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**Three-Dimensional Electromagnetic Plasma Modeling of Inductively Coupled Plasma Source and Antenna** SHAHID RAUF, ANKUR AGARWAL, JASON KENNEY, MING-FENG WU, KEN COLLINS, Applied Materials, Inc. — Inductively coupled plasmas (ICP) are widely used for etching and deposition in the semiconductor industry. As device dimensions shrink with concomitant decreased tolerance for variability, it is critical to improve plasma and process uniformity in all plasma processes. In ICP systems, one of the major sources of non-uniformity is the radio-frequency (RF) antenna used to generate the electromagnetic wave. Discontinuities at current feed and grounding locations as well as electromagnetic field variations along the antenna coils can perturb the azimuthal electric field, resulting in a non-uniform plasma. For plasma modeling of ICP systems, a related problem is how capacitive coupling from the antenna is accounted for. ICP models have generally considered field variation along the antenna and capacitive coupling using simplified circuit models for the antenna structures. Modern ICP antennas are however quite complicated, making circuit approximations of the antenna too crude for system design. A three-dimensional parallel plasma model is described in this paper, where the full set of Maxwell equations are solved in conjunction with plasma transport equations for the plasma and the antenna. Several examples from the use of this model in ICP system design are presented.

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