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An Oxford Instruments Company

# APPLICATION NOTE

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## Lift-Out Strategies for Xtreme Access (XA) Owners

### In-situ Lift-Out (INLO) by the traditional needle-weld method

The traditional method for in-situ lift-out is comprised of 3 basic steps: 1) FIB-milling a small select area (microsample), 2) using a straight probe needle (typically tungsten) to physically attach to the lift-out sample via FIB-assisted deposition (welding) for lift-out, and 3) transfer of the sample from the probe needle to a holder (such as TEM grid) for final thinning and/or analysis. [1,2] The Xtreme Access™ manipulator can be easily adapted to this method with a few accessories.

There are significant advantages of traditional in-situ lift-out for XA owners:

**1) Reliability.** INLO is the most secure, successful strategy for lift-out compared to ex-situ methods and non-welding in-situ methods, with a success rate of 90-100%. [3] One customer reports that 9 out of

10 lift-outs in his lab are performed using straight needles instead of Xtreme Magic™ end effectors, because nearly every sample is too valuable to lose.

**2) Speed.** Lift-out is fast using Omniprobe's patented Total Release™ method [2] to create the lift-out sample, and there is no requirement to mill the desired final shape into an end-effector. Total Release™ enables high through-put for labs using TEM for process control and labs needing quick sample preparation and minimal use of FIB time. Details of the Total Release™ method are found at (<http://www.omniprobe.com/pdf/sp1.pdf>).

**3) Cost.** Straight needles (W or W/Ni) plus Omniprobe grids (Cu or Mo) are less expensive than the Xtreme Magic™ end effectors (<http://www.omniprobe.com/consume.htm>).

The following accessories offered by Omniprobe enable needle INLO with the Xtreme Access™ nanomanipulator:

#### TEM GRID HOLDERS:

**Single Sample Holder** TGH-0001.10.01  
(holds single TEM grid)

**TEM Grid Holder, SS** TGH-0001.06.00  
(holds 2 TEM grids)

**TEM Grid Holder** TGH-0001.07.00 (holds 2 grids, non-magnetic to enable ultra high magnification (>80kx) applications)

**TEM Grids**  
(3-post Cu and Mo grids, 4 and 5-post Cu grids)

“ Many Xtreme Access users are familiar only with the Xtreme Magic lift-out process. They can realize benefits by augmenting their capability to include a needle-based process. ”

***XA Probe Tip Holder for Straight Needles***  
FG - 100317 (probe holder & storage vial)

***Straight needles for XA Short-Cut™***  
PT-0001.06.01

***PT - 0001.04.01, box of 10***

### **In-situ Lift-Out (INLO) by the Short-Cut™ modification of the traditional needle-weld method**

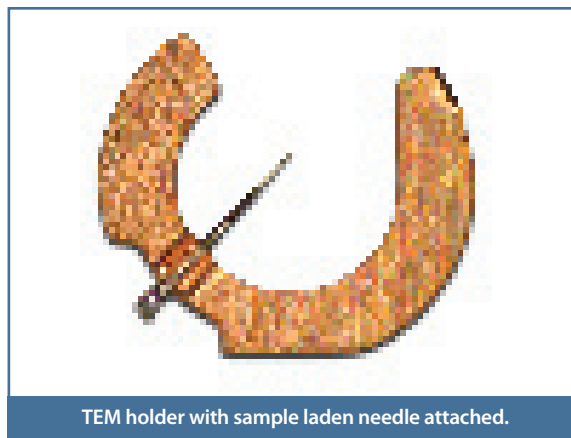
Omniprobe has made traditional INLO more user friendly and even more reliable by modifying step 3 of traditional INLO (attaching the sample to a holder, typically a TEM grid). This approach also effectively reduces the amount of preparation time in the FIB. Instead of performing the task of welding the sample to a grid and cutting away the probe, the probe needle carrying the sample is removed from the FIB immediately after the lift-out step and is mechanically attached to a TEM compatible holder by a simple push-button, table-top, Short-Cut™ pneumatic press. [4] Once attached, it can be re-introduced into the FIB for final thinning or STEM imaging, etc. The innovative TEM-compatible sample holder easily enables backside thinning for complex samples that exhibit severe curtaining effects when milled from the top side, allowing production of high quality TEM lamellae leading to superb images. Additionally, the Short-Cut™ joining method limits the volume of excess support material surrounding the sample, enabling cleaner EDX spectra.

The following accessories offered by Omniprobe enable INLO with the Short-Cut™:

***250 probe tip holder for straight needles***  
FG-100319-0

***Short-Cut™ Tool***  
Contact Omniprobe for a quote

***Short-Cut™ Coupons***  
( available for frontside or backside thinning  
in Cu, Mo coated Cu)



TEM holder with sample laden needle attached.

### **References**

- [1] T.M. Moore et al., U.S. Patent 6420722.
- [2] T.M. Moore, U.S. Patent 6570170.
- [3] Langford, R.M., Rogers, M., In situ lift-out: Steps to improve yield and a comparison with other FIB TEM sample preparation techniques, Micron (2008), doi: 10.1016/j.micron.2008.02.006
- [4] Kendrick, A. B., T. M. Moore, et al. (2006). "Mechanical Conversion for High-Throughput TEM Sample Preparation." Journal of Physics Conference Series 26: 227-230.

