1. Title:	Removal of Nano Particles on EUV Mask Buffer and Absorber Layers by Laser Shockwave Claning
2. Full names of all authors:	Sang-Ho Lee, Jin-Goo Park, Tae-Hoon Kim, Ahmed Busnaina, Jong-Myung Lee

3. Abstract body:

The nano sized particle removal on the blanket EUV buffer and absorber surfaces was evaluated. Before cleaning, the adhesion force was previously calculated between a particle and EUV mask layers. The highest adhesion force was observed at Cr absorber layer. However, Si capping and SiO2 buffer layer was estimated to be easily cleaned as a result of adhesion force calculation. For the nano particle removal, 50 nm fluorescent PSL particles were deposited on 4 nm Si capping, 100 nm SiO2 buffer and 70 nm Cr absorber layers. The particles were measured by fluorescent microscopy with their spectroscopic excitation and emission properties before and after cleaning. Laser shockwave cleaning method was used to remove nano particles on each EUV surfaces. For the increase of cleaning efficiency, UV laser combined laser shockwave was irradiated at the damage free condition. Most contaminated particles were removed on the SiO2 buffer and Si capping layer. But relative particle removal efficiency of Cr absorber layer was not higher than those of SiO2 buffer and Si capping layers. This indicates that the adhesion force can expect the particle removal on different EUV surfaces. An absorber layer was highly difficult in nano particle removal.