AN 432

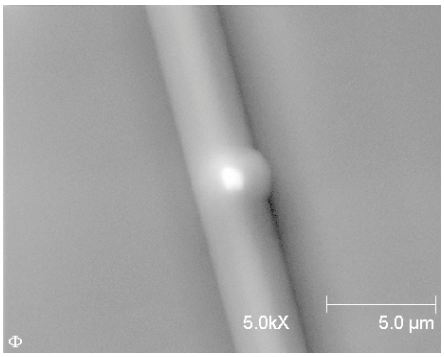
Identification of Stainless Steel Particles Using Auger and FIB on Whole Wafer SMART-Tool™ and SMART-200™ Systems

May 7, 2007 (Version 2.0)

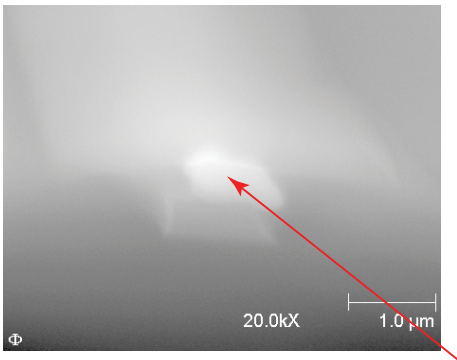
Discussion

The integration of defect inspection at only a few process steps during device fabrication results in the detection of defects that are often buried. In order to effectively identify these defects, it is necessary to determine their composition. The 200mm and 300mm Whole Wafer SMART systems combine in-situ, Focused Ion Beam (FIB) cross-sectioning to expose the buried defect, and Auger analysis for high spatial resolution compositional measurements. This combination provides a powerful capability for accurate identification of buried defects. Real-time SEM monitoring of the FIB cut allows precise positioning of the cross-section face. Auger measurements can then be made without moving the wafer. The SMART products provide an efficient and straight forward analysis of surface and buried defects, saving valuable time and effort in the resolution of defect and yield issues and providing clear results that are critical for quickly ramping to higher yields and recovering from yield excursions.

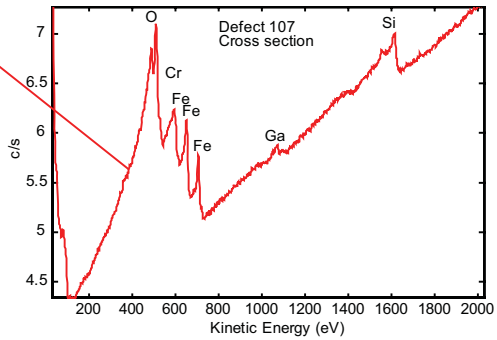
Defect inspection following metal 2 deposition and etch found multiple surface and buried defects. A defect associated with the buried M1 line was FIB cross-sectioned for subsequent Auger analysis. An Auger spectrum of the cross-sectioned particle shows Fe and Cr, indicating that it is a stainless steel particle. Auger maps for Fe, Ti, Al and O show that the stainless steel particle is sitting on the TiN cap of the metal 1 Al line and is surrounded by Si oxide. The defect hangs over the edge of the metal line, indicating that it arrived after M1 etch. The M1 line and stainless steel particles were subsequently covered by the dielectric deposition. The source of these particulate defects may be stainless steel plumbing or the wafer transfer mechanism used after the metal etch process and before dielectric deposition.



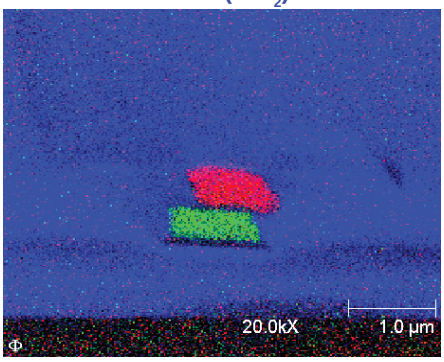
Buried particle before FIB cut.



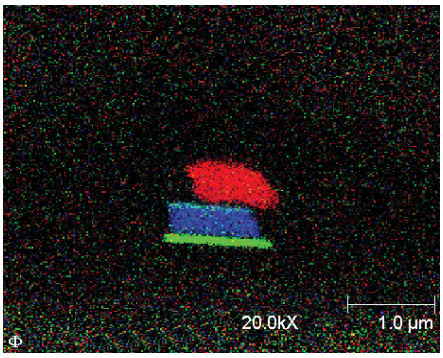
After FIB cut.



Fe Al O (SiO_2) Si

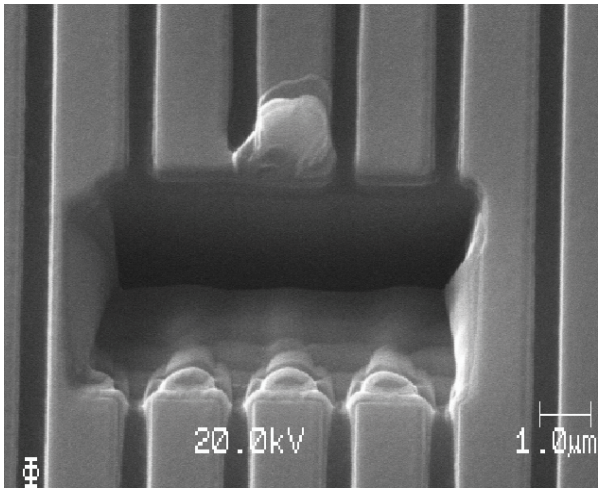


Fe Ti Al



Color overlays of Auger maps showing location of particle on metal line.
Note the thin TiN layer on top of the Al line.

The FIB on EAG's 200mm and 300mm whole wafer Auger tools provides the capability to make in-situ cross-sections for Auger analysis. This capability is useful for analyzing buried defects and particles, as well as examining patterned structures and devices in cross-section. The system configuration allows the user to monitor the cut during the FIB process, using the electron beam generated secondary electron image. This allows the cross-section face to be positioned at precisely the location desired. Auger analysis of the cross-section face can then be performed without repositioning the sample.



SEM image of FIB cross-section on buried stainless steel particle.

United States Locations

Tempe, Arizona
+1 480 239 0602 info.az@eaglabs.com
+1 602 470 2655 fax

Sunnyvale, California
810 Kifer Road
+1 408 530 3500 info.ca@eaglabs.com
+1 408 530 3501 fax

1135 E Arques Avenue
+1 408 738 3033
+1 408 530 3035 fax

785 Lucerne Drive
+1 408 737 3892
+1 408 737 3916 fax

Peabody, Massachusetts
+1 978 278 9500 info.ma@eaglabs.com
+1 978 278 9501 fax

Chanhassen, Minnesota
+1 952 828 6411 info.mn@eaglabs.com
+1 952 828 6449 fax

East Windsor, New Jersey
+1 609 371 4800 info.nj@eaglabs.com
+1 609 371 5666 fax

Syracuse, New York
+1 315 431 9900 info.ny@eaglabs.com
+1 315 431 9800 fax

Raleigh, North Carolina
+1 919 829 7041 info.nc@eaglabs.com
+1 919 829 5518 fax

Round Rock, Texas
+1 512 671 9500 info.tx@eaglabs.com
+1 512 671 9501 fax

International Locations

Shanghai, China
+ 86 21 6879 6088 info.cn@eaglabs.com
+ 86 21 6879 9086 fax

Tournefeuille, France
+ 33 5 61 73 15 29 info.fr@eaglabs.com
+ 33 5 61 73 15 67 fax

Frankfurt, Germany
+ 49 (0) 693053213 info.de@eaglabs.com
+ 49 (0) 69307941 fax

Tokyo, Japan
+ 81 3 5396 0531 info.jp@eaglabs.com
+ 81 3 5396 1930 fax

HsinChu, Taiwan
+ 886 3 5632303 info.tw@eaglabs.com
+ 886 3 5632306 fax

Uxbridge, United Kingdom
+ 44 (0) 1895 811194 info.uk@eaglabs.com
+ 44 (0) 1895 810350 fax