Standalone actinic EUV tools supplementing PTB beamline metrology – challenges in measuring extremely low EUV Reflectance

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RI Research Instruments develops and produces stand-alone laboratory tools for actinic EUV metrology based on our EUV-LAMP gas discharge source. Our AIMER™ Tools apply “effective inband EUV measurements” using spectrally filtered emission of the EUV-LAMP to 2% bandwidth at 13.52 nm for measuring properties “as seen by the scanner”. Recording data with back-illuminated CCDs, this concept excels in very high throughput and provides unique mapping capabilities for the EUVL supply chain. Mapping of full a mask or pellicle surface with complete areal coverage and intrinsic resolution in the 20 µm range is achieved in less than one hour.

The first industrial application for this technique has been our EUV pellicle transmission qualification tool EUV-PTT which allows for recording AIMER-Images of about 20x20 mm² in less than 5 seconds. Hence, a full pellicle characterization with more than 60 images taken is accomplished in less than one hour. The first prototype of the EUV-PTT is in production quality control since over one year at our customer and achieving targeted quality in measurement performance, cleanliness and reliability.

AIMER reflectometry provides a full mask blank characterization as a “quality- map” of the sample with 20µm spatial resolution and is accomplished in about the same time as commonly applied spectrally resolved characterization - at either synchrotron beamlines or with dedicated EUV reflectometers - where only a limited number of spots (typ. 1*1mm²) distributed across the surface are measured. In this presentation, we compare our AIMER results with spectral reflectance curves from ALS at selected samples. For both high reflective mask blanks and absorber coated blanks with low reflectance we find an excellent agreement of both methods.

Finally, as the quality of EUV pellicles is steadily increasing, also secondary aspects like the extremely low reflection from the pellicles become important in controlling and tuning the printing performance in the scanner. Hence, recently, we have performed concept studies on applying the AIMER technique to carbon nano tube pellicles and on measuring the reflectance of low reflectance samples.

On one hand, those measurements and the tool under installation have to rely on reference samples with calibrations provided by the PTB. On the other hand trying to measure reflectances in the range of 0.02 % with demonstrated sensitivities and reproducibilities in the range of 0.002 % is cumbersome. Moreover, it will be discussed that the absolute accuracy of such measurements poses quite a challenge, as totally different approaches and components are used.