The Mass-filtered Ion Gauge (MFIG), a vacuum-contamination sensor for yield enhancement

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To produce high-end products, clean vacuum is often required. Even small amounts of high-mass molecules can reduce product yield. For example, (sub)monolayer of contaminant molecules can already negatively impact the reflectivity of an EUV mirror or mask.[1,2] The challenge in yield enhancement is to timely detect the presence of relevant contaminants. Here is where MFIG can help. The mass-filtered ion gauge sensor (MFIG) continuously and selectively monitors the presence of high-mass contaminant molecules with a sensitivity down to 1E-13 mbar at total pressures up to 1E-5 mbar.

TNO's development of a Mass-filtered Ion Gauge (MFIG) started in 2007, when experts realized that IC manufacturing with EUV needs extremely clean vacuum, while existing sensors are either too slow, expensive or insensitive for real-time monitoring of vacuum cleanliness. The promising results of a "quick-and-clean" test were well-received at the AVS fall meeting in 2008. Hence TNO incubated the concept in an EU project, in which both instrumentation was improved and application requirements were clarified by interacting with the consortium partners. In 2015 TNO has been awarded an NanoNextNL valorization grant to further mature the instrumentation for sensitivity selectivity and cost, as well as to collect field test data to validate MFIG's value in realistic usage conditions.[3]

This contribution discusses some beam-induced contamination mechanisms in UHV and presents laboratory and field-test data to demonstrate the capabilities of the latest MFIG sensor in continuously and selectively detecting high-mass contaminant molecules in (U)HV vacuum.

References

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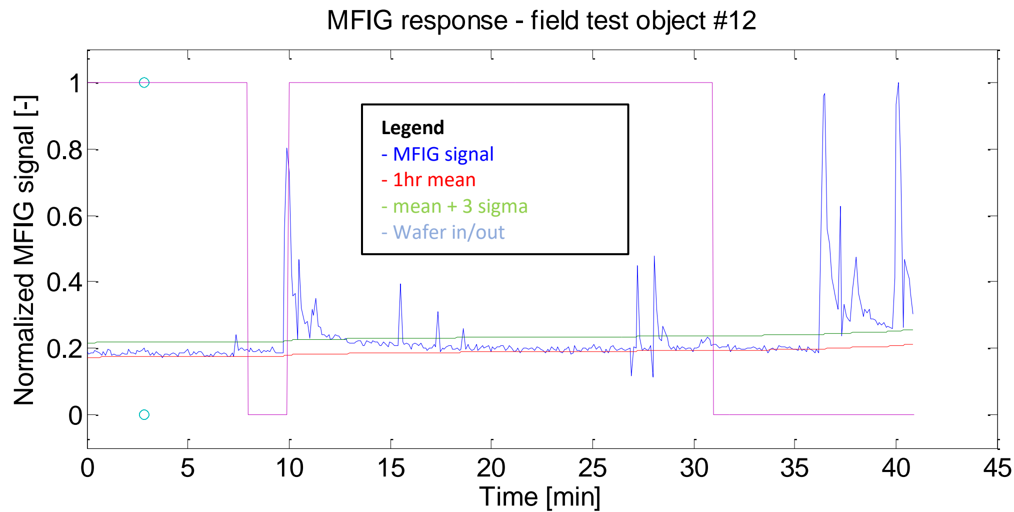

Figure 1: MFIG field test data: Real-time monitoring of contamination precursors in a state-of-the-art UHV defect review SEM. The blue line is the MFIG signal, showing tens of short-yet-significant events (i.e. MFIG signal exceeding mean + 3 sigma) during between a wafer load-unload cycle.

Funding The research described in this paper was performed in the framework of the NanoNextNL Valorisation Programme, partly linked to the EEM450PR and E450EDL projects. TNO gratefully acknowledges funding by NanoNextNL, the ECSEL Joint Undertaking and the Netherlands Enterprise Agency (RVO).