He^-/H^- High-Current Low-Metal-Contamination Volume-Cusp Ion Source for Semicon Applications

Supervisor: Dr. Neil Broderick, Professor, Physics Dept. University of Auckland
Industrial Co-Supervisor: Dr. Morgan Dehnel, Chief Science & Innovation Officer, Buckley Systems, Ltd.

Anticipated PhD Intake: 2019 or 2020 Academic Year. **Conditions**: (i) Student to meet UofA requirements for PhD. (ii) The PhD project is contingent upon successful application for and receipt of Callaghan Fellowship.

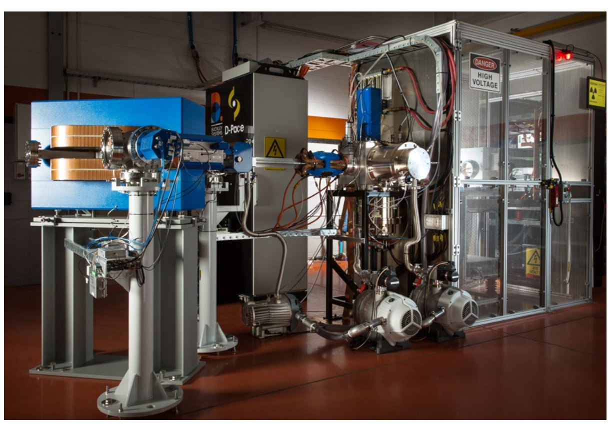
PROJECT DESCRIPTION: Implanted Helium or Hydrogen ions are used to exfoliate a thin layer of GaAs, which can be bonded to Silicon to create high quality Silicon-On-Insulator wafers having applications in optoelectronics, microwave electronics, and high temperature electronics [1].

The class of ion implanter that utilizes the Tandem acceleration technique, such as the Varian 3000XP, requires a negative ion to be stripped to positive at the midpoint of the accelerator which ultimately results in an accelerating potential that is twice the bias voltage. At present the VARIAN 3000XP utilizes a positive ion source to generate energetic H^+ or He^+ ions, and to achieve negative charge states H^- and He^-, the positive ions are focused through a vacuum chamber with a high metallic vapour content (Group 1 or 2 in the Periodic Table) where charge exchange occurs and the energetic negative ions emerge at the downstream exit port of the chamber, and are ready after mass analysis for acceleration by the Tandem technique [2]. This charge exchange technique results in a transmission of only ~1%, and more importantly the metallic vapour tends to work its way downstream in the implanter such that it becomes a contaminant to the semiconductor wafers being implanted. This contamination adversely affects the performance of the wafer.

The goal of this PhD thesis project is to R&D an innovative concatenated volume-cusp ion source arrangement that achieves industry leading beam currents (Direct Production of H^- > 10 milli-Ampere; and Charge Exchange Production of He^- > 50 micro-Ampere) at ~30 keV with normalized 4-RMS emittances less than 1 mm.mrad with the elimination of metallic vapour charge exchange for the purpose of reducing metallic contamination of semiconductor wafers by an order of magnitude.

The experiments and developments will be undertaken at the Buckley Systems/D-Pace Ion Source Test Facility (ISTF) located at the Buckley Systems manufacturing facility in Mount Wellington. This would be a collaborative project involving the U. of Auckland, Buckley Systems and D-Pace. The successful applicant would join a group of PhD students from U. Auckland and UBC (Canada) researching ion sources at the ISTF. Buckley Systems Ltd is the largest manufacturer of precision electromagnets for the global accelerator industry. D-Pace is a Canadian subsidiary of Buckley Systems Ltd that is the market leader in commercial negative ion sources.

Prospective students please contact: (i) Dr. Neil Broderick n.broderick@auckland.ac.nz, or (ii) Dr. Morgan Dehnel morgan.dehnel@buckleysystems.com . Please provide a CV and cover letter describing your research interests and motivations for applying for this PhD candidacy.



Ion Source Test Facility (ISTF)

[1] I. Radu *et al*, "Blistering and Exfoliation of Hydrogen and Helium Implanted (100) GaAs", IEEE Semiconductor Conference, CAS 2002 Proceeding, Volume 2, pp. 305-308, October 2002, Sinaia, Romania.
[2] S. Chang *et al*, "High Energy Hydrogen and Helium Ion Implanter", 20th International Conference on Ion Implantation Technology, June 26 – July 4, 2014, Portland, Or, USA.