Abstract Submitted
for the GEC19 Meeting of
The American Physical Society

Electron number density measurements from the frequency shift of a plasma defect state in a one-dimensional photonic crystal DAVID PAI, CNRS Institut Pprime, University of Poitiers, FABIO RIGHETTI, BENJAMIN WANG, DAVID BIGGS, MARK CAPPELLI, Mechanical Engineering Department, Stanford University — We describe the use of a plasma-functionalized vacancy defect in a one-dimensional microwave photonic crystal to experimentally measure the electron number density of glow discharges at 5 - 40 torr. The photonic crystal consists of spaced alumina plates with a built-in void defect that breaks the repeating symmetry of the layers, resulting in narrow defect transmission peaks within relatively deep bandgaps. We exploit the sensitivity of the defect transmission at 28 GHz to varying plasma density to measure electron number densities down to about 10^9 cm^{-3}. Defect energy shifts are proportional to plasma density, in reasonable agreement with theoretical predictions of photonic crystal performance. At higher discharge current densities and discharge pressure, we see a departure from the model predictions, largely attributable to the heating of the alumina structure, causing expansion and changes in the lattice parameter that counter-act the effect of the increased plasma density on the defect state frequency.

David Pai
CNRS Institut Pprime, University of Poitiers

Date submitted: 30 May 2019 Electronic form version 1.4