



Samples such as integrated circuits, solar cells, batteries and magnetic media have been prepared on Thermal and Electrical E-chips using FIB methods. This sample preparation technique can be challenging, but with careful preparation steps it can become routine. This sample preparation guide steps through a few methods for FIB sample preparation, and provides suggestions for successfully preparing your samples; other steps and techniques may be effective as well.

### Method 1

#### *In Situ* Lift-Out Method

1. Extract a thin section from the area of interest, weld and thin it (< 100 nm) on a half grid using normal FIB sample preparation procedures. See images below.

*Note: For the in situ method an E-chip should be mounted on the FIB stage within reach of the micromanipulator tip to facilitate transfer.*

*Note: The steps described in this method work for the Omniprobe micromanipulator system. Micromanipulator systems from other manufacturers may or may not work using this method.*

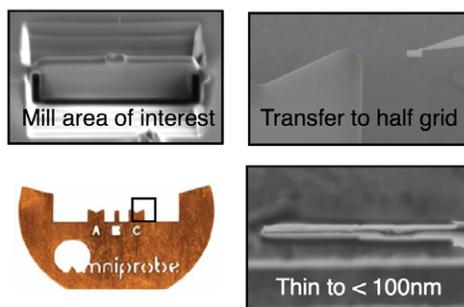


Figure 1: E-chip configuration

2. Alternatively, the sample can be thinned in place while still secured in the substrate before lift out occurs, and the transfer step to the half grid can be skipped.
3. Transfer the thinned sample to the E-chip with one of the following three methods:

*Note: Orient the E-chip such that transfers from the half grid or sample substrate is straightforward. Tilting the E-chip at a 45° angle helps make transfers easier.*

- a. If the thinned sample was mounted to a half grid: free the section from the half grid after the micromanipulator tip is secured to the sample. If the micromanipulator system has a rotation option installed, the operator can rotate the tip using the instrument software. Rotate such that the flat side of the thin section is parallel to the E-chip membrane. If the E-chip is tilted at a 45° angle, be sure to rotate the micromanipulator accordingly.
- b. If the thinned sample was mounted to a half grid: before remounting the tip to the thinned sample, the half grid can be taken out of the FIB chamber and laid flat. This orients the sample so that the flat side is in the same orientation as the E-chip membrane. Reinsert the half grid with an E-chip into the FIB chamber, remount the tip and release the thinned sample to complete the transfer to the E-chip membrane.

- c. If the manipulator system does not have rotation, in some cases the tip can be rotated manually. If this is possible, rotate the tip so that the flat part of the thinned sample is parallel to the E-chip membrane. Again if the E-chip is tilted take care that the orientation of the E-chip and the flat side of the thinned sample align.

*Note: Use care when rotating the manipulator to avoid damaging the sample or internal microscope components.*

The thinned sample should now be placed on the membrane. The sample should just touch the E-chip membrane; if too much pressure is applied the membrane may fracture.

*Note: When using a Thermal E-chip, orient the sample so that the area of interest is over a hole in the ceramic membrane. For Electrical E-chips the sample can be placed over a hole in the membrane when applicable, but it should always be near the electrical leads so electrical contact can easily be made.*

4. Once the sample is in place on the membrane it can be welded in place. Static forces are also usually strong enough to hold the sample in place.
5. Release the micromanipulator tip.
6. If you are using an Electrical E-chip, and require electrical contact to the sample, deposit Pt or W from an electrode on the E-chip to the area of interest with FIB induced deposition.

### Method 2

#### *Ex Situ* Lift-Out Method

1. Mill, thin and release a thinned area of the sample while it is still in the substrate.
2. Remove the substrate with the thinned sample(s) from the FIB chamber. Use the *ex situ* tool to lift out the sample(s) and place it directly on the E-chip membrane. If a Thermal E-chip is used ensure the area of interest is over a hole in the ceramic membrane. If an Electrical E-chip is used, ensure that the section is near the electrical leads so electrical contact can easily be made. If possible lay the area of interest over a hole in the membrane to maximize electron transparency and resolution.
3. The thin section will stick to the membrane via electrostatic forces. The E-chip can also be inserted back into the FIB for further processing, such as making electrical contacts or welding the sample to the membrane.

*Note: At high temperatures deposited metal forming a weld point or electrical contact may melt. Please keep this in mind when mounting samples.*



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