MHD SIMULATION OF LOW CURRENT PINCH PLASMA DYNAMICS*

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The plasma dynamics in a low current (~ 50 kA) miniature plasma focus device has been investigated by using a two-dimensional single fluid MHD analysis under the assumption of axisymmetric discharge[1] development within a coaxial tube. The influence of a gas pressure in the formation of a current sheath during the breakdown phase and the neck formation during the radial compression are presented. The effects of the electrical circuit parameters such as discharged voltage, current amplitude and pinch time are also assessed for the efficient EUV radiation emission. Simulation results of the plasma dynamics are compared with the experimental observation of the pinch plasma obtained by time-resolved laser shadowgraph technique. The main advantage of such approach is the opportunity to obtain time dependence parameters of MPF plasma, thus giving a more effective interpretation of the experimental results. The variation in EUV yield at different filling gas pressures indicates that the plasma dynamics play an important role in the compression of plasma to reach a necessary temperature of about 20 eV for the EUV emission which significantly increases at discharge currents beyond 25 kA. The multiple peaks in the EUV region have been noted both experimentally and in simulation results. More importantly in the inverse pinch phase, the simulated result shows that the radial velocity of the current sheath is much slower as compared to the axial velocity and the density has less parabolic profile as observed experimentally.[2] These results reveal that the outer electrode may not necessarily affect the current sheath in the early stage of the current sheath lift-off. The presence of rod type outer electrodes may have less impact on the fast current-rise in miniature plasma focus devices.

[1] V. V. Vikhrev, et. al, "Development of sausage-type instability in a Z-pinch plasma column", Nuclear Fusion **33** (2), 311 (1993).

[2] T. Zhang, et. al, "Current sheath curvature correlation with the neon soft x-ray emission from plasma focus device", Plasma Sources Sci. Technol., **14** (2) 368 (2005).

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