NUMERICAL SIMULATION OF SPUTTERING VIA THE FEATURE PROFILE SIMULATOR

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Numerical simulation of etching/deposition profiles is an important factor for semiconductor industry, as it allows analysis and prediction of the outcome of materials processing on a micron and sub-micron scale. A feature profile simulator has to be able to treat various chemical/physical processes taking place at or near the surfaces, which definitely include sputtering. Physical/chemical sputtering is a complex process, depending not only on the species and materials involved (incident ions and target materials) but also, for example, on energies of striking ions and their angles of incidence. There is significant experimental database as well as numerous theoretical and empirical considerations for sputtering of elemental targets. However, most of that was specifically applicable to high ion energies, usually significantly higher than the typical ion energy during the plasma materials processing. Numerical simulation tools such, for example, as the Monte Carlo codes, MARLOWE and TRIM, were developed, but again, for the higher energy ions. In this report, we present analysis and simulation of sputtering for most of the elemental targets and various incident ions, carried out with the feature profile code FPS-3D [1-2]. The FPS-3D code allows general distribution of particle fluxes on energy and angle. However, for the present studies, the flux of ions was set as a beam at particular energy and angle. That allowed us to compare simulation results more directly with available experimental data and literature. The FPS-3D simulator uses input, chemistry, and flux files to specify all the simulation parameters, and does not require recompilation for different species, energies or angles. We are thankful to HFS [3] for providing us with the RANGE code, capable of calculating penetration depth of ions and their sputter yields, and with the advanced graphics package utilized in the FPS-3D code for viewing of evolving profiles during the simulation runs.

[1] P. Moroz, “Feature Profile Simulator Algorithm Utilizing Finite Penetration Depth”, GEC, URP.00101, Saratoga, NY, 2009.
[2] P. Moroz, “Feature Profile Simulation Taking into Account the Finite Penetration Depth”, APS-DPP, NP8, Atlanta, GA, 2009.
[3] www.highfactor.com