29A2

LIDAR MEASUREMENT OF METALLIC SPECIES IN MESOPAUSE REGION USING A Ti:SAPPHIRE LASER

Chikao Nagasawa and Makoto Abo
Department of Electronics and Information Engineering, Tokyo Metropolitan University
Minami-Osawa, Hachioji, Tokyo 192-03, JAPAN
Phone: 81-426-77-2766 Facsimile:81-426-77-2756

A Ti:sapphire laser is a tunable solid state laser scanning wavelengths from 700nm to 900nm. This new light source has already been developed for water vapor DIAL measurements and measurements of temperature and pressure using oxygen molecule absorption lines. This paper suggests the possibility of measurement of some metallic species in the mesopause region using the Ti:sapphire lidar and presents a potassium (K) layer profile observed preliminarily by the Ti:sapphire lidar at Tokyo Metropolitan University.

Table 1 shows the resonance lines of some mesospheric metallic species covered by fundamental and second harmonic wavelengths of the Ti:sapphire laser. Particularly, the Ti:sapphire laser is available to measure K (770nm), Al (396nm) and Fe (372nm) atoms, and Ca ions (393nm) in the mesospheric region, because the peak gain of the laser is around the 800nm wavelength.

Table 1 Some resonance lines of mesospheric metallic species covered by fundamental and second harmonic wavelengths of the Ti:sapphire laser.

Species	Resonance line λ (nm)
K	769.898
	766.491
Cr	427.480
	425.435
Ca	422.673
Al	396.152
	394.400
Ca+	396.847
	393.367
Fe	385.991
	371.994

The Potassium layer was measured by Megie et al. (1978) using a ruby laser pumped dye laser. Iron atoms and calcium ion layers were measured by two groups using the dye lasers pumped by an eximer laser or frequency mixing between a dye laser and a Nd:YAG laser. As the output efficiency of the Ti:sapphire laser is higher than the dye laser in the near infrared range, it is convenient to use the Ti:sapphire laser.

Our Ti:sapphire laser system consists of a narrowband oscillator and a four-paths amplifier pumped by one doubled frequency Nd:YAG laser respectively. The specifications of the Ti:sapphire lidar are shown in Table 2. On the other hand, we have routinely observed mesospheric sodium layers with a Nd:YAG laser pumped dye laser above our university campus at Hachioji, Tokyo.

Figure 1 shows the mesospheric potassium profile measured by the Ti:sapphire laser and the mesospheric sodium profile measured simultaneously by the dye laser. The Ti:sapphire laser is tuned to the D_1 line (769.9nm) of K using a computer-controlled grating in the laser cavity. Tuning is monitored by observing the opto-galvanic signal induced in a hollow cathode potassium lamp.

Table 2 Specifications of the Ti:sapphire lidar.

Pump laser (Nd:YAG SHG)	
wavelength	532nm
energy	300mJ/pulse
repetition rate	10Hz
Ti:sapphire laser	
wavelength range	700-900nm
(SHG)	350-450nm
energy	>10mJ/pulse (at 770nm)
bandwidth	500MHz
Receiver	
diameter	350mm
method	photoncounting
range resolution	100m

The signals from 8000 laser shots were accumulated for one profile, and the data are smoothed by forming a sliding average over 2100m for heights. We can see the peak concentrations of both profiles at same altitude, and the abundance ratio of the sodium and potassium is about 10. These results are consistent with those of Megie et al. (1978).

We will measure the iron atoms and the calcium ions in the mesopause region using the second harmonic wavelengths of the Ti:sapphire laser.

REFERENCES

G.Megie, F.Bos, J.E.Blamont and M.L.Chanin (1978), Simultaneous nighttime lidar measurements of atmospheric sodium and potassium, Planet. Space Sci., **26**, 27-35.

C.Granier, J.P.Jegou, and G.Megie (1989), Iron atoms and metallic species in the earth's upper atmosphere, Geophys. Res. Lett., **16**, 243-246.

C.Granier, J.P.Jegou, and G.Megie (1985), Resonant lidar detection of Ca and Ca^+ in the upper atmosphere, Geophys. Res. Lett., **12**, 655-658.

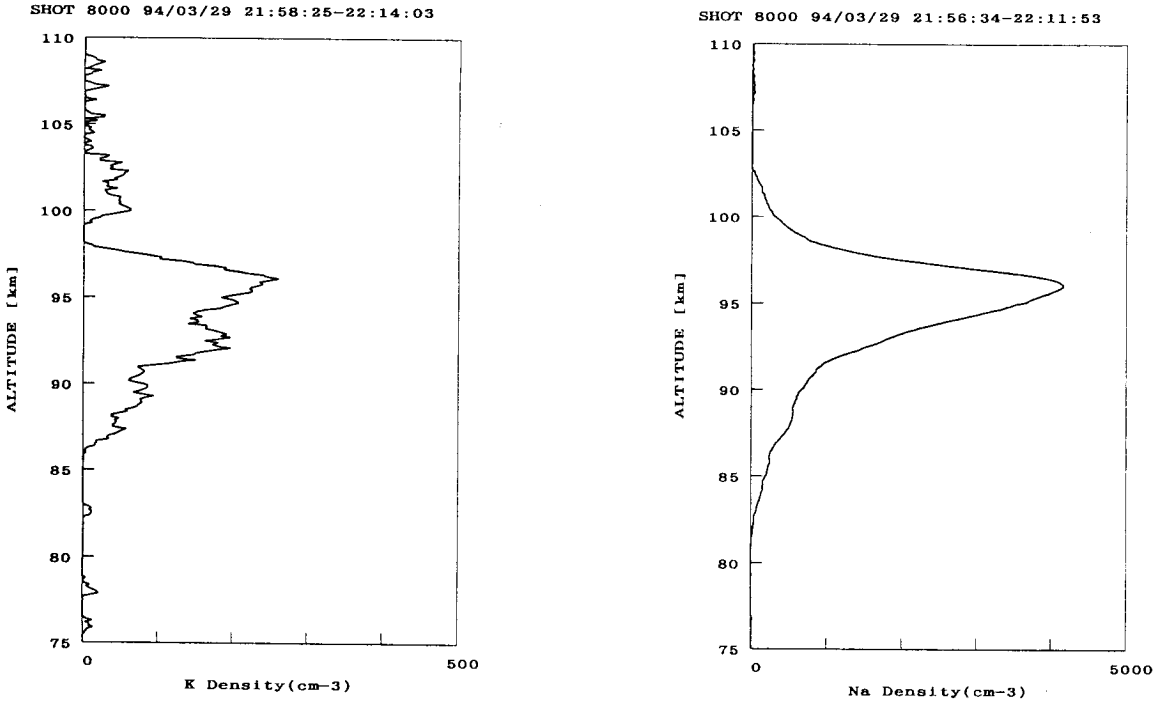

Fig. 1 The mesospheric potassium profile measured by the Ti:sapphire laser and the mesospheric sodium profile measured by the dye laser simultaneously.