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Simulation of neutral beam etching for material processing

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Abstract

Nowadays the neutral beam etching is being demanded to manufacture the nano-scale semiconductors by the reason of a damage-free etching process compared to other etching processes. Generally, the neutral beam etching consists of three parts in the simulation :Ion-gun, reflection reaction, neutral beam transport.

We have used the XOOPIC code for the simulation of the ion-gun. The ion-gun which is the ion source of a neutral beam etching has been optimized by variations of a geometry and a grid voltage to obtain the high ion flux and the low angle distribution of ions. Moreover, several new ideas, such as the funnel shape, the application of magnetic field, the ion-ion plasma, have been proposed. In order to save the computational time, the attempt os made to simulate the electron-free plasma.

For the simulation of reflection reactions and the neutral beam transport, we modified the XOOPIC[1] code. The reflection characteristic of a ion is achieved by using TRIM code. Using these codes, we have been able to carry out a variety of variations related to the angle of the reflector, an ion current, the distance, and material of the reflector. According to this implementation, the neutral beam etching system at the region of low pressure has been optimized to obtain the high neutral flux and high etch rate.

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[1] M.S.Hur, S.J Kim, H.S.Lee, J.K.Lee, and G.Y.Yeom, "Particle in Cell simulation of a Neutral Beam Source for Materials Processing", IEEE Trans. Plasma Science (Feb.2002)