EAG[SM]
Evans Analytical Group

AN 429

Compositional Defect Review on the 300mm Whole Wafer SMART-Tool™ and 200mm Whole Wafer SMART-200™ Differentiates Particles that Look Alike but Originate From Different Sources

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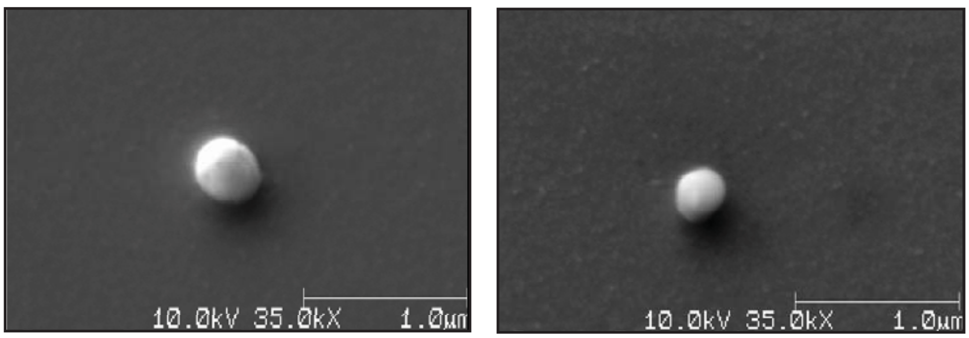
Discussion

In order to effectively increase yields by eliminating defect sources, it is necessary to correctly identify particulate defects that occur during device processing. This is complicated by reduced design rules and new processes which result in smaller critical defects, and in particulate defects which may look alike but often have different compositions and originate from very different sources. Thus, imaging alone does not uniquely identify the defect type or the defect source. However, measuring the particle composition provides accurate identification, and leads to more reliable determination of the particle source. The inherent spatial resolution limits of EDS make it a less desirable method for analyzing sub-micron defects like these. Auger measurements with the SMART-200 and SMART-Tool are ideally suited for compositional defect identification of small, thin and complex defects on 200mm and 300mm wafers respectively. This information leads to identification of different sources for defects that may look alike, resulting in faster and more comprehensive yield improvement.



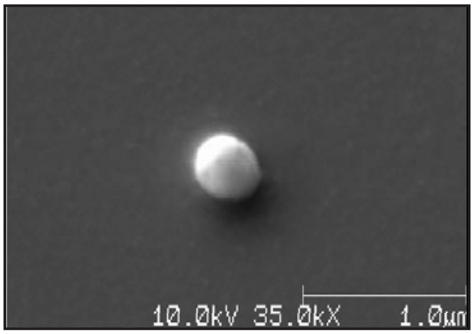
SEM images
> Same size
> Same Shape
> Same Brightness

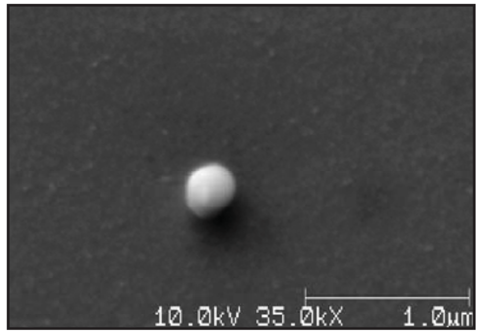
SEM images of two defects do not discriminate between defect types, nor suggest their source.

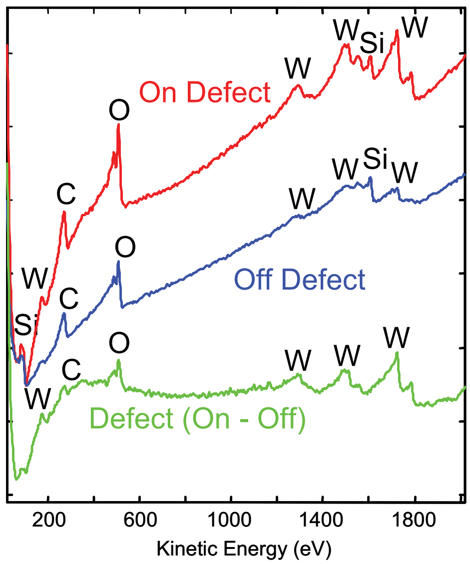
W Silicide CVD Process

Optical inspection after W silicide CVD (WF_6+ $SiCl_2H_2$) revealed multiple defects. SEM images of two particles on this wafer show that they have the same shape. Defect classification by morphology would indicate that these defects are therefore the same type, and have a single defect source. This classification does not indicate a specific, probable defect source that could be eliminated to increase yield. Energy Dispersive X-ray Spectroscopy (EDS) was also unable to determine the composition or source of these defects since the particle sizes are much smaller than the excitation and analysis volume of EDS.

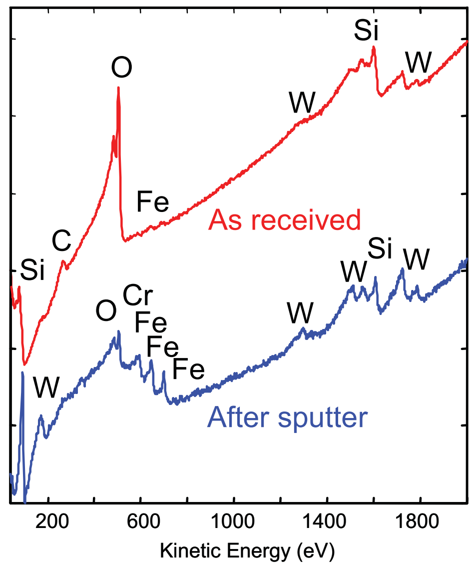
Auger compositional measurements identified one defect as unreacted W, and the other defect as a stainless steel particle with a thin SiO_2 coating. This information identifies two different defect types with two different defect sources. The unreacted W particle originates from a process chemistry problem. The stainless steel particle originates from the process tool hardware. Additionally, the thin Si oxide coating on the steel particle shows that it has also been through an oxide deposition tool, indicating cross-contamination between process tools.







Unreacted Tungsten Particle
Process Chemistry



Stainless Steel Particle with SiO_2 Coating
Process Tool Hardware

Auger Measurements
> Different Composition
> Different Defect Types
> Different Defect Sources

Auger compositional measurements of two defects reveals two different defect types, and indicate probable defect sources.

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