STUDY ON CAPILLARY DISCHARGE SOFT X-RAY LASER IN Ne-LIKE Ar

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Abstract: The important advantages of capillary discharge are conducive to produce axial uniformity plasma for its geometrical structure, highly energy conversion efficiency, as well as compact size and low cost. J.J.Rocca et al. reported the first demonstration of a large soft x-ray amplifier at 46.9nm on the 3p-3s J=0-1 transition in Ne-like Ar plasma by capillary discharge in 1994. These pioneering great achievements motivate us to devote our effort on such compact soft X-ray laser. A fast high voltage pulsed generator has been developed in our laboratory. The whole system consists of a Marx Generator system, main switch, Blumlein transmission line, pre-pulse circuit and detector system. A polythene capillary is placed in the axis of the device. This device will be utilized to excite electron-collision pumping scheme in Ne-like Ar at 46.9nm. 40kA current pulse with 40ns rising time has been achieved. That pulse results in $1.0x10^{12}$A/s, providing the possibility of pumping capillary to excite x-ray lasing in Ne-like ions. A flat-field spectrometer assembled with an adjustable grazing incidence cylindrical mirror is used to carry out spectroscopic investigation. The effects of different discharge conditions on producing Ar plasma are studied under these spectroscopic investigations. The approximate range of discharge conditions for producing Ar IX is given as well as the relationship between the amount of the material ablated from the wall and the value of pre-pulse. Using XDCH， a one-dimensional Lagrangian magneto-hydrodynamics code, simulation results of a capillary discharge-pumped $2p^53p \rightarrow 2p^53s$ transition 46.9nm laser line in Ne-like Ar is presented; The physical schemes of 46.9nm laser line are also studied. Finally we discuss the probability of pumping soft x-ray laser by the device built by ourselves.