Remote sensing of volcanic gases using wavelength-tunable mid-infrared laser

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In recent years, the need for research on natural disasters is growing urgency. Various researchers have actively carried out observed activities such as volcanic eruptions and gas research to elucidate the mechanisms of volcanic eruptions. Measurement of volcanic gases is of great help in order to observe the volcanic activity. Component of volcanic gases is due to the movement of underground magma. For example, Gases from magma coming up from deep underground contains many H2O than DHO. We depending on the percentage of the DHO and H2O in the water vapor contained in the volcanic gases, it is seen lifting movement of magma underground.

Observation of volcanic gas might be the best efficiency that is directly observation in the active volcano. However, the direct observation has significant risk of danger.

We have a tunable laser technology was originally developed by RIKEN. Raman LiDAR or LAS can be used to utilizing this technology to observe the composition of the gas phase chemistry is possible.

For example, the absorption spectra of major pollutant substances (H2O, DHO, NO, NO2, CH4, CO2 etc.) are generally detectable in the mid-infrared (IR) range from 3 to 5 um. On the other hand, absorption spectra of chemical agents are also observed from 6 to 11 um. To remotely conduct the identification of chemical agents, the development of LiDAR system equipped with a high-energy tunable mid-IR coherent light source as a transmitter is one of urgent issues for a safe observation of volcanic gas.

Optical parametric oscillation (OPO) is required to accomplish high-energy (10 mJ) pulsed oscillation in a mid-IR wavelength range using a tunable high-energy pulsed laser. Especially tunable lasers in the range from 2 to 3 um are useful as a pump source to generate mid-IR wavelength exceed 5 um in OPO. Moreover, rapid tunability is an attractive element in tunable lasers for real-time LiDAR environmental detection.