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Extraction of positive and negative ion beams by discrete and modal focusing effects EUGEN STAMATE, Technical University of Denmark — Positive or negative ion beams extracted from plasma are used in a large variety of surface functionalization techniques such as implantation, etching, surface activation, passivation or oxidation. Of particular importance is the surface treatment of materials sensitive to direct plasma exposure due to high heath fluxes, the controllability of the ion incidence angle, and charge accumulation when treating insulating materials. Despite of a large variety of plasma sources available for ion beam extraction, there is a clear need for new extraction mechanisms that can make available ion beams with high current densities that can treat surfaces placed adjacent to the extraction region. This work introduces a new phenomenology for ion beam extraction using the discrete and modal focusing effects associated with three-dimensional plasma-sheath-lenses. Three- dimensional simulations are used to explain the plasma sheath lens design and the extraction mechanism. Experiments are performed in a matrix-ECR plasma source with transversal magnetic filter for electron temperature control. The discharge is operated at pressures below 1 mTorr and low plasma densities for a density ratio of negative ions to electrons larger than 300. The focused ion beams of positive or negative ions are used to induce surface modification on conductive and insulating substrates.

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