Absolute Absorption Cross Section Measurements of Schumann-Runge Continuum of O_2 at 90K and 295K

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Introduction

The photoabsorption cross section for the Shcumann-Runge (S-R) system of O_2 has most of its strength in the dissociation continuum which extends from 175 nm to around 125 nm. Atmospheric absorption of solar radiation in this wavelength region is important because it provides the main source of oxygen atoms in the lower thermosphere. The measurements of atmospheric absorption of solar radiation in this wavelength region can be used to determine the molecular oxygen density profile in the 100-200 km altitude region where O_2 is the principal atmospheric absorber. In the region 100-150 km, the thermospheric temperature may vary 200K to 600K, and this effects the absorption by O_2. Since nearly all of the atomic oxygen produced by the direct photodissociation of O_2 in the thermosphere descends to close to the mesopause where recombination occurs to form O_2, a basic aeromic parameter is the total production of atomic oxygen. Measurements of photoabsorption cross sections of the S-R continuum at room temperature have been made by many investigators, however, no cross sections have been measured at the temperature below 295K. This report presents the photoabsorption cross section measurements of the S-R continuum at 90K and 295K in the wavelength region 130 nm-175 nm.

Manuscript preparation

The 1-m Seya-Namioka vacuum spectrometer on the BL-12A was used with a 1200 *l*/mm grating. The absorption cell is directly connected to the exit slit assembly of the spectrometer. The expected instrumental width (FWHM) is 0.066 nm with entrance and exit slit widths of 0.05 mm. An integrated detector with an EMR 541F photomultiplier is mounted at the other end of the absorption cell without further optical elements. The entire oxygen column can be cooled by immersing the cell in a liquid nitrogen bath. The absorption cell has two MgF_2 windows and provides a path length of 12.08 cm. We repeated absolute cross section measurements by using the 3-m vacuum spectrometer on the BL-20A, and obtained the same results.

Results and Discussion

The cross sections of S-R continuum of O_2 in the region 130 nm-175 nm are presented in Fig. 1 for 90K and 295K. The ratios of the cross sections, σ_{90}/σ_{295}, are around 0.88 at 175 nm, and increase gradually to 0.95 at 135 nm. Below 135 nm, rapid changes are noticed because of the feature associated with $^3\Pi$ state.

The cross sections at 295K are compared with those of previous measurements in Fig. 2. All the measurements agree well with each other within the experimental uncertainty.

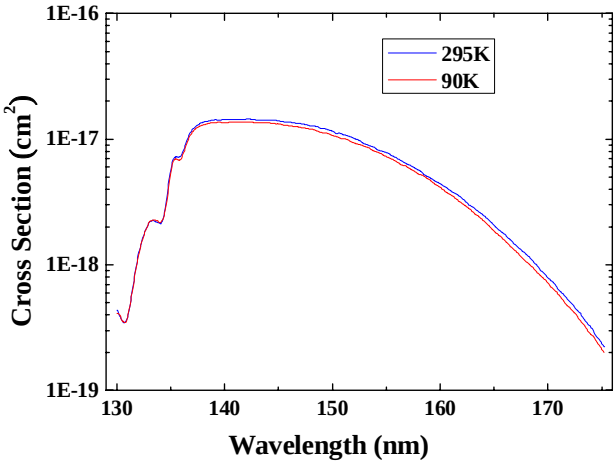

Fig. 1 Photoabsorption cross section measured at room temperature and liquid nitrogen temperature.

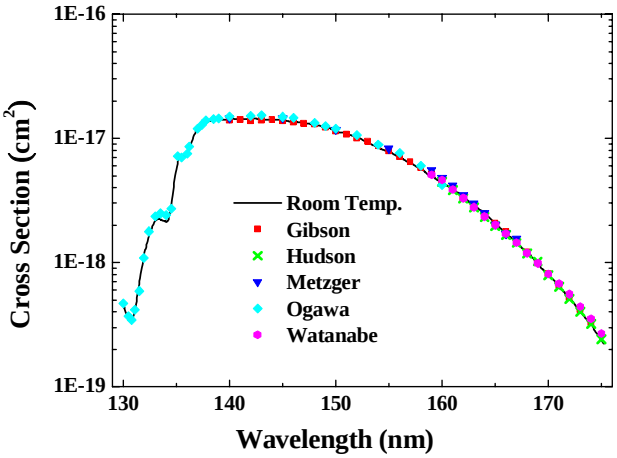

Fig. 2 Photoabsorption cross section measured at room temperature together with the previous measurements.

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