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# Development of a Negative Helium Ion Source with Non-Metallic Charge Exchange

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Negative Helium ion beams are required for tandem accelerators used at research centers and at implanter facilities. The common production method of such $He^-$ beams involve the interaction of a positive Helium ion beam with a low pressure alkali metal vapour. This results in a small portion of $He^+$ undergoing two charge exchanges to create the desired $He^-$, on the order of a few [ref]. However, utilizing alkali metal vapour is problematic: leaving interior surfaces prone to flammability, contributing to sparking near electrostatic devices, and, for implanter facilities, negatively impacting silicon wafer production due to metallic contamination [1, 2]. Additionally, the use of a vapour for charge exchange requires a specialized vacuum system and considerable expense to limit the dispersion of the vapour. In efforts to address or remove these issues, a possible alternative creation method for $He^-$ is here investigated, which uses a non-metallic foil as the charge exchange medium. To date reports of using graphite with this technique to convert (30 keV) $He^+$ to $He^-$ yield a conversion rate on the order of 0.01% [3].
In this paper we shall describe using the $He^+$ beam generated by SFU's helium ion microscope (HIM), the conversion rate to $He^-$ is measured using non-metallic foils. The $He^+$ beam collides with a non-metallic foil and the transmitted particles (anticipated to be $He^{2+}$, $He^+$, $He^0$, and $He^-$) are separated electrostatically into discrete beam spots and detected using a radiation camera (AdvaCam MiniPIX). The current of each beam is measured with the camera and compared with each other, and the incident beam current, to deduce relative intensities and conversion rates. The $He^+$ incident beam energies shall be varied through the range of 15 to 30 keV (at ~10 pA) and shall be incident on foils of carbon, and silicon, in thickness range 25 to 100 nm. The corresponding charge exchange conversion rates (excitation functions) will be reported.

References

[1] J.F. Ziegler, Handbook of Ion Implantation Technology, North Holland, 1992.
[2] G. Borionetti, P. Geranzanzi, R. Orizio, P. Godio, F. Bonoli, F. Pagani, C. Pello, "Metal and Organic Contamination Effects on the Characteristics of thin Oxides Thermally Grown on Silicon Based Wafers", NIMB Beam Interactions with Materials and Atoms, Vol 253, Issues 1-2, pp. 278-281, December 2006.
[3] R. Holeňák, S. Lohmann, F. Sekula, D. Primetzhofer, "Simultaneous assessment of energy, charge state and angular distribution for medium energy ions interacting with ultra-thin self-supporting targets: A time-of-flight approach", Vacuum 185 (2021) 109988.

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