"Explorations in the Production of Negative Carbon Ion Beams using Volume-Cusp Ion Sources with Sputtering Enhancement"

The University of Auckland - Physics - Ph.D. Project Proposal
The University of Auckland Student: To be determined
The University of Auckland Supervisor: Dr. Peter Derrick
Industrial Supervisor: Dr. M.P. Dehnel, CSIO, Buckley Systems Ltd.
Location of Research: Ion Source Test Facility at Buckley Systems Ltd in Auckland, New Zealand

Executive Summary for Negative Carbon (C^-) Ion Source Development Ph.D. Project

There is a strong interest in C^- ions for ion implantation if currents greater than 750 micro-amperes can be achieved. The literature shows that sputter ion sources can achieve this requirement, however, they utilise caesium ions as a catalyst, which is not permitted for implantation due to risk of contamination of the wafers. To date the literature does not show C^- ion production using RF or Filament based volume-cusp ion sources (i.e. basis of D-Pace source technology). There is reason to believe that these volume-cusp sources, which are optimized for negative hydrogen production, could be effective producers of C^- ions. The research project would be for the student candidate to utilize the Ion Source Test facility (ISTF) to (a) test the volume production of C^- ions for the case of both RF and Filament plasma heating using standard D-Pace sources with a carbon based gas such as acetylene. This would be a global 1^{st}. The student would have plenty of scope to compare and analyze the measured beam currents, emittances, and mass spectrums against theory of negative ion production. (b) The student would proceed to improve C^- ion production through enhancement of sputtering processes within the volume-cusp context. This could include utilizing a graphite plasma electrode and reversing the bias voltage to encourage heavy ions to strike the plasma electrode to create a sputtered C^- ion component to the extracted beam. Carbon based gases could be used, inert gases such as neon, argon, or helium could be used, various electrode geometries could be experimented with, and the ISTF Faraday Cup, Emittance Scanner, and Mass Spectrometer instruments would be used to characterize the C^- beams in each case. Again the student would compare measured data to theory with significant opportunity to extend existing theoretical and empirical models. This research programme will make great strides in previously unexplored ion source experimental and theoretical territory, and will translate into a significant commercial application if large currents are achieved.

Prospective students: Please contact Dr. Morgan Dehnel at morgan@d-pace.com