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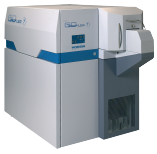
Measuring Erosion Rate, Crater Depth and Layer Thickness using the Differential Interferometry Profiling



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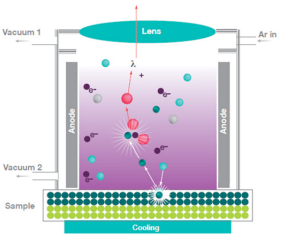
Motivation

The recent introduction of the Differential Interferometry Profiling (DiP) inside the GD instruments is a powerful advancement for Glow Discharge Optical Emission Spectrometry. **Thanks to DiP it is now possible to obtain the direct measurement of the crater depth during the GDOES profiling.** In case of non transparent materials, such measurement is straightforward and it gives direct access to important quantities such as: crater depth, erosion rate, layer thickness and variations in reflectivity.

Up until now the time-to-depth conversion was the last step of the GDOES quantification and it was based on an estimate of the material density. However, now, being able to directly measure the crater depth allows to reduce the errors related to a wrong estimation of this structural parameter.

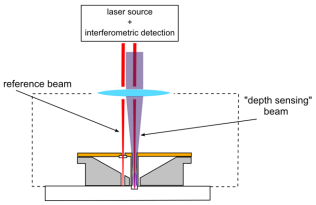
GDOES

The GDOES analysis relies on the **sputtering of a representative area of the material of interest** by a dense plasma, operated in RF mode. The same plasma simultaneously excites the sputtered species producing a characteristic light which is analysed by a high resolution optical spectrometer.

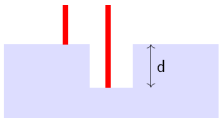


DiP

Now available inside the GD instrument: a **differential interferometry profiler (DiP)**.
In case of **non transparent materials**, thanks to DiP it is possible to directly obtain the crater depth as a function of time.
This solution is based on the relative measurement between two laser beams reflected inside the GD crater and at the surface close to the crater



Determining the thickness for non transparent materials



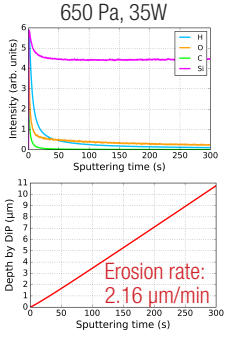
In case of **non transparent materials**, the thickness determination is straightforward
→ There is always a linear relation between phase shift (Δφ) of the laser beams and the depth (d) of the crater.

$$d = \frac{\lambda}{4\pi} \cdot \Delta\varphi$$

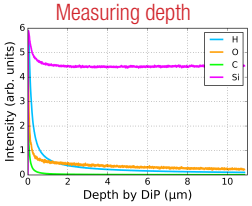
Conversion factor: 50.5 nm/rad

Bulk sample - Si wafer: depth, erosion rate and accuracy

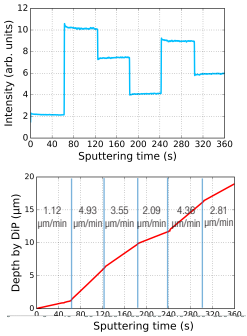
650 Pa, 35W



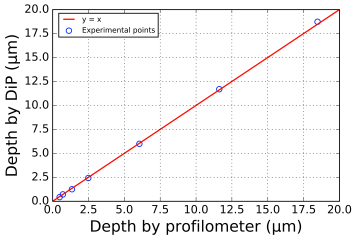
Measuring depth



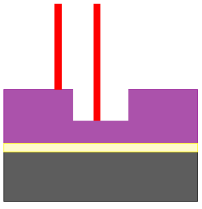
Evolution of erosion rate



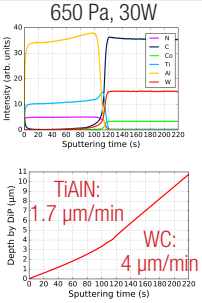
Accuracy



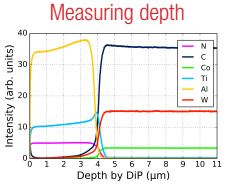
Layered samples – TiAlN



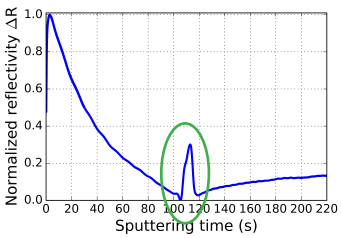
650 Pa, 30W



Measuring depth



Variations in reflectivity



Conclusion

The GDOES analysis of non transparent materials has known a great advancement thanks to the development of the Differential Interferometry Profiling.

This accessory gives direct access to important information such as erosion rate and layer thickness, and proves to be in excellent agreement with standard thickness measurement techniques, such as standard mechanical profilometers.

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