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Controlling Ion and UV/VUV Photon Fluxes in Pulsed Low Pressure Plasmas for Materials Processing[1] PENG TIAN, MARK J. KUSHNER, University of Michigan — UV/VUV photon fluxes in plasma materials processing have a variety of effects ranging from damaging to synergistic. To optimize these processes, it is desirable to have separate control over the fluxes of ions and photons, or at least be able to control their relative fluxes or overlap in time. Pulsed plasmas may provide such control as the rates at which ion and photon fluxes respond to the pulse power deposition are different. Results from a computational investigation of pulsed plasmas will be discussed to determine methods to control the ratio of ion to photon fluxes. Simulations were performed using a 2-dimensional plasma hydrodynamics model which addresses radiation transport using a Monte Carlo Simulation. Radiation transport is frequency resolved using partial-frequency-redistribution algorithms. Results for low pressure (10s of mTorr) inductively and capacitively coupled plasmas in Ar/Cl_2 mixtures will be discussed while varying duty cycle, reactor geometry, gas mixture and pressure. We found that the time averaged ratio of VUV photon-to-ion fluxes in ICPs can be controlled with duty cycle of the pulsed power. Even with radiation trapping, photon fluxes tend to follow the power pulse whereas due to their finite response times, fluxes of ions tend to average the power pulse. Due to the overshoot in electron temperature that occurs at the start of low-duty-cycle pulses, disproportionately large photon fluxes (compared to ion fluxes) can be generated.

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