Extraction of Positive and Negative Ion Beams from Large Area Plasma Sources

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Energetic ion beams, extracted from large area radio frequency (RF) plasma sources, are used for material modifications in the leading-edge technologies.
One example is the large area inductively coupled plasma (ICP) source used in flat panel plasma vapour deposition (PVD) system, where an ion beam sputter etch is used to reduce the contact resistance prior to depositing an oxide layer.
While implantation and deposition are mainly utilizing positive ions, etching and beam neutralization can be done with negative ions, as well. Negative ions are extracted from the afterglow phase of pulsed plasmas, while positive ions can be extracted from both the DC and pulsed plasmas. In the case of pulsed plasma, extraction electrodes and a treated surface are biased synchronously with the discharge modulation for positive/negative ion transport to the target. The energy of extracted ions closely follows the amplitude of the applied bias voltage and it ranges from few hundreds of electron volt to 20 keV. The peak beam current density can reach 100 A/m^2.
In this paper we review the production and extraction of positive and negative ions from the DC and pulsed RF plasma sources.
The experimental verification of the ion angular distribution (IAD), ion current and ion composition is reported. The extraction physics requires correlating the positive and negative ion and electron densities near the extraction opening with the extracted currents. This system is modelled using the CRTRS, 2D/3D code, a plasma fluid code that self-consistently solves for ICP power deposition, electrostatic potential and plasma dynamics in the drift-diffusion approximation.
The focus is on the transport of low energy beams. A new perspective on the possible production of angled ion beams on surfaces is discussed.

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