Abstract Submitted
for the GEC08 Meeting of
The American Physical Society

Estimating and controlling the atomic oxygen content in an argon-oxygen plasma BERNARD KEVILLE, Dublin City University, Ireland, DEREK D. MONAHAN, MILES M. TURNER — Oxygen rich plasmas have been applied in many plasma processing applications for decades. In most such applications, process yield could be improved significantly by applying closed loop control of atomic oxygen radical concentration. The design of effective, real time, closed loop control algorithms is facilitated by simple dynamical models of the relationship between inputs, or actuators in control terminology, and the process quantities to be controlled. In the case of an oxygen rich plasma process, one requires the relationship between the inputs - flow-rate set points, forward power from the RF supply and residence time, for example - and the oxygen radical density. With the aid of an argon-oxygen plasma simulation, this presentation describes how, with the aid of simplified dynamical models of the process, one would design model-based control algorithms for the real-time, closed loop control of oxygen radical density. A sine qua non of real time, closed loop control is an accurate estimate of the process quantities to be controlled. Although actinometry provides a non-invasive method for estimating species densities, atomic oxygen actinometry is complicated by the fact that photon emission can occur through dissociative as well as direct excitation, leading to potential ambiguity between the emission intensity and the actual radical concentration in the plasma. Optimal estimation of process states given indirect measurements corrupted by process and measurement noise is a classical topic in control theory and has yielded some spectacular results, notably the ubiquitous Kalman filter.

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Date submitted: 17 Jun 2008 Electronic form version 1.4