High Temperature Equilibrium Air Emission in the UV/VUV

S. McGuire, A. Tibère-Inglesse, C. Laux

CentraleSupelec
3 rue Joliot-Curie
91190 Gif-sur-Yvette

Summary
We present UV/VUV emission spectroscopy measurements of high temperature air emission. These measurements are calibrated in absolute intensity down to wavelengths below 150 nm. Furthermore, the air plasma responsible for the emission is in thermochemical equilibrium at a known temperature and pressure (6500 K and 1 atm). This enables us to do a fundamental study focused on validating radiative models for high temperature air emission.

The air plasma responsible for the emission is produced using an inductively coupled plasma torch. It exits the torch directly into atmospheric air forming a high temperature plasma jet. Fig. 1 shows the measured temperature profile across the jet profile, obtained by measuring the absolute intensity of the oxygen 777 nm triplet. Previous studies of this plasma have shown it to be in thermochemical equilibrium.[2] Details of the VUV system used for the UV/VUV measurements are available in previous publications.[1] Briefly, the system is assembled around a McPherson vacuum spectrometer. An imaging box is attached to this with two mirrors for imaging the exit slit of the spectrometer onto the plasma. Finally, an adapter extends from this imaging box to the plasma where a final water-cooled copper piece is placed directly in contact with the plasma to avoid cold oxygen absorption of the signal. The system is put under a vacuum (1×10^{-5} Torr) with the exception of the final 10 cm of optical path length before the plasma, which is placed under an argon purge for practical reasons. Substantial effort was made to verify that the system yields accurate results and that it does not perturb the plasma emission via plasma cooling or other effects.

Fig. 1 also shows a preliminary comparison between the experimental emission measurements and radiation calculations down to 200 nm. The radiation calculations were done with the SPECAIR radiation code.[2] Our current focus is to extend the radiation modelling down to VUV wavelengths for comparison and validation with our experimental data.

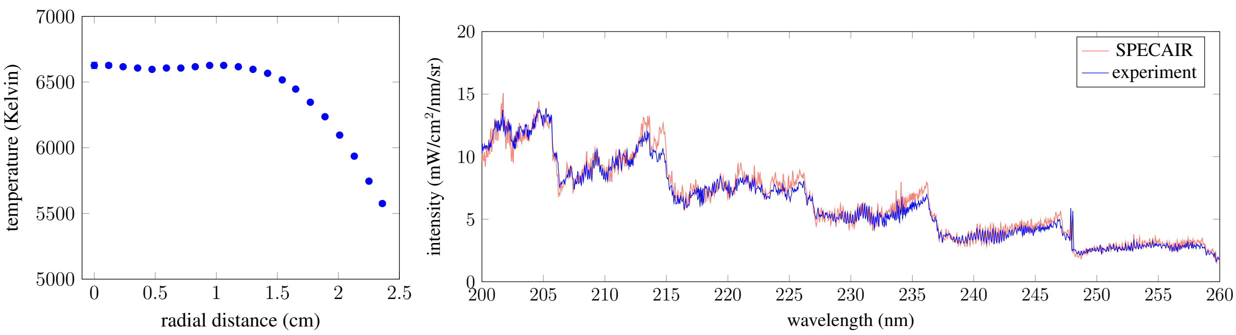

Figure 1. (left) Measured temperature profile of plasma jet – error bars are included in the figure. The plasma jet was produced using a 5 cm diameter nozzle. (right) Preliminary comparison of experimental data with radiation model calculations (SPECAIR) down to 200 nm.

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References

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