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Monte Carlo Simulations of Focused Electron Beam Induced Etching RAJENDRA TIMILSINA, University of Tennessee Knoxville, PHILIP RACK, University of Tennessee Knoxville and Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, Tennessee, KARSTEN WOLFF, MICHAEL BUDACH, KLAUS EDINGER, Carl Zeiss SMS, Industriestr 1, 64380 Roßdorf — Focused beam (electron-ion-photon) induced processing has long been utilized as a micro-/nano-scale direct synthesis method for both additive (via deposition) and subtractive (via etching) machining for a variety of editing and prototyping applications. Nanoscale lithography mask editing is one critical area which is pushing the limits for these beam induced processing methods. Beam damage associated with liquid gallium and the recently developed gas field ion source limits their utility in lithography mask repair due to the stringent optical requirements. Thus, electron beam induced processing for mask repair of both clear and opaque defects is the method of choice. To understand the fundamental electron-solid-precursor interactions, a Monte Carlo electron-solid simulation has been developed with an appropriate precursor gas routine which emulates adsorption/desorption, surface diffusion and electron stimulated reactions. The simulation was recently modified to handle electron beam induced etching. The electron beam induced etching of silicon dioxide is studied over a range of beam energy, current, dwell times and etch precursor gas conditions to elucidate important rate limiting regimes. Furthermore, the temporal behavior of the high-aspect ratio etch process is demonstrated. Simulation results are compared to various experimental conditions to validate appropriate parameters.

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