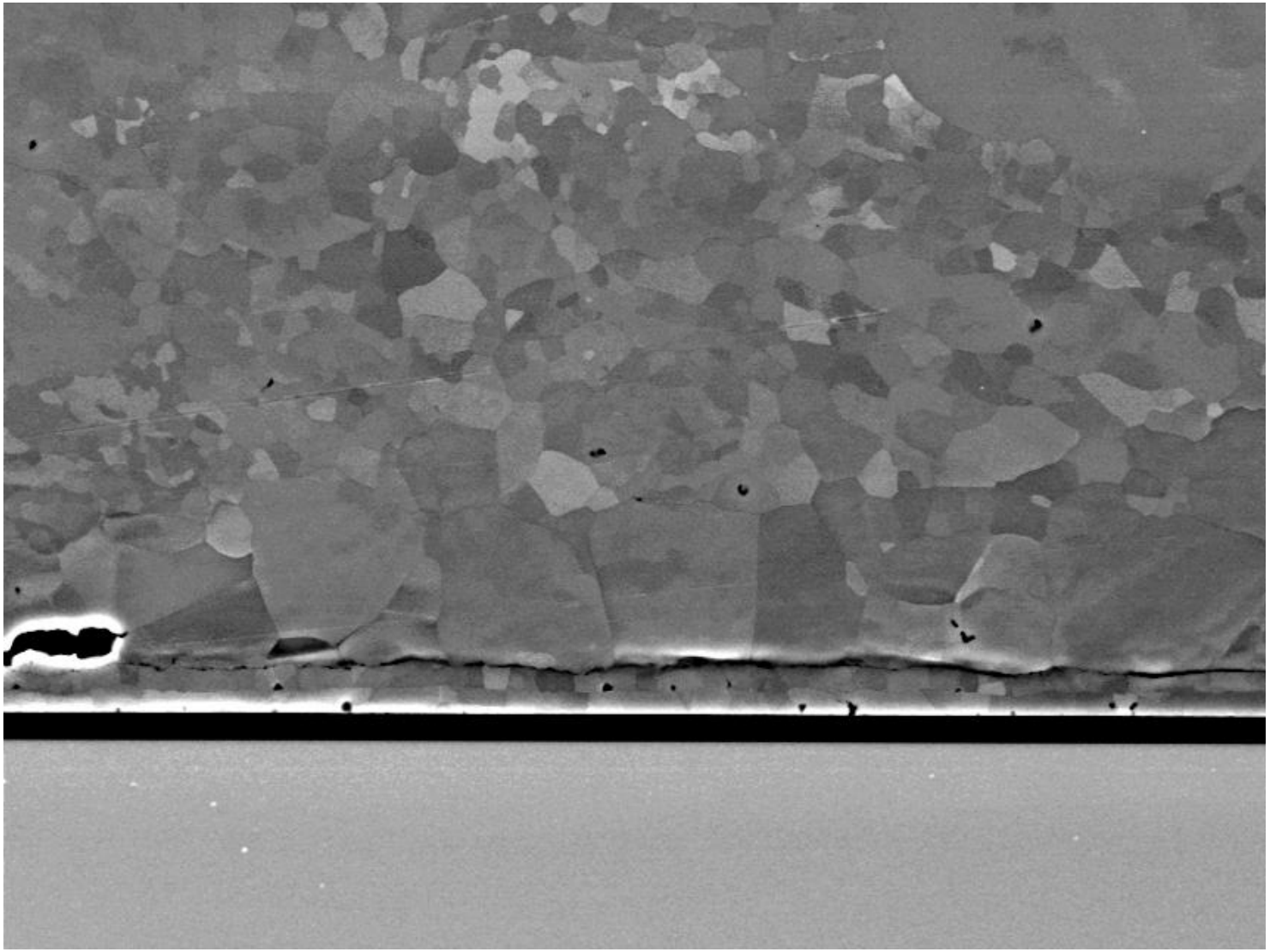
Wire Bonding部



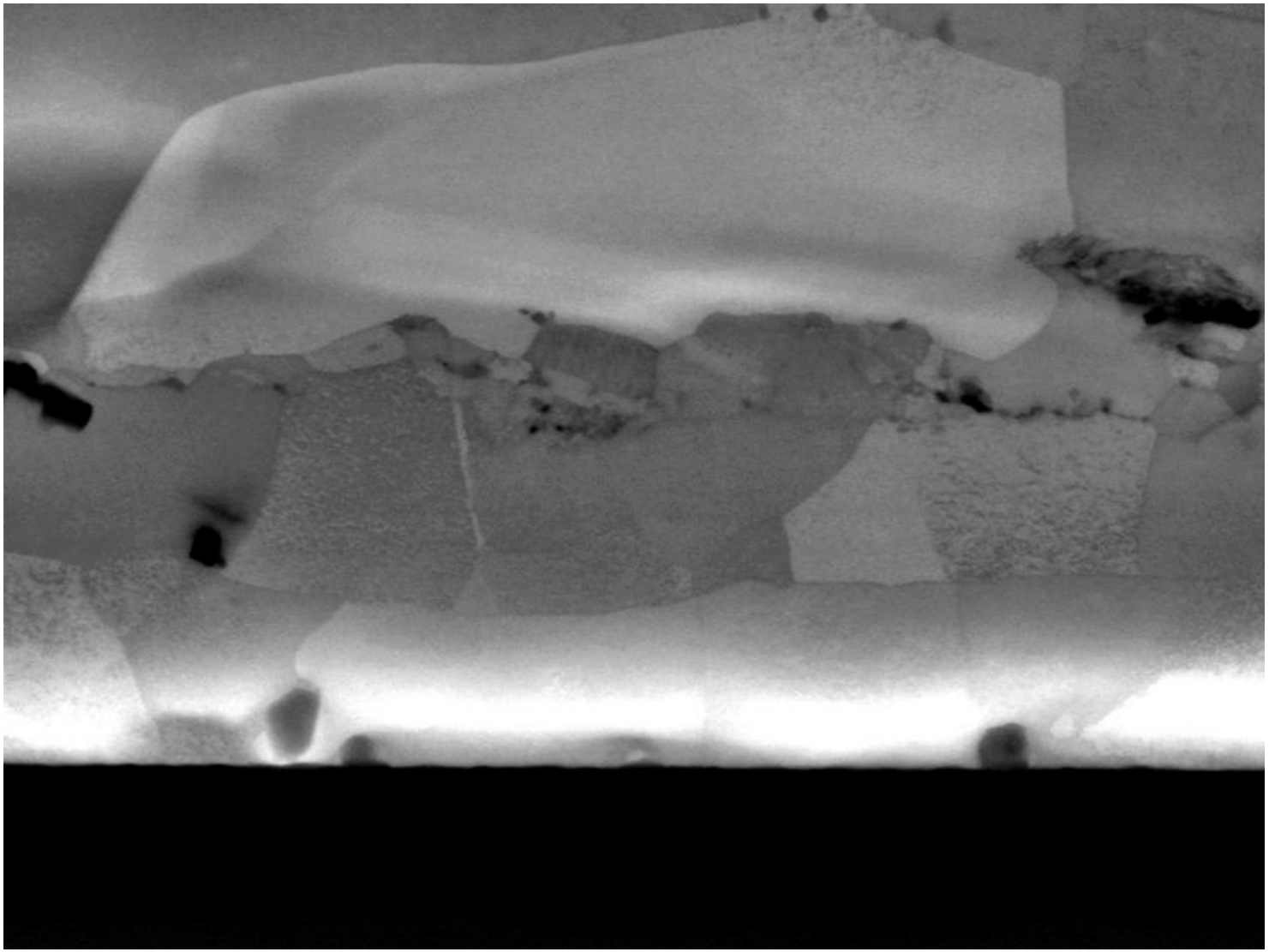
Wire Bonding部（圧痕箇所）



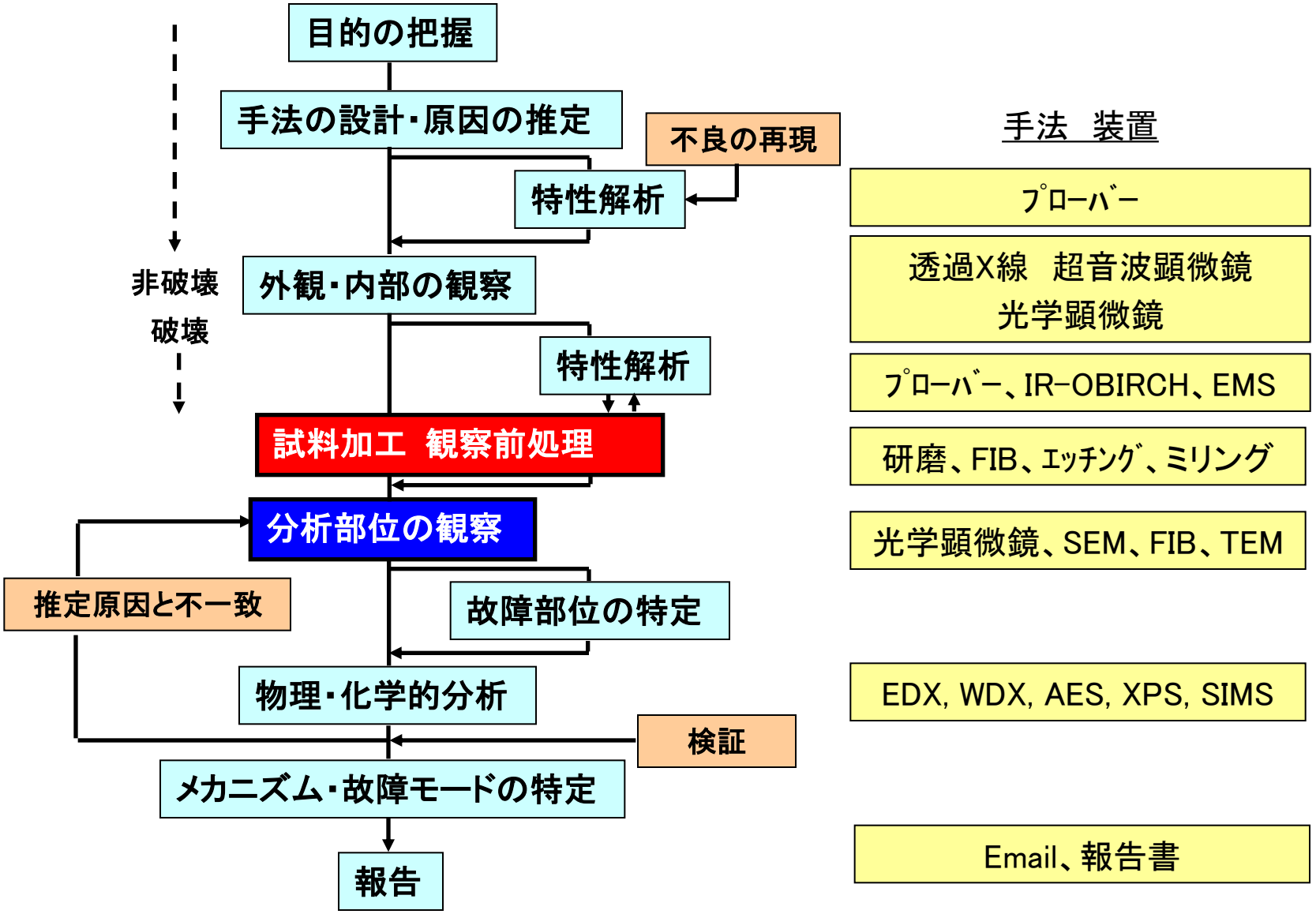
Wire Bonding部（接合箇所）



Wire Bonding部（接合箇所）



不良解析の流れ


目的の把握
手法の設計・原因の推定
不良の再現
特性解析
非破壊
外観・内部の観察
破壊
特性解析
試料加工　観察前処理
分析部位の観察
推定原因と不一致
故障部位の特定
物理・化学的分析
検証
メカニズム・故障モードの特定
報告
手法　装置
ﾌﾟﾛｰﾊﾞｰ
透過X線　超音波顕微鏡
光学顕微鏡
ﾌﾟﾛｰﾊﾞｰ、IR-OBIRCH、EMS
研磨、FIB、ｴｯﾁﾝｸﾞ、ミリング
光学顕微鏡、SEM、FIB、TEM
EDX, WDX, AES, XPS, SIMS
Email、報告書

最後に

かゆいところに

手がとどく解析を．．．

ご清聴を感謝します。