Mechanism of Current filament generation in plasma focus

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An important feature of the plasma focus discharge (PF) is the generation and dynamics of current filaments [1, 2]. Filaments have a significant impact on plasma parameters and its radiation characteristics [3]. Moving current filaments in PF were observed in the earlier experiments [4, 5]. However, the theoretical description of supersonic, subsonic and stationary current filaments appeared recently [6–8]. In addition, in the simple plasma model with the London current, we found the solution for rarefaction shock waves [9].

The proposed report presents the research results of the current filament generation mechanism in PF due to the development of a corrugation instability of rarefaction shock waves. The problem is solved using the simple plasma model with the London current. It is shown that the corrugation instability increment is determined by self-energy density of currents induced on the rarefaction shock wave side with a higher plasma density.

Considering an induced filament generation, we conclude that the reproducibility of PF emission characteristics can be improved and the radiation intensity can be increased during the optimal filamentation of PF current sheath. To create an optimal filament structure, it is proposed to use the special metal inserts on the electrodes according to the experiments described in the paper [4].

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