Contribution ID: **19** Type: **Parallel Session (Contributed Oral) talk**

Cesium Balance of the ISIS H- Penning Ion Source

Friday 24 September 2021 06:45 (20 minutes)

The ISIS Penning ion source is a cesiated pulsed DC discharge surface plasma source delivering 55 mA beam of H^- ions in 250 μs pulses at 50 Hz pulse repetition rate. The constant H^- output, i.e. <5% change, at constant discharge current implies that the cathode work function remains nearly unchanged during the beam current pulse in a wide range of cesium pressures and electrode temperatures. We have developed a model predicting the equilibrium cesium coverage of the cathode (in eV) and the expected H^- beam current (in arb. units). The model is based on semi-empirical expressions for the cathode work function, negative ion surface ionization yield, and cesium adsorption and desorption rates. We compare the model predictions to experimental data. It is concluded that the ISIS Penning ion source operates near the optimum cathode work function in a wide range of cesium pressures and cathode temperatures. The implications of the cesium balance on long pulse operation are discussed.

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Track Classification: Negative ion sources