High-Resolution, High-Temperature Cross Section Measurements of N_2 and O_2 in the 834 and 917 Å Regions

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This paper reports the temperature-dependent ultrahigh-resolution photoabsorption cross section measurements of N_2 and O_2 in the extreme ultraviolet (EUV) region, and their atmospheric modeling implications. One of the important issues regarding the interpretation of the NII 916 Å extreme ultraviolet airglow emissions of the Earth, Titan, and Triton, and the OII 834 Å EUV airglow emission of the Earth, is the effect of temperature on the atmospheric extinction due to absorption by N_2 and O_2. Since the temperature of the upper atmosphere of the Earth is typically in the 200 to 1000 K range it is therefore important to know these molecular cross sections at such temperatures.

We have carried out high resolution photoabsorption cross section measurements of (1) N_2 with a resolution of 0.003 Å and 0.008 Å in the 915.0-917.28 Å and the 833.1-834.5 Å regions at temperatures of 555 and 295 K and (2) O_2 with a resolution of 0.008 Å in the 830-835 Å region at a temperature of 295 K. The 6VOPE (6.65-m vertical off-plane Eagle spectrograph) spectrometer available at the Photon Factory, KEK, Tsukuba, Japan, was employed in the present study.

We are currently carrying out N_2 modeling calculations using our measured data as constraints. Interpolation of the data within the measured temperature range, i.e., 295 and 555 K, will follow. After that, we plan to extend our calculation/modeling using N_2 measurements extended to temperatures as high as 900 K, the temperature of the upper atmosphere of the Earth. This would thus provide a complete set of measured/modeled high-temperature high-resolution data of N_2 for NII and OII airglow modeling of the Earth's upper atmosphere where the temperature profile ranges from 200 to 1000 K. Similar measurements and modeling on O_2 will be performed in the near future.

We also plan to measure the high-temperature absorption cross section of S_2 in the 2600-2800 Å region with a resolution of 0.08 Å. The cross section data thus obtained will allow modelers to better determine the temperature ranges, resolution, and specific vibrational progressions of S_2 which are particularly important to a significant improvement of the determination of the column abundance of S_2 in the observed SL9/Jupiter spectra.