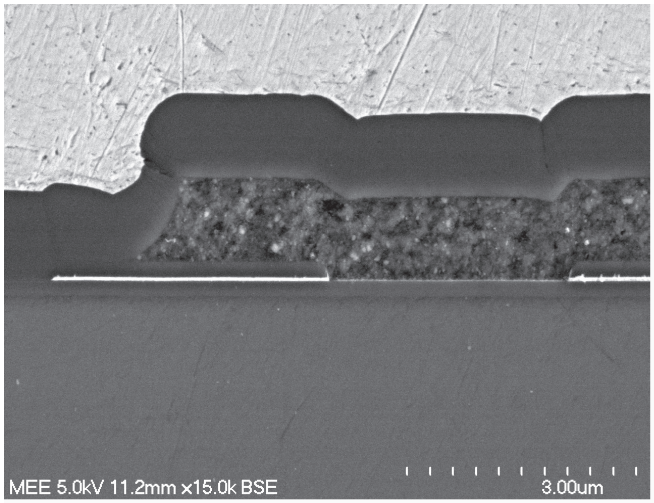
BROAD BEAM ION MILL SAMPLE PREPARATION

DESCRIPTION OF TECHNIQUE

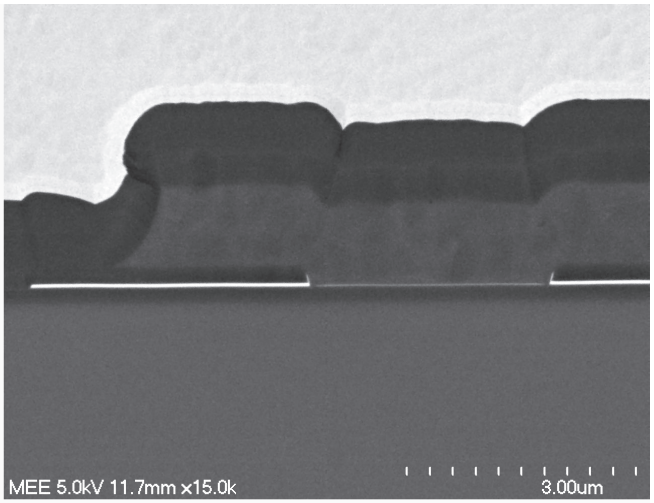
Microscopic inspection for device quality assurance, failure analysis, and materials characterization relies on optimum sample preparation to produce accurate and useful data. Good sample preparation for medical devices, semiconductors, microelectronics, and nano-materials has become more challenging in recent years due to high-technology materials, complex assemblies, and smaller components. Although mechanical cross sectioning, polishing, and chemical etching are sufficient for many applications, ion beam milling provides an additional level of quality and clarity for critical and difficult-to-prepare samples. Ion beam milling is a unique method of sample preparation that complements and significantly extends the capabilities of the traditional microscopy and metallographic laboratories.

The ion beam milling method uses high-energy argon ion bombardment to remove material or modify the surface of a sample. An ion gun directs energetic argon ions toward the sample, which is placed so that the surface is bombarded at a controlled angle. A low angle of ion incidence with respect to the sample surface gradually removes surface layers of material at the atomic level - cleaning and polishing the sample. Surface modification to produce contrast or microstructure can be realized with higher milling angles up to 90°. Thus, ion beam milling effectively removes contamination and mechanically deformed material to produce nearly artifact-free surfaces for SEM and light microscopy inspection.

Additionally, the ion mill can be used to directly prepare cross sections by cutting through a sample with the argon-ion beam (35° or 90° slope cuts). This is effective for samples that are difficult to section mechanically, such as semiconductors, multi-layer structures, or material combinations with large hardness differences. Multi-layer structures are revealed without the distortion that can occur with mechanical polishing.



Semiconductor cross section after mechanical polish only

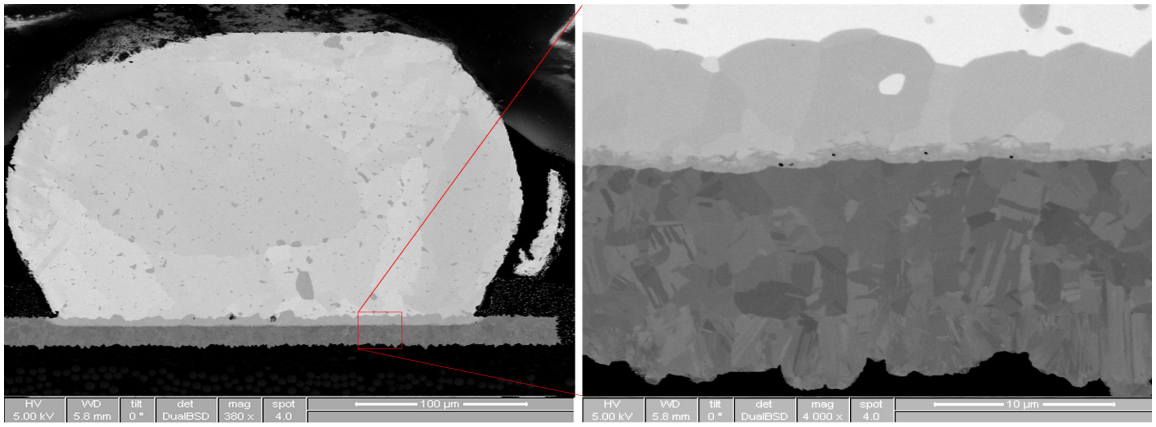


Semiconductor cross section after mechanical polish and ion milling

TYPICAL APPLICATIONS

The ion mill is particularly useful for revealing microstructures of medical grade materials, such as the noble metals like gold and platinum or corrosion-resistant alloys bonded to less noble metals (without galvanic interferences). Samples may be prepared mechanically and then finished with the ion beam milling to produce the desired finish free of mechanically induced artifacts. Samples may also be sectioned by ion beam milling without previous mechanical sectioning. Surface films can be effectively and quickly removed.

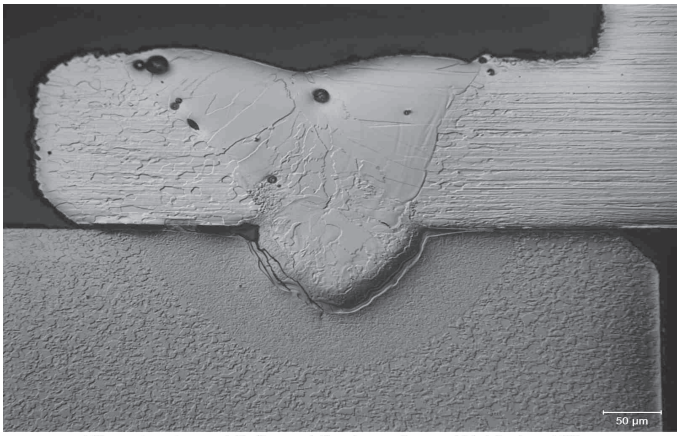
- Preparing cross sections of semi-conductor devices
- Removing contamination films
- Removing thin plating layers to reveal substrate
- Surface modification to reveal microstructure for materials difficult to chemically etch
- Sectioning of soft materials or soft-hard material combinations



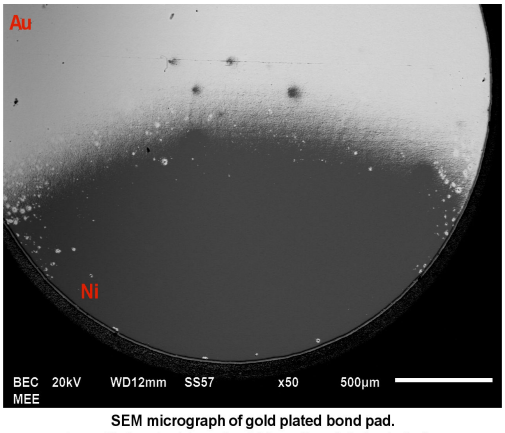
SEM micrographs of ion mill cross section through solder ball on copper pad.

SAMPLE REQUIREMENTS

Samples must be vacuum compatible with dimensions no greater than 25 mm across and 12 mm tall.



Microstructure - Platinum Titanium - Laser Weld - Ion Mill



SEM micrograph of gold plated bond pad.
Ion mill cleanly stripped gold from the nickel substrate.