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Influence of a phase-locked RF substrate bias on the E- to H-mode transition in an inductively coupled plasma PHILIPP AHR, Institute for Plasma and Atomic Physics, Ruhr University Bochum, 44780 Bochum, EDMUND SCHUENGEL, JULIAN SCHULZE, Department of Physics, West Virginia University, WV 26506, USA, TSANKO V. TSANKOV, UWE CZARNETZKI, Institute for Plasma and Atomic Physics, Ruhr University Bochum, 44780 Bochum —
The influence of a capacitive radio frequency substrate bias on the E- to H-mode transition and the electron heating dynamics in a low pressure inductively coupled plasma (ICP) in hydrogen is investigated. The inductive and capacitive power sources are driven at the same frequency and can be operated in a phase-locked mode with a fixed, but adjustable phase between them. This approach of phase-locked discharge operation is a new feature which enables time-resolved studies of both the inductive and the capacitive energy coupling by phase-resolved optical emission spectroscopy (PROES). The inductive power at which the mode transition occurs, P_{mtp}, is determined by PROES and from probe measurements of the electron density. For both, phase-locked and phase-unlocked operation, the plasma density in the E-mode is significantly influenced by the applied capacitive power: Already low values of bias power can reduce the value of P_{mtp}. This coupling between the power sources is dependent on the adjustable phase between them and is attributed to a phase sensitive confinement mechanism for the energetic electrons produced by the expanding sheaths at the substrate and at the ICP coil. At higher pressures the effect diminishes. In contrast, by using electrodes with ring-shaped trenches the coupling is enhanced.

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