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Electron heating in magnetized capacitively coupled discharges

BOCONG ZHENG, THOMAS SCHUELKE, Michigan State Univ, QI HUA FAN, qfan@egr.msu.edu, PLASMA SOURCES AND PROCESSING LAB TEAM — It is known that in capacitively coupled discharges, a small transverse magnetic field can induce a heating mode transition from a pressure-heating dominated state to an Ohmic-heating dominated state. Here, by using a particle-in-cell/Monte Carlo collision code, *ASTRA*, and a moment analysis of the Boltzmann equation, we demonstrate that the enhancement of Ohmic heating is induced by the Hall current in the $\mathbf{E} \mathbf{B}$ direction. As the magnetic field increases, the Ohmic heating in the $\mathbf{E} \mathbf{B}$ direction dominates the total electron power absorption. The time-averaged pressure heating can be negative under strong magnetic fields. Electric field reversals are observed during the sheath collapse phase, because the motion of electrons is prohibited by the transverse magnetic field and cannot follow the sheath collapse, resulting in a reversed ambipolar electric field. The ratio of Ohmic heating in different directions can be well approximated from the electron gyration, the voltage, and the collision frequencies, implying that the electron heating of a magnetized CCP discharge can be estimated from the unmagnetized CCPs.

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