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Three-dimensional Self-consistent Particle-in-cell and Monte Carlo Collisional Simulation of DC Magnetron Discharges

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DC magnetron discharges were studied using three-dimensional self-consistent particle-in-cell and Monte Carlo collisional (PIC-MCC) simulation codes. Two rectangular sputter sources (120 mm * 250 mm and 380 mm * 200 mm target sizes) were used in the simulation modeling. The number of incident ions to the Cu target as a function of position and simulation time was obtained. The target erosion profile was calculated by using the incident ions and the sputtering yields of the Cu target calculated with SRIM codes. The maximum ion density of the ion density distribution in the discharge was about 10^{10} cm^{-3} due to the calculation speed limit. The result may be less than one or two order of magnitude smaller than the real maximum ion density. However, the target erosion profiles of the two sputter sources were in good agreement with the measured target erosion profiles except for the erosion profile near the target surface, in which which the measured erosion width was broader than the simulation erosion width.

Keywords: Three-dimensional PIC-MCC simulation, Magnetron discharge, Sputter source