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Real-time, Noninvasive Monitoring of Ion Energy at Insulating Electrodes MARK SOBOLEWSKI, NIST — The dc self bias voltage is often monitored during plasma processing to provide a rough estimate of ion bombardment energies. However, many plasma reactors use electrostatic chucks, which have a large dc impedance that makes dc bias measurements impossible. A chuck may also have a large rf impedance that produces a significant rf voltage drop across the chuck. In this study chuck impedance effects were investigated in an inductively coupled plasma reactor by incorporating insulating structures into the rf-biased lower electrode. Measurements were made to characterize the capacitive impedance of the insulating electrode itself and the combined impedance of the electrode plus the wafer. This impedance was included in a numerical model of the plasma and its sheaths and the combined model was used to analyze measured rf bias current and voltage waveforms. This approach allows a real-time, noninvasive monitoring technique developed for bare metallic electrodes to be extended to insulating electrodes, including electrostatic chucks. The technique not only determines the dc self bias voltage but also the total ion current and ion energy distributions at the wafer or chuck surface.

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