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Ion Energy Distribution Control Using Ion Mass Ratios in Inductively Coupled Plasmas With a Pulsed DC Bias on the Substrate[1]
MICHAEL D. LOGUE, MARK J. KUSHNER, University of Michigan — In many applications requiring energetic ion bombardment, such as plasma etching, gas mixtures containing several ion species are used. In cases where two ions have significantly different masses, it may be feasible to selectively control the ion energy distributions (IEDs) by preferentially extracting the lighter ion mass with a controllable energy. In this work, we investigate the possibility of using a pulsed DC substrate bias in an inductively coupled plasma (ICP) to obtain this control. Pulsing of the substrate bias in the afterglow of a pulsed ICP plasma should allow for shifting of the IED peak energy by an amount approximately equal to the applied bias. If short enough pulses are used it may be possible to obtain a higher flux at high energy of the lower mass ion compared to the higher mass ion. A computational investigation of IEDs in low pressure (a few to 100 mTorr) ICPs sustained in gas mixtures such as Ar/H_2 or Xe/H_2(having large mass differences) was conducted as a proof of principle. The model is the Hybrid Plasma Equipment Model with which electron energy distributions (EEDs) and IEDs as a function of position and time are obtained using Monte Carlo simulations. We have found a selective ability to mass and energy discriminate ion fluxes when using sufficiently short bias pulses. Results from the model for plasmas densities, electron temperatures, EEDs and IEDs will be discussed.

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