Abstract Submitted
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Finite skin depth consideration in the inductive transformer matrix model: implications for external circuit design and pulsed power operation[1] CARL SMITH, JOEL BRANDON, KRISTOPHER FORD, DAVID PETERSON, STEVEN SHANNON, North Carolina State University, SANG-KI NAM, Samsung Electronics — The most commonly employed transformer matrix model for an inductively coupled plasma uses a thin skin depth approximation to obtain the relationship between coil geometry, plasma conditions, and the equivalent circuit elements that make up the transformer matrix equivalent circuit for an RF driven ICP source. A generalized skin depth dependent form of the transformer matrix elements L_{12} & L_{22} was derived and is presented in this work. This model, along with experimental comparison, suggests that these skin depth effects can be especially impactful at low density and during pulsed power operation. Compared to experimental results, prior global models have had difficulty capturing transients in n_e in the early power-on cycle. Generalization of skin depth dependence in L_{12} particularly exuberates impedance mismatch in the early on cycle and better accounts for dn_e/dt at low n_e where the thin skin depth approximation does not capture the transformer matrix terms. Steady state and time resolved pulsed results were obtained using hairpin data from a cylindrical ICP system with Ar at pressures below 50 mTorr and powers between 5 W and 50 W and were compared to a global equivalent circuit model of the plasma.

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