

Mechanical Conversion for High-Throughput TEM Sample Preparation

Anthony B. Kendrick (SEM-FIB Solutions, UK)

Thomas M. Moore (Omniprobe, USA)

Lyudmila Zaykova-Feldman (Omniprobe, USA)

Mechanical Conversion for High-Throughput TEM Sample Preparation

Agenda:

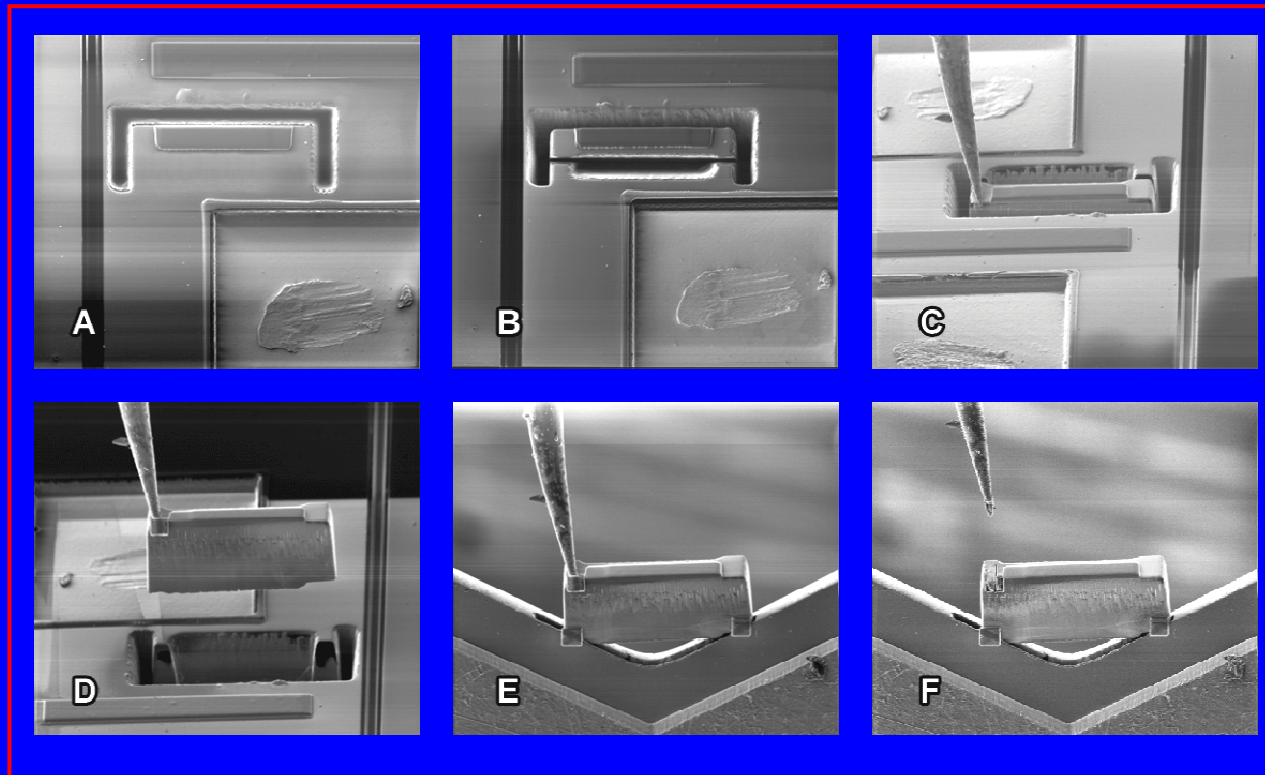
1. Background: FIB In-Situ Lift-Out

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

Mechanical Conversion for High-Throughput TEM Sample Preparation

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



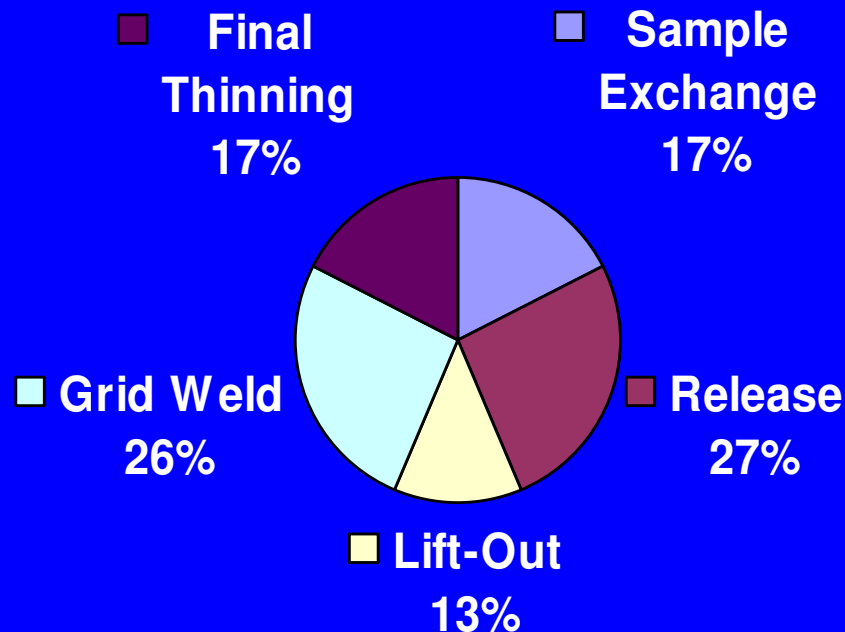
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Time management in FIB in-situ lift-out



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.

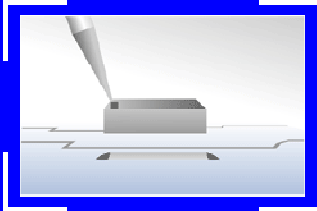
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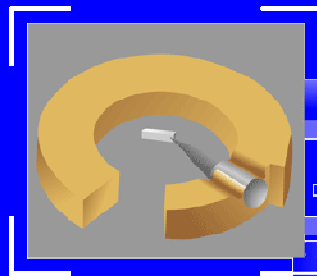
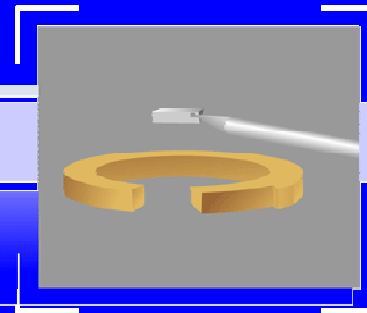
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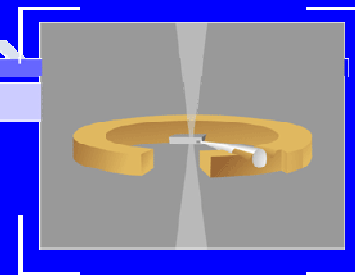
In-Situ FIB Lift-Out



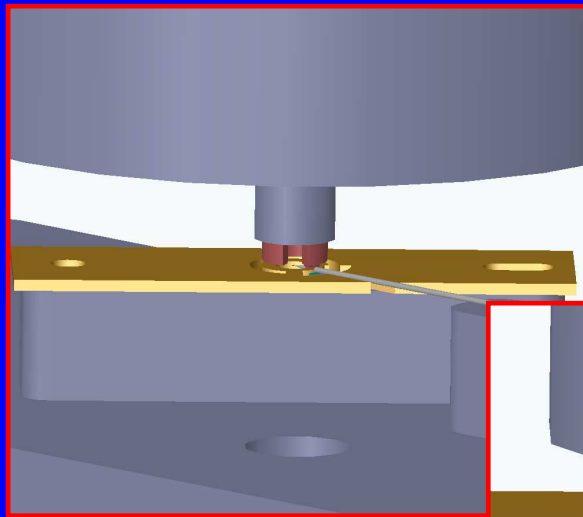
Mechanical Conversion



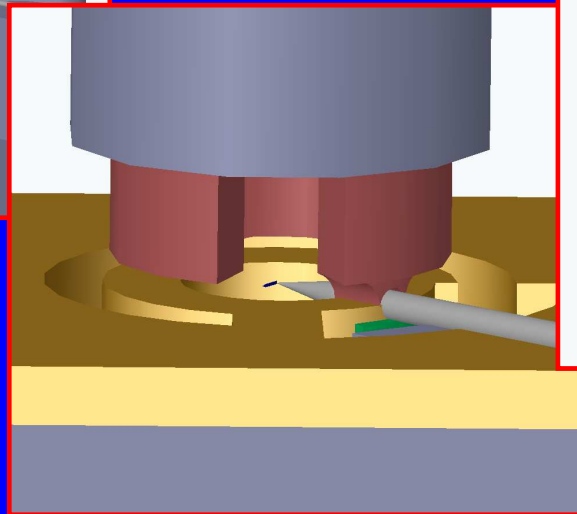
TEM Inspection



Mechanical Conversion for High-Throughput TEM Sample Preparation

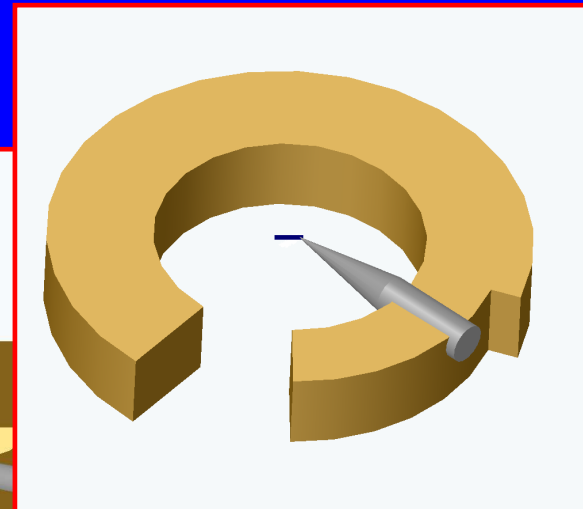


**Convenient coupons
replace TEM grids**



**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**

Mechanical Conversion for High-Throughput TEM Sample Preparation

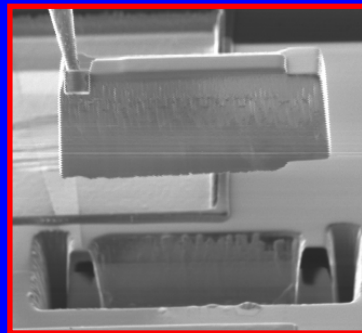
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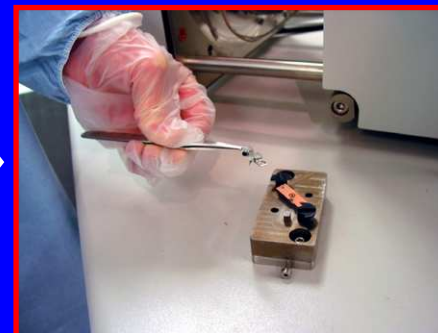
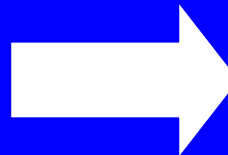
Mechanical Conversion for High-Throughput TEM Sample Preparation

Efficient management of in-line and off-line FIB resources

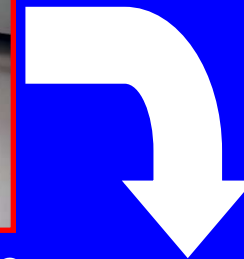
In-Line



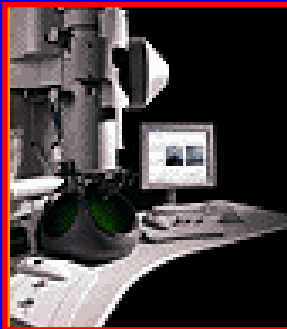
In-Situ Lift-Out (Full Wafer FIB)



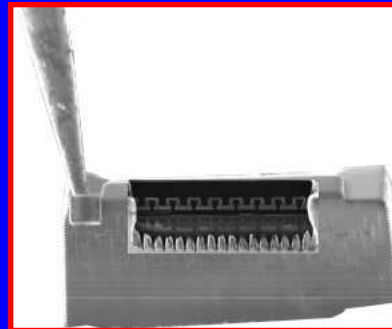
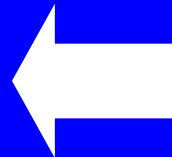
In-Situ Tip Change



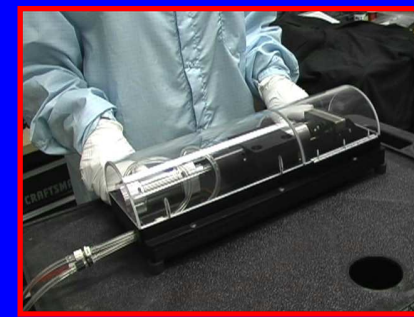
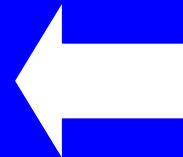
Off-Line



TEM or DB-STEM



Final Thinning



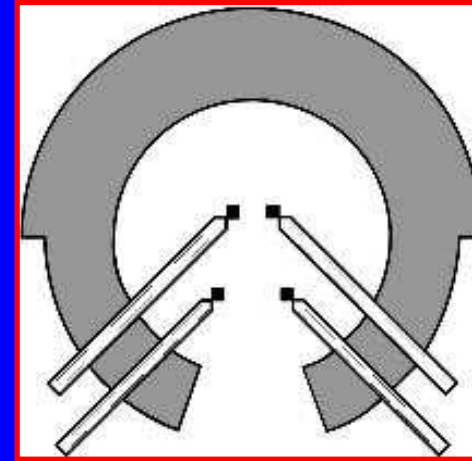
Mech. Conversion

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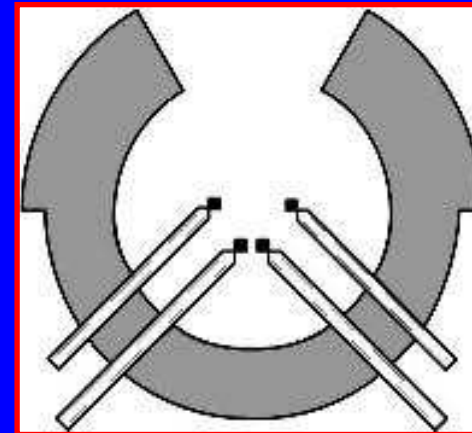


Top-side thinning,
Single sample

Top-side thinning,
Multiple samples



Back-side thinning,
Multiple samples



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Mechanical Conversion for High-Throughput TEM Sample Preparation

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.

Mechanical Conversion for High-Throughput TEM Sample Preparation

Summary [2]:

6. Compatible with Total Release in-situ lift-out method.
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.

Mechanical Conversion for High-Throughput TEM Sample Preparation

Acknowledgements:

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Marlin Anderson, Omniprobe, Inc.



SEM-FIB Solutions