Transport of highly charged ions through nano-structured capillaries

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We report first results from studies of the transport of relatively slow (< 5 keV/u), multiply (e. g. Ar^{3+}) and highly charged ions (e. g. Xe^{44+}) through dielectric (silicon nitride) and metallic (nickel) membranes. The goal of these ongoing studies is to extend earlier work [1][2] to higher charge states, smaller hole diameters, and specific materials, and to determine benchmark data for our development of single ion implantation techniques [3]. Arrays of holes with diameters ranging from 2 nm to 100 nm are formed in thin (30 to 200 nm thick) membranes by focused ion beam drilling, and electron beam lithography followed by dry etching. Aspect ratios of holes range from 1:1 to about 5:1. Charge exchange fractions will be compared to model predictions.

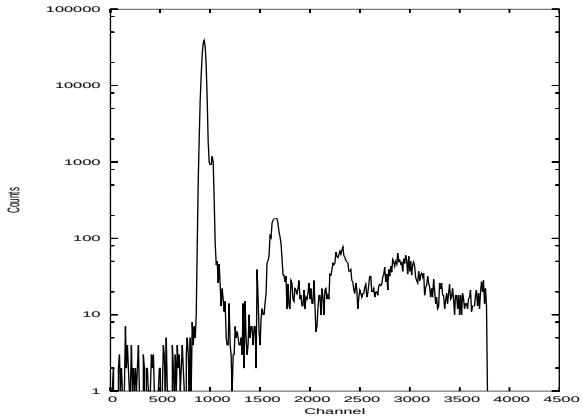

Fig. 1. Charge state fractions of Ar (3+, 2+, 1+ and neutral, from left to right) ions from Ar^{3+} (Ekin=9.4 keV) tranmission through 100 nm wide silicon nitride holes in a 200 nm thick membrane.

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