1. Title:	Flatness Response of an EUV Mask during Exposure Chucking
2. Full names of all authors:	Madhura Nataraju, Jaewoong Sohn, Andrew R. Mikkelson, Kevin T. Turner, Roxann L. Engelstad, and Kevin J. Orvek

3. Abstract body:

Stringent flatness requirements have been imposed for the front and back surfaces of Extreme Ultraviolet Lithography (EUVL) masks to ensure successful pattern transfer that satisfies the image placement error budget. It is critical that the electrostatic chucking process during exposure and its effect on mask flatness be well-understood. The current research is focused on the characterization of the mask flatness during electrostatic chucking through advanced finite element (FE) models and experiments using a typical pin chuck.

FE models have been developed to use interferometric flatness measurements of the mask and the chuck to predict the final flatness of the pattern surface. These models simulate electrostatic chucking and include the effect of the nonuniformity of the electrostatic forces due to the nonuniform gaps between the backside of the mask and the chucking surface. These models also account for the pin characteristics. Electrostatic chucking experiments have been performed in a clean room, within a vacuum chamber mounted on a vibration isolation cradle, to minimize the effects of particles, and humidity. A Zygo interferometer was used to measure the flatness of the substrate after chucking. This was compared to the FE prediction and was found to match quite closely.

The FE models have been validated by experiments and can be used to expedite the design of electrostatic chucks and the development of the SEMI standards.