Abstract submitted to EUCASS Conference, Flow Physics for reentry applications

Experimental characterization of NO radiation in a high enthalpy plasma torch facility

P.J. Bertrand, C.J. Casses, C.M. Jacobs, M.E. Mac Donald, and C.O. Laux

Nitric oxide emits intense radiation in the ultraviolet through its beta, gamma, delta and epsilon band systems. For reentry vehicles at velocities from 3 to 8 km/s, NO emissions represent a significant fraction of the radiation emitted by the plasma layer located between the bow shock and the surface of the vehicle. Various spectroscopic models have been implemented in radiation codes such as Specair to predict the spectral intensity of these NO systems and generally good agreement has been obtained with the measurements at medium spectral resolution (see Figure 1). However a close inspection of the spectra shown in Figure 1 shows some discrepancies between the measurements and the experiments at particular wavelengths.

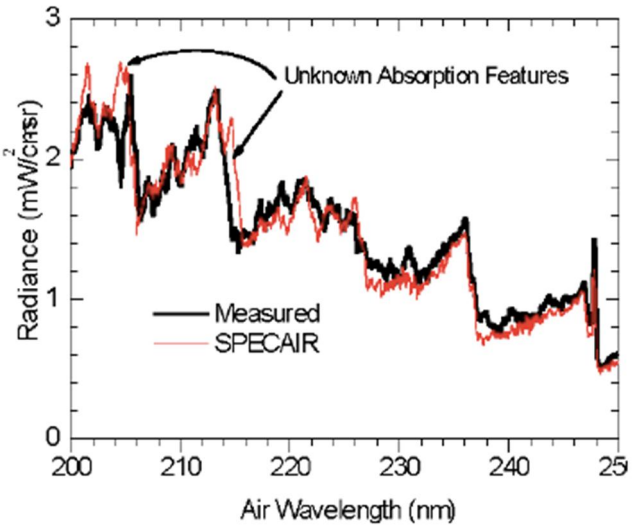

Figure 1. Comparison of measured and predicted spectra of NO emitted by an LTE air plasma at 7500 K (reference 1).

The purpose of this work is to test the spectral models with measurements of NO bands with higher spectral resolution than reported in the literature. To this end, we generate a thermal air plasma with a 50 kW inductively coupled plasma torch operating with air at atmospheric pressure. This facility provides high enthalpy air plasmas at temperatures up to 9000 K, a range well suited for the study of the intense NO emissions between 200 and 300 nm. The measurements are made with a 0.75-m focal length SpectraPro 2750i Acton spectrometer equipped with a 1200 gr/mm grating blazed at 300 nm and an intensified CCD camera (PIMAX, Roper Scientific). The Specair model will be tested and improved if necessary on the basis of this comparison.

1. Laux, C.O. "Spectroscopic Challenges in the Modelling and Diagnostics of High Temperature Air Plasma Radiation for Aerospace Applications,"5th International Conference on Atomic and Molecular Data and Their Applications, 2007.