Abstract Submitted
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Non-invasive, real-time measurements of plasma parameters with an industry standard spectrograph[1] SHICONG WANG, A.E. WENDT, Department of Electrical and Computer Engineering, University of Wisconsin-Madison, JOHN B. BOFFARD, CHUN C. LIN, Department of Physics, University of Wisconsin-Madison, SVETLANA RADOVANOV, HAROLD PERSING, Applied Materials Inc., Varian Semiconductor Equipment Business Unit, 35 Dory Road, Gloucester, MA 01939 USA — Plasma process control applications require acquisition of diagnostic data at a rate faster than the characteristic timescale of perturbations to the plasma. Diagnostics based on optical emission spectroscopy (OES) of intense emission lines permit rapid non-invasive measurements with low-resolution ($\sim$1 nm), fiber-coupled spectrographs, included on many plasma process tools for semiconductor processing. Here we report on rapid analysis of Ar($3p^5 4p \rightarrow 3p^5 4s$) 650-800 nm emissions with such a system to obtain electron temperatures and metastable densities in argon and argon/mixed-gas (Ar/N_2, Ar/O_2, Ar/H_2) inductively coupled plasmas. The OES-derived values are compared to measurements made by electric probes, white-light absorption spectroscopy, and OES measurements made with a high-resolution 0.5 m spectrometer. In a pure Ar plasma, for example, we have measured the metastable densities to better than $\pm$15% accuracy within 0.25 seconds. A number of subtraction procedures have been evaluated to extract the Ar emission intensities in the presence of overlapping molecular emissions. This is especially necessary for Ar/N_2 plasmas, which feature intense N_2 molecular emissions in the wavelength range of interest.

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