Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Focused helium and neon ion beam induced etching for advance EUV lithography and mask repair RAJENDRA TIMILSINA, CARLOS GONGALEZ , University of Tennessee Knoxville, Tennessee, PHILIP RACK, University of Tennessee Knoxville and Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, Tennessee — The gas field ion microscope was used to investigate helium and neon ion beam induced etching (IBIE) of nickel as a candidate technique for extreme ultraviolet (EUV) lithography mask editing. No discernable nickel etching was observed for room temperature helium exposures at 16 and 30 keV in the range of $1x10^{15}$-$1x10^{18}$ He^+/cm^2, however transmission electron microscopy (TEM) revealed subsurface damage to the underlying Mo-Si multilayer EUV mirror. Subsequently, neon beam induced etching at 30 keV was investigated over a similar dose range and successfully removed the entire 50 nm nickel top absorber film at a dose of approximately $3x10^{17}$ Ne^+/cm^2. TEM also revealed subsurface damage in the underlying Mo-Si multilayer. To further understand the helium and neon damage, we simulated the ion-solid interactions with our EnvizION Monte Carlo sputtering program which reasonably correlated the observed damage and bubble formation to the nuclear energy loss and the implanted inert gas concentration, respectively. A critical nuclear energy density loss of approximately 80 eV/nm^3 and critical implant concentration of approximately 10^{20} $atoms/cm^3$ have been calculated for damage generation in the multilayer structure.

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Date submitted: 14 Nov 2013 Electronic form version 1.4