Virtual cathode for ions acceleration and nuclear synthesis at low energy nanosecond vacuum discharge

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We analyze further the database on random interelectrode "dusty" media of high power density created at low energy nanosecond vacuum discharges [1,2]. Generation of energetic complex ions (~1 MeV), DD burning, trapping or release of fast ions and x-rays from interelectrode complex plasma ensembles are discussing [2]. The estimated value of the neutron yield from DD collisional micro fusion at interelectrode space is variable and amounts to ~ 10^5-$10^7/4\pi$ per shot under ≈ 1 J of total energy stored to initiate all discharge processes (U = 70 keV, I_{max} = 1kA). In a limiting case of total trapping of fast deuterium ions by the dense "dusty cloud" of clusters under partial hard x-rays diffusion and multiple fusion events inside, the pulsating neutrons yield has the maximum values (table-top complex plasma *"microreactor"*) [2] being two order of magnitude higher than for experiments on DD fusion driven by Coulomb explosion of laser irradiated deuterium clusters [3].

The results of PIC simulation of experimental conditions [2] using fully electrodynamics code [4] are presented. The principal role of virtual cathode oscillator (*vircator*) [5] and correspondent potential wells formations at interelectrode space are discussed. In particular, space-time evolution of potential wells and electrostatic mechanism of ions acceleration at the regime of unstable current-carrying [6] are considered. The depth of calculated single or double potential well which plays the role of reactor chamber is about 50-60 keV. Deuterium ions being trapped by these wells are accelerating up to the same order of energies that provides efficient DD burning (calculated D^+ distribution function has correspondent plateau "tail" up to 50-60 keV). Also, cylindrical virtual cathode immersed into complex anode plasma and potential well dynamics could be responsible for some pulsating regimes (~ 50-70 MHz) of DD burning at interelectrode media and related intermittent pulsating neutron yields observed in experiments. In whole, PIC simulations are in a good agreement with observations, and allow clarifying the specifics of *high fusion power density* due to D^+ head-on collisions at interelectrode space of vacuum discharge [2].

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