Non-electrostatic diagnostics for ion beams and sputter effects

T. Trottenberg, A. Spethmann, J. Rutscher, H. Kersten

Institute for Experimental and Applied Physics, University of Kiel, Kiel, Germany

Broad beam ion sources are an important tool for industrial surface treatments. They are used for ion beam etching, sputter deposition, structuring and ion implantation [1]. In such sources, positively charged ions are extracted and accelerated by a grid system to energies of typically some 100 eV to some keV. Beside terrestrial applications, ion sources are increasingly used as electrostatic thrusters for the propulsion of space vehicles [2].

The physical, and in case of reactive gases also chemical, action of the beam on material surfaces depends essentially on the beam parameters, which might be altered by gas, objects and walls in the beam path. Similarly, the development of ion thrusters requires suitable on ground beam diagnostics in test chambers.

Aside from conventional, electrostatic diagnostics like Faraday cups and retarding-field probes, non-electrostatic methods have been applied less frequently. Such methods do not depend on the electrical charge of the beam particles and can therefore in combination with electrostatic probes provide more information about the beam, especially energetic neutral particles produced by ion-neutral collisions. Known for a long time are calorimetric techniques [3, 4, 5, 6].

In this contribution, we present novel methods measuring the force exerted on small surfaces in the beam. Since the “ram pressure” of the beam results both from the momentum transferred by the impinging beam particles and from the momentum carried away by sputtered target atoms and recoiled beam particles, a systematic study of sputter processes becomes possible.

References