Chapter 4

Conclusion

4.1 Summary of the computational results

In this project, the dynamics of the current sheath of a 600 J Mather-type plasma focus device using argon as operating gas is studied. A simple 1-D computational model based on the Snow-plow model has been employed to compute the axial rundown time and speed of the current sheath. In addition, the computational results are compared with the experimental results.

It was found that prominent focusing can be obtained from the experiments with operating pressure ranges between 9.0×10^{-3} mbar to 1.8×10^{-2} mbar, while no pinching was observed for pressure greater than 1.8×10^{-2} mbar.

By using the Snow-plow model, the axial rundown time and speed of the current sheath have been simulated based on the parameters of the 600 J Mather-type plasma focus device. The mass factor, f_m and current shedding factor, f_c are determined by referring to the experimental results. The mass factors f_m obtained are between 0.018 and 0.34, whilst f_c is between 0.8 and 0.9. That means, only about 1.8% – 34% of the gas mass is swept up and the current that flows through the tube is about 80% – 90% of the total current.

The computed axial speed of the current sheath reaches 9.22 cm μs^{-1} to 21.10 cm μs^{-1} at pressures of 9.0×10^{-3} mbar to 1.8×10^{-2} mbar upon reaching the end of the electrodes. Based on the strong shock theory, the shock front velocity, v_{sf} can be obtained from the velocity of the piston and thus the temperature of the plasma slug can be estimated. The calculation shows that the temperature of the plasma slug increases and attains its maximum value of 97.59 eV at pressure 9.0×10^{-3} mbar, and then decreases to 27.97 eV at 1.8×10^{-2} mbar.

In conclusion, the dynamics and the evolution of the current sheath in a plasma focus device are very sensitive to the pressure variations during the breakdown phase. The formation and the motion of the plasma sheath are not only dependent on the operating gas, but also the charging voltage, anode shape and geometry of electrodes. A good focusing effect emanates from the optimum range of axial current sheath velocity.