EUV induced degradation studies on reticles by XPS

Shriparna Mukherjee[1], Alessandro Troglia[1], Véronique de Rooij-Lohmann[1],

[1]Department of Semicon Equipment Lifetime, TNO, the Netherlands Organisation for Applied Scientific Research, The Netherlands

Keywords: XPS, surface-interface analysis, EUV, oxidation

EUV reticles play an important role in the semiconductor manufacturing since their quality directly impacts the resolution and accuracy of the transferred image onto the wafer. This, in turn, affects the performance and yield of the resulting chips. Meanwhile, these reticles are very costly and subject to degradation. Better understanding of degradation mechanisms is therefore necessary to improve the designs and further increase the life-time. Under the framework of the European project 14ACMOS, TNO develops metrology for reticle degradation assessment. Test samples are produced for metrology studies by inducing degradation on various types of reticles. One of the criteria is that the degradation should be non-reversible upon exposure to the ambient, as the samples will be transported to metrology equipment in ambient conditions. Also, it is preferred to have lateral variations and real EUV-induced degradation. Different types of reticles (multilayer blank, absorber blank, patterned reticles) were exposed to EUV at TNO's EUV beam line 2 (EBL2). To facilitate oxidation, water and oxygen were introduced into the exposure chamber. XPS analysis was performed before and after the EUV exposures. Severe oxidation of Ru and Si were primarily observed on the multilayer blank. Moreover, compared to the pre-XPS, the post XPS analysis showed significant decrease in Ru while no such decrease was observed in case of Mo/Si. This might indicate that EUV induced oxidation resulted in intermixing or surface segregation and delamination in the multilayer blanks.

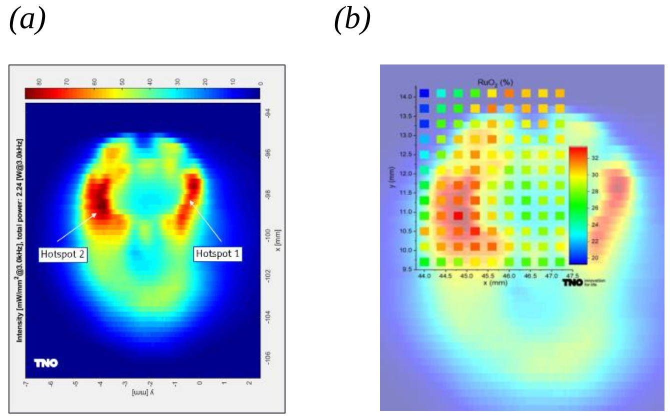

Figure 1: (a) EUV intensity profile and (b) Overlay of XPS map for Ruthenium oxide with the EUV intensity profile

This project is supported by the Chips Joint Undertaking (under grant agreement No 101096772) and its members, including the top-up funding by The Netherlands.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or The Netherlands. Neither the European Union nor The Netherlands can be held responsible for them.