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Characteristics of Spatial Electron Density Variation in a Pulsed-Rf and Bi-polar Pulsed-DC Magnetron Discharge S.K. KARKARI, A.R. ELLINGBOE, C. GAMAN, Dublin City University, Ireland, I. SWINDELLS, J.W. BRADLEY, University of Liverpool, United Kingdom — Magnetron discharges are highly popular in reactive sputtering of metals and insulators for depositing value-added coatings onto a wide variety of substrates. A large problem associated with DC sputtering is due to deposition of insulating films on to the target itself; resulting in frequent arcing and de-stabilization of the plasma process. Arcing is elevated by modulating the magnetron target voltage at pulse frequencies between 20 kHz to 350 kHz in the range of 50% to 90% duty cycle. Time-modulation can be achieved either by Bi-polar Pulsed DC or by Pulsed rf voltages applied to the sputtering target. We apply a time-resolved floating hairpin resonance probe, to characterize the spatial electron density as the discharge progresses during the pulsed cycle. With the Bi-polar pulsed biasing, we observe an expanding pre-sheath during the rise of the on-phase (negative voltage) and anomalous growth in density during the reverse phase (positive voltage) at specific positions in the discharge. This is contrasting to the pulsed-rf case, where we observe the electron density in the off-phase decays uniformly at all positions, with faster decay rates closer to the target. The electron density perturbations in the case of Bi-polar pulsed DC are explained using the expanding sheath theory and the state of the plasma potential modulation in the discharge.

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