Ar II Emission Processes and Emission Rate Coefficients in ASTRAL Helicon Plasmas

R.F. BOIVIN, A. GARDNER, O. KAMAR, A. KESTERSON, S. LOCH, J. MUNOZ, Physics Department, Auburn University, 206 Allison Laboratory, Auburn, AL 36849, C. BALLANCE, Physics Department, Rollins College, White Park, FL 32789 — Emission processes for Ar II line emission are described for low temperature plasmas (Te < 10 eV). It is found that Ar II emission results primarily from Ar ion ground state excitation rather than from any Ar neutral state. This suggests that Ar II emission results from stepping processes which includes ionization and then excitation of the neutral Ar atom filling the vacuum chamber. The Ar II emission rate coefficients are measured in the ASTRAL helicon plasma source using a 0.33 m monochromator and a CCD camera. ASTRAL produces Ar plasmas with the following parameters: ne = 1E11 – 1E13 cm-3 and Te = 2 - 10 eV, B-field ≤ 1.3 kGauss, rf power ≤ 2 kWatt. RF compensated Langmuir probes are used to measure Te and ne. In this experiment, Ar II transitions are monitored as a function of Te while ne is kept constant. Experimental emission rates are obtained as a function of Te and compared to theoretical predictions. Theoretical predictions make use of the ADAS suite of codes as well as recent R-matrix electron-impact excitation calculations that includes pseudo-states contributions. Our collisional-radiative formalism assumes that the excited levels are in quasi-static equilibrium with the ground and metastable populations.

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