

Multi-wavelength LED lidar for near ground atmospheric monitoring

Alifu Xiafukaiti, Nofel Lagrosas, Tatsuo Shiina

Graduate School of Engineering, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba 263-8522, Japan

E-mail: xapkat.alip@hotmail.com

Atmosphere monitoring near the surface is important from the viewpoint of air pollution and radiation budget studies. For the operation of a lidar system, the laser, as a transmitter, plays a vital role in the whole system. Up to now, laser diodes (LD) and diode-pumped solid state (DPSS) laser technology have evolved, making the lidar system more compact compared to Nd:YAG laser sources. This miniaturization of lidar system is suitable for portable measurements such as flux of aerosols and dusts in urban area, or motion of sea waves in seaside. However, the conventional laser sources have a restriction for ground-based horizontal measurement when viewed from eye-safety in urban area. Also, it is vulnerable to static electricity, and it needs to stabilize electric power.

In this work, a multi-wavelength lidar system with a Light Emitting Diode (LED)-based light source is designed and developed to monitor near-surface atmosphere during long-time and continuous observation in nighttime. The LED light source does not require any heat dissipation system and can emit optical power for long periods with constant output. Depending on the viability of estimations of particle size distribution and Angstrom exponent, we aim to develop the LED lidar with multi-wavelength. The LED light sources with wavelengths of 365, 450, 525, and 630 nm are used as lidar transmitters. The pulse circuit for realizing the pulsed oscillation of the LED lights is applied by the avalanche breakdown of the transistor. These LED pulsed lights can be synchronized by serially concatenated to the circuit. The LED's pulse width of around 7 ns, the repetition frequency of over 500 kHz, and each peak power of up to 3 W. With characteristics of this LED transmitter, the lidar system accomplish to monitor rapid activities of the atmosphere in the near-range measurement. Initial near-surface observation results show that atmospheric echoes can be monitored in the range of 0 m to 200 m at an accumulation time of a few tens of seconds in nighttime. Analysis of the backscattering light intensity with multi-wavelengths from this LED lidar system produces a real-time extinction coefficient in the near the surface. This report discusses the design and practical test of the multi-wavelength LED lidar.