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Optimization of Target Utilization in Planar Circular Sputtering Magnetron Using PIC-MCC Modeling

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This study investigates the optimization of target utilization, defined as the ratio of the total sputtered mass at the target's end-of-life to its initial mass, in a 3" planar circular sputtering magnetron. The study is conducted by modeling the ion bombardment process and predicting the resulting sputtering behavior. A self-consistent, axisymmetric 2D-3V Particle-In-Cell Monte Carlo Collision (PIC-MCC) model is implemented to simulate the generated plasma discharge properties and the effects of ion bombardment on the target surface.

A unique feature of the model is the dynamic management of the target shape using a pixelated approach, where the cathode consists of a set of target volume elements (pixels) that are progressively removed based on the sputtering profile calculated from ion bombardment. This allows for the estimation of sputtered mass and the calculation of the target mass ratio at the target's end-of-life compared to its initial state. Various magnetic field configurations were studied, and a prototype magnetron was built using the configuration that provided the best utilization. Experimental measurements of target utilization for this prototype revealed an efficiency greater than 40%. Plasmionique Inc. is now commercializing this magnetron and continues to use this code for the ongoing development of its magnetron series. These results demonstrate the model's potential to optimize magnetron design, offering significant time and cost savings by reducing the need for extensive experimental testing and prototyping.

Keyword-1

Magnetron Sputtering

Keyword-2

PIC-MCC

Keyword-3

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