Multiple Double Layers and Emergence of Turbulence
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Emergence of neutral turbulence associated with transition of multiple double layers is observed. Multiple double layers are generated by driving an electron beam towards a positively biased electrode submerged in glow discharge plasma. When \( v_d \geq 1.3 v_e \), Buneman instability leads to the excitation of double layer structure consisting of more than one layers with simultaneous emergence large amplitude burst electrical oscillations. For \( v_d \geq 3 v_e \) multiple layered structure vanishes into an anode glow and the burst saturate in to a relaxation oscillation with small amplitude and large frequency. Beyond a certain critical value, the anode glow became unstable and the oscillation begins to grow in time. At this stage, the system transformed into turbulent state characterized in terms of large amplitude and large frequency. Three regions were identified in the transition of multiple double layered structure, i.e., an instability region, stable region and a turbulent region. An analysis based on wavelets were used to obtain the long-term correlation between structures embedded in time series electrical signals. The analysis reveals the existence of neutral turbulence in the signal.

Reference: