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On the physical mechanism at the origin of multiple double layers appearance in plasma

D.G. Dimitriu, S. Gurlui, M. Aflori, L.M. Ivan

Faculty of Physics, "Al. I. Cuza" University of Iasi, Romania,
11 Carol I Blvd., RO-700506, Iasi, Romania,
e-mail: dimitriu@uaic.ro

Double layers (DLs) in plasma are nonlinear potential structures consisting of two adjacent layers of positive and negative space charge, respectively. Between these layers a potential jump exists, creating an electric field. A common way to obtain a DL structure is to positively bias an electrode immersed in asymptotic stable plasma. In this way, a complex space charge structure (CSCS) in form of a positive "nucleus" surrounded by a nearly spherical DL is obtained.

Under certain experimental conditions (gas nature and pressure, plasma density, electron temperature) a more complex structure in form of two or more subsequent DLs was observed [1], which was called multiple double layers (MDL). It appears as several bright and concentric plasma shells attached to the electrode. The successive DLs are located at the abrupt changes of luminosity between two adjacent plasma shells. Probe measurements emphasized that the axial profile of the plasma potential has a stair steps shape, with potential jumps close to the ionization potential of the used gas. Experimental results clarify the essential role of excitation and ionization electron-neutral collisions for the generation and dynamics of MDL structures [2].

However, if the electrode is large, the MDL structure appears non-concentrically, as a network of plasma spheres, near each other, almost equally distributed on the electrode surface [3]. Each of the plasma spots is a CSCS as described above.

Here, we will present experimental result on concentric and non-concentric MDL, which prove that the same physical mechanism is at the origin of their appearance in plasma. In this mechanism the electron-neutral impact excitations and ionizations play the key role. A simultaneously generation of both types of MDL was recorded. The dynamics of the MDL structures was analyzed by using the modern methods provided by the nonlinear dynamics. In this way, a scenario of transition to chaos by torus breakdown was emphasized, related with the successive appearance of non-concentric plasma spots.

[1] L. Conde and L. León, Phys. Plasmas **1** (1994) 2441.
[2] C. Ionita, D. G. Dimitriu and R. Schrittwieser, Int. J. Mass Spectrom. **233** (2004) 343.
[3] Y. A. Astrov and H.-G. Purwins, Phys. Lett. A **283** (2001) 349.