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In Situ Electromigration Testing Fixture for X-Ray Microtomography Systems & Electron Microscopes

Electromigration is the transport of material caused by an uneven distribution of current, causing atoms to accumulate at the anode and separate from the cathode of an electronic circuit. Materials that experience electromigration undergo a complex 3D evolution, which often results in short and open circuit failures at soldering joints. Electromigration's effect only increases in magnitude as electronic devices and their solder connections shrink in size, and makes electromigration a critical reliability issue in electronic packaging. High resolution electromigration testing presently requires access to a synchrotron, which are costly and scarce, making it challenging to perform frequent or long-term experimentation. Existing lab-scale systems lack experimental control and flexibility, and can only examine material microstructures after electromigration has occurred.

Researchers at ASU have created a testing fixture for x-ray microtomography systems and electron scanning microscopes that measures the effects of electromigration as it is happening. This fixture can hold specimens of a high aspect ratio and down to 100 micrometers in diameter. It provides a wide range of characterization probes access to the region of interest, and can be equipped with a side-mounted resistive ceramic heater for studying electromigration damage at elevated temperatures. Additionally, ASU researchers have developed supporting projection processing algorithms and numerical models to reduce noise in reconstructed data and aid scan parameter optimization. This fixture facilitates an unrivaled ability to explore failed solder specimens, and offers key insight to the behavior of materials undergoing electromigration.

Potential Applications

- Microelectronics Testing
- Scanning Electron Microscopes
- Semiconductor Packaging
- X-Ray Microtomography

Benefits and Advantages

- Adaptable – Can be equipped with a ceramic heater for studying electromigration effects at elevated temperatures.
- Innovative – Enables in situ access to a material's region of interest during x-ray microtomography and electron microscopy.
- Precise – Includes software support for reducing image noise and optimizing scan parameters.
- Versatile
  - Works with a wide range of characterization probes.

- Handles specimens of a high aspect ratio down to 100 micrometers in diameter.

For more information about the inventor(s) and their research, please see

Dr. Nikhilesh Chawla's directory webpage

For more information about related technologies, please see

M14-010P: Modular High Resolution X-Ray Tomography System: Source, Sample Manipulation, Detector