The effects of impurities and incidence angle on the secondary electron emission of Ni(110)


1 University of Chicago
2 University of California, Los Angeles
3 Princeton Plasma Physics Laboratory
4 Department of Chemical and Biological Engineering, Princeton University

2015 PPPL SULI Program

Secondary Electron Emission (SEE)

- SEE is induced when primary incident electrons of sufficient energy strike the surface of a material
- SEE decreases sheath potential in magnetic fusion devices and plasma hall thrusters
- Total secondary electron yield (SEY) could be expressed as a function of primary electron energy

\[ \text{SEY} = A \times \text{incident electron energy} \times \text{interaction length} \]

- Incidence angle, bulk material, surface composition, crystal structure, and temperature also affect total SEY

Experimental Setup

- 10^-10 Torr base pressure
- Quadrupole mass spectrometer monitors background gases and gases absorbed on single crystal surface
- Utilizes both Auger electron spectroscopy (AES) and low energy electron diffraction (LEED) optics
- Continuously varies incident electron beam energy

Procedure

- SEE measurements of a single crystal of Ni(110) were taken at different incidence angles with impurity levels monitored
- Primary electron current from electron guns was measured on plasma hall thrusters
- Total secondary electron yield (SEY) could be measured using sample method 15 times over a period of approximately 120 minutes
- Applied universal curves for total SEY reveal a decrease of total SEY as a function of time

- Concentrations of carbon and oxygen on the surface of Ni(110) were determined through AES scans after each of the 15 measurements
- There was an increase in carbon and oxygen and a decrease of nickel on the surface as a function of time after cleaning

Future Work

- Conduct SEE measurements for lithium, which is utilized in limiters
- Characterize change in SEE when using collective method at different temperatures
- Determine the effects of individual contaminants on SEE by dosing the sample

Acknowledgments


This work was made possible by funding from the Department of Energy for the Summer Undergraduate Laboratory Internship (SULI) program. This work is supported by U.S. DOE Contract No. DE-AC02-09CH11466.

References