1. Title:	Development of EUV pellicle for reticle defect mitigation
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3. Abstract body:
The lack of a suitable pellicle is one of the principal challenges in EUV lithography. Pel-licles are normally required to protect the mask from particulate contaminations in optical lithography systems. In this paper, we report development towards full size EUV pellicles that can be mounted and utilized like conventional pellicles today. The EUV pellicles must satisfy a number of critical requirements such as transmission at EUV wavelength and robustness during handling. Most importantly, the pellicle itself should not be a cause of defects on the mask. Organic pellicles have traditionally been employed for optical lithography but as they are highly opaque at EUV wavelengths, they are unsuitable for EUV lithography applications. We present rigorous modeling results and experimental data to demonstrate the impact of pellicle on far-field imaging.
Two approaches to fabricate the EUV pellicles are currently under development. In one method, a thin film is deposited on a wire mesh with the aid of a sacrificial polymer layer. In the other approach, a wire-mesh is eutectically bonded on a thin film. Both proc-esses use Si as the core thin film due to its high transmittance at EUV. In terms of imag-ing performance both methods are considered equivalent.

Ru capped Si thin film membranes for one of the processes discussed in this paper is a result of combating the twin effects of silicon oxidation and diaphragm stress. Previous studies by this group have shown that Ru films are better than Si at producing dia-phragms with the desired tensile stress. On the other hand, the high transmission of EUV in Si is mitigated by inevitable surface oxidation when exposed to atmosphere. In this paper we will present results from our studies with trilayer diaphragms composed of Ru capped Si films. Auger depth profiling of Ru capped Si membranes confirms that oxida-tion penetration into Si is effectively mitigated.

A ray tracing model is developed to understand the impact of pellicle on a reflective reti-cle. Mitigation strategies for NILS and contrast degradation of various patterns due to a mesh based pellicle have also been studied. Pellicle stand-off distance, mesh pitch, thin film absorbance are varied, and impact on illumination uniformity at the image (wafer) plane are investigated.

To gain experimental validation of our model and concept, blank meshes with >90% transmission are exposed with a DUV scanner. Comparison of CD uniformity, process window, and illumination uniformity data is presented, and the results are compared to the modeling.