Ar + CO$_2$ and He + CO$_2$ Plasmas in ASTRAL

R.F. BOIVIN, A. GARDNER, J. MUNOZ, O. KAMAR, S. LOCH, Physics Department, Auburn University, 206 Allison Laboratory, Auburn, AL 36849-5311 — Spectroscopy study of the ASTRAL helicon plasma source running Ar + CO$_2$ and He + CO$_2$ gas mixes is presented. ASTRAL produces plasmas with the following parameters: $n_e = 10^{10} - 10^{13}$ cm$^{-3}$, $T_e = 2 - 10$ eV and $T_i = 0.03 - 0.5$ eV, B-field $\leq 1.3$ kGauss, rf power $\leq 2$ kWatt. A 0.33 m scanning monochromator is used for this study. Using Ar + CO$_2$ gas mixes, very different plasmas are observed as the concentration of CO$_2$ is changed. At low CO$_2$ concentration, the bluish plasma is essentially atomic and argon transitions dominate the spectra. Weak C I and O I lines are present in the 750 - 1000 nm range. At higher CO$_2$ concentration, the plasma becomes essentially molecular and is characterized by intense, white plasma columns. Here, spectra are filled with molecular bands (CO$_2$, CO$_2^+$, CO and CO$^+$). Limited molecular dissociative excitation processes associated with the production of C I and O I emission are also observed. On the other hand, He + CO$_2$ plasmas are different. Here, rf matches are only possible at low CO$_2$ concentration. Under these conditions, the spectra are characterized by strong C I and O I transitions with little or no molecular bands. Strong dissociative processes observed in these plasmas can be linked to the high $T_e$ associated with He plasmas. An analysis of the spectra with possible scientific and industrial applications will be presented.

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