

Abstract Submitted
for the GEC10 Meeting of
The American Physical Society

Control of ion bombardment energies in low-temperature plasmas

TIM BALONIAK, RÜDIGER REUTER, ACHIM VON KEUDELL, University of Bochum, Germany — Ion bombardment of the substrate is a significant parameter in plasma processing such as dry etching or thin film deposition. The energies of the ions are manipulated by external bias voltages which are applied to the substrate holder. It is desirable to possess a technique to tailor ion energy distributions to the needs of different applications. In this contribution, we report about the control of ion bombardment energies in low-temperature plasmas by means of arbitrary radio-frequency bias voltage waveforms. The substrate voltage is monitored and controlled in the frequency domain using fast Fourier transformation. Ion energy measurements are performed by a miniaturized floating retarding field analyzer. A full modulation of the ion energy distribution function is only obtained if sufficiently high sheath voltages are applied. If the applied sheath voltages become too low, the distribution functions are only partly determined by the bias waveforms and the system response becomes nonlinear. This nonlinear behavior is visible both in the electrode voltage and in the ion energy distributions. It is shown that a combined DC and RF biasing is required to gain full control over the ion bombardment of the substrate.

Tim Baloniak
University of Bochum, Germany

Date submitted: 11 Jun 2010

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