Mechanical Conversion for High-Throughput TEM Sample Preparation

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Mechanical Conversion for High-Throughput TEM Sample Preparation

**Agenda:**

1. **Background: FIB In-Situ Lift-Out**
2. Time management in FIB in-situ lift-out
3. Mechanical conversion for high throughput
4. Efficient management of in-line and off-line FIB resources
5. Summary
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Sequence for In-Situ Lift-Out (Total Release™ Method):

A. 1st cut
B. 2nd cut
C. Tip attach
D. Lift-out
E. Grid attach
F. Tip detach
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Reduces time in the on-line FIB by ~43% (300mm wafer FIB)
Reduces overall FIB time required by ~26%
Reduces skill level required at on-line FIB
(only lift-out required)
Leverages FIB resources in off-line labs
for final thinning (FIB or small dual beam, flip stage, etc..)

Based on typical “novice” lift-out experience
of less than 2 hours in a DB235 with the grid holder in the chamber with the sample.
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In-Situ FIB Lift-Out

Mechanical Conversion

TEM Inspection
Mechanical Conversion for High-Throughput TEM Sample Preparation

Convenient coupons replace TEM grids

From lift-out to TEM grid at the push of a button

Robust horse-shoe grids fit standard 3mm holders

Compatible with standard TEM sample holders
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Efficient management of in-line and off-line FIB resources

**In-Line**
- In-Situ Lift-Out (Full Wafer FIB)
- In-Situ Tip Change

**Off-Line**
- TEM or DB-STEM
- Final Thinning
- Mech. Conversion
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Top-side thinning, Multiple samples
Back-side thinning, Multiple samples
Top-side thinning, Single sample
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Summary [1]:

1. A system for increasing throughput of FIB in-situ TEM sample prep involving mechanical conversion of the lift-out sample to a standard TEM sample has been developed.

2. Robust mechanically converted TEM samples survive rigorous mechanical testing with no drop-outs.

3. Compatible with standard 3mm TEM sample holders.

4. Alignment (planarity and center) of the TEM sample is established in the FIB and maintained through the process.

5. Maximizes resource efficiency in a high throughput “in-line + off-line” plan for FIB and TEM resources.
Summary [2]:


7. Thinning for TEM can be performed prior to or after conversion.

8. Enables both top-side and back-side thinning (to avoid “shower curtain” effect).

9. Reduces contamination from grid during low-energy ion cleanup.

10. Compatible with a multi-sample format and additional throughput features in development.
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