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Physical Sputtering vs. Gas Assisted Etching of Silicon Dioxide with a Gallium Focused Ion Beam: Elucidating Experiments via Monte Carlo Simulations RAJENDRA TIMILSINA, Unviersity of Tennessee Knoxville, SHIDA TAN, RICHARD LIVENGOOD, Intel Corporation, PHILIP RACK, Unviersity of Tennessee Knoxville and CNMS, Oak Ridge National Laboratory — In order to increase ion beam nanomachining precision and improve imaging resolution, fine tuning of the ion beam profile is absolutely necessary. To understand the effects of ion beam tails, experiments and Monte Carlo simulations were conducted with a 40 keV gallium beam with and without gas assisted chemical etching. A gallium ion beam was scanned in an area of 25x25 nm^2 on a silicon dioxide film with and without a localized XeF_2 gas at 1pA current. Four different ion doses (0.23, 0.9, 1.8 and 3.6 $nC/\mu m^2$) were experimentally considered to study the sputtered and etched via profiles. Monte Carlo simulations using EnvizION program was performed to elucidate the sputtered and gas-assisted etch process. New features including gas-assisted etching by secondary electrons and a binary collision model to dissociate the precursor molecules were introduced. Sputtered via and gas assisted etching (XeF_2 precursor gas) via profiles with various gas-assist pressures were studied to understand the experimental temporal behavior. Various contributions including sputtering from primary, forward scattered, backscattered ions as well as etching by recoiled atoms and secondary electrons will be discussed.

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