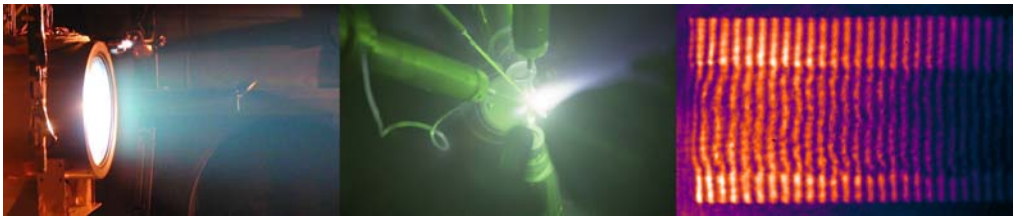

Michigan Institute for Plasma Science and Engineering Seminar

Plasma Science in Development of Industrial Etching and Deposition Tools: The Presence of Normal Modes Above a Capacitive Plasma Applicator

Dr. Michael S. Barnes

Intevac, Inc.

Wednesday, 7 Oct. 2009 - 4:00 pm, Room 1005 EECS.
(Refreshments will be served after seminar.)

Abstract

Capacitively-coupled plasma glow discharges are extensively used for materials processing in numerous industrial applications, and microelectronics fabrication in particular. Considerable research has been performed on plasma sheaths and standing waves over a capacitive applicator which typically holds the processed substrate (e.g., a semiconductor wafer). Normal modes of standing waves in the plasma potential, V_p, have been observed over the entire surface of a dual-frequency capacitive applicator immersed in an inductively-generated rf glow discharge. An emissive probe used to measure the plasma potential is located 0.95 cm above the applicator and moved by a two - dimensional drive system. The heater current to the probe is switched off during the 100 μs measurement to eliminate uncertainties due to the heater voltage. V_p is mapped at 208 spatial locations and digitized at 1 GHz. An electrically floating probe is located 1.84 cm above the center of applicator to afford a means to generate correlation functions for the detection of waves in the low temperature plasma. The observed normal modes in potential exist at several frequencies and can be expressed as summations of Bessel functions much like the vibrational modes in circular membranes and plates. The modes are most likely excited by the oscillations of the plasma - sheath interface including harmonic oscillations arising from the nonlinear mechanisms governing the sheath dynamics. As the frequency is increased, the order of the normal modes is postulated to increase as these modes are likely determined by the impedance terminating conditions on the chamber surfaces. The implications of these observations on industrial plasma equipment will be discussed.

About the Speaker:

Dr. Michael S. Barnes started his career at IBM developing plasma processing technology for manufacture of semiconductor integrated circuits. He then joined Lam Research Corp. and Applied Materials, Inc. leading the development of new plasma etch and plasma chemical vapor deposition (CVD) products that have since generated billions of dollars in revenues. More recently Dr. Barnes was General Manager for High Density Plasma CVD at Novellus Systems, Inc., and is now Chief Technical Officer of Intevac, Inc., a leading supplier of plasma equipment for manufacturing hard disk drives and semiconductor integrated circuits. He is inventor on over 75 patents and served on the National Research Council Plasma Sciences Committee. Dr. Barnes received his B.S., M.S., and Ph.D. in Electrical Engineering from The University of Michigan.