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Laser cooling and compression of an atomic beam for use in a focused ion beam STEINAR H.W. WOUTERS, GIJS TEN HAAF, TIM C.H. DE RAADT, PETER H.A. MUTSAERS, EDGAR J.D. VREDENBREGT, Eindhoven University of Technology — Magneto-optical compression is performed on a thermal beam of rubidium atoms effusing from a collimated Knudsen source with the aim of generating a high density, low temperature atomic beam that can be ionized into a high brightness ion beam. Such an ion beam can be used in a focused ion beam system (FIB) that is widely used in science and industry to image and modify structures at the nanoscale. Simulations of the proposed setup including the compact magneto-optical compressor, photo-ionization and ion beam focusing have shown that a 1 nm resolution can be achieved, for rubidium at a beam current of 1 pA and 30 keV energy. This will be a mayor improvement over commercial offerings. A collimated Knudsen source for rubidium has been constructed and characterized. The resulting atomic beam is loaded into a compact (70 mm long) magneto-optical compressor (MOC). Behind the MOC sub-Doppler cooling is applied to lower the transverse temperature even further. The resulting beam flux is equivalent to 0.6 nA and the brightness of the beam reads 6×10^6 A/m^2/sr/eV which is an order of magnitude higher than conventional ion sources promising a higher resolution. This contribution reports about the experimental characterization of the Knudsen source, MOC and sub-Doppler cooler.

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