Cutting DRAM IC's to Specific Area Prior to FIB Preparation

1.0: Purpose

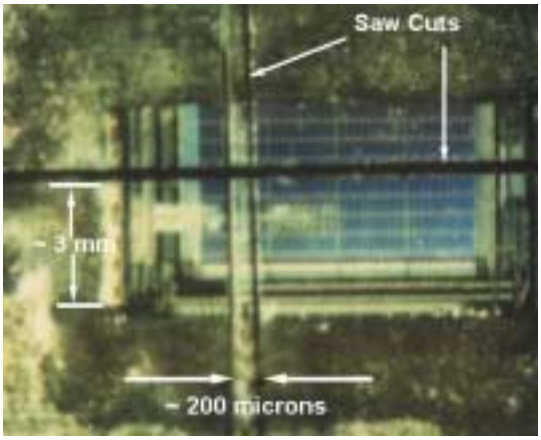
Semiconductor failure analysis of devices is a critical part in the successful manufacture of reliable memory chips for all types of applications. Part of the failure analysis includes destructive analysis of the devices which have failed to determine the location and cause of failures and to help prevent further failures from occurring. Using cutting and sectioning techniques which do not present new defects or alter existing defects is important when performing any failure analysis technique. This paper outlines a simple process of wire saw cutting to selected areas prior to FIB (Focused Ion Beam) cross sectioning. Considerations such as mechanical damage, thickness of the final specimen, and specimen configuration are all import factors which will determine the success of the cutting process.

2.0: Procedure

A DRAM memory device was found to be defective with the site of interest marked using a laser. Using the Model 850 Wire Saw, the aim of the cutting process is to cut out a sliver of the device as close to the failure site as possible without damaging the failure site yet thin enough to facilitate further thinning using a FIB machine. The specimen was mounted on to the work table of the Model 850 using a low melting point wax (MWH 135, MP @ 135° C). The position of the wire blade on the specimen was aligned using the Model 85040 Alignment Microscope attachment for the Model 850 Wire Saw. The specimen size initially started out to be around 6 mm x 12 mm, with the final dimension of the specimen to be 200 µ x 3 mm long. The cuts were done using a 0.005" diameter stainless steel wire to produce the smallest amount of kerf loss during the cutting process. The small wire diameter allowed specific placement of the saw cuts to produce a very thin section. The cuts were made along each side of the defect of interest and then followed by a final cut to create the desired length of the specimen. The following parameters were used during the cutting process:

Wire: 0.005" stainless steel Slurry: 8 µ Boron Carbide abrasive slurry Cutting Time: 5 minutes per cut
Load: 50 grams Speed: 2

Below are two micrographs showing the specimen following the cuts. Note the thin slice which has been produced without gross edge chipping and damage created in the specimen.



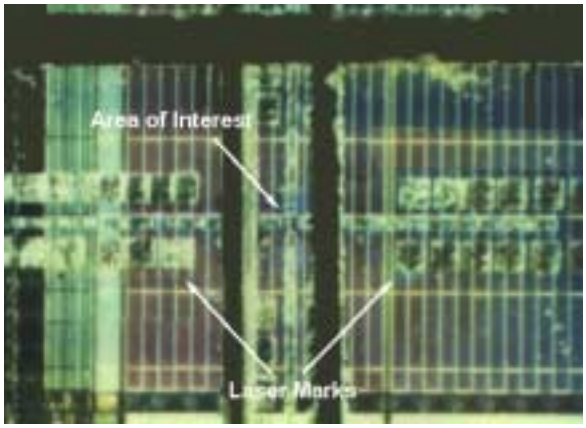


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Figure 1: Images of the DRAM device following the cutting process. A) Low magnification image showing the dimensions of the device following cutting on the Model 850. B) Higher magnification image of the same device clearly showing the laser marks and cuts. Note the area of interest is still preserved with no visible chipping or deformation to the device visible.

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3.0: Results

It has been shown that cutting devices down to a much smaller size can be advantageous to those producing FIB thin sections. Proper selection of a cutting method can drastically reduce the specimen preparation time involved for producing FIB specimens. Use of the Model 850 Wire Saw can be a great benefit as it easily cuts through Si, produces low damage cuts, preserving the desired structure, is site specific and is relatively fast.

Using the Wire Saw drastically reduces polishing times and other steps of the preparation process commonly necessary for producing a good specimen. With setup time, cutting time, and specimen mounting, specimens can be mounted into the FIB in less than 30 minutes and drastically reduces the milling time necessary for producing good specimens.

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