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Model Describing The E-H Mode Transition With Intrinsic Electrical Properties Of Inductively Coupled Plasma Reactors SHAUN SMITH, DAVID J. COUMOU, MKS Instruments, Inc. — For inductively coupled plasma sources, there exists a minimum operating power, below which, the plasma source abruptly shifts from the inductive coupling mode. This transition point for an RF driven ICP is from the electrostatic mode to the electromagnetic mode, or more commonly referred to, as the E-H mode transition. For increasing current, the power absorbed during E-mode precipitously *drops* toward a minimum defined by a power loss boundary, similar to that seen in a toroidal plasma source. After the transition to H-mode, the plasma current *increases* the power absorbed by the plasma source. For pattern transfer, the E and H modes both serve selectivity and etch benefits, however the mode transition remains a vexing challenge for RF power delivery systems.

The existence of the E-H mode transition is well known in RF inductively coupled plasmas, but has not been extended to toroidal plasma sources. We present a self-consistent electrical description of the mechanism for the E-H mode transition. We show the transition point can be intentionally manipulated with the variation of an electrical property of the system. Commensurate with model experimental results, we describe the impact the E-H mode imposes on RF power delivery coupled to ICP reactors.

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