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Li^+ alumino-silicate ion source development for NDCX-II

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We report experimental progress on ion source development in preparation for warm dense matter heating experiments on the new Neutralized Drift Compression Experiment-II (NDCX-II). NDCX-II has been designed to use Li^+ beam with an injected ion kinetic energy of 100 keV, charge 50 nC, pulse duration 500 ns, and 100mA beam current. The practical limit to the current density for a lithium alumino-silicate source is determined by the maximum operating temperature that the ion source can withstand before running into problems of heat transfer, melting of the alumino-silicate material, and emission life time. Moreover, tight process controls are necessary in preparing and sintering the alumino-silicate to the porous tungsten substrate to produce an emitter that gives uniform ion emission, sufficient current density and low beam emittance. Using small prototype emitters, our data have shown that at temperature of approximately 1275° C, the space charge limited Li+ beam current density of $J \sim 1$ mA/cm^2 was obtained for a 0.64 cm diameter source. The lifetime of the ion source is ≥ 50 hours while pulsing the extraction voltage at a rate similar to the pulse rate expected in NDCX-II. In order to obtain 100 mA at the same current density, the required source diameter for NDCX-II is 11.3 cm, which will require ≈3kW of heating power. We are designing and fabricating a prototype 11.3-cm diameter source, in parallel with continuing R & D effort to increase the life time of the ion source.

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