Study of THz-band heterodyne spectroscopy system on board Mars micro-satellite/lander

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Recently the heterodyne instrument for the far infrared band on board Herschel space observatory revealed that molecular oxygen in the Martian atmosphere may increase at the lower atmosphere. The NASA’ s infrared telescope and rover, Curiosity have also discovered the concentration of Methane on Mars. For understanding of the sources of these species, it is crucial to reveal the chemical reaction network of the Martian atmosphere as well as the presence or absence of life. We have just started to study the development of 0.4 and 0.7 THz band heterodyne spectroscopic systems for the remote sensing of the minor constituents such as O2, H2O, O3, CO, and their isotopes in the Martian atmosphere. At present we are planning to install this THz system on the Mars micro-satellite/lander under consideration by Nakasuka group of the University of Tokyo. For the frontend Schottky barrier diode mixer devices implemented with frequency multiplying local oscillators (Virginia diode Inc.) are used. For the backend high-resolution chirp transform spectrometers (1 GHz bandwidth) developed in Max Planck Institutes will be utilized. Due to the budget limitations of the weight, space, and electric power, it’ s vital to optimize the thermal and structural design and components of the system. The candidate landing sites in the low latitude plains range in temperature from 190 - 280 K according to the Mars Climate Database. With this in mind thermo-fluid simulations of the system were performed for the thermal design. In this conference we present the spectral lines expected to be observed at the landing sites on Mars and the preliminary design studies of the THz band heterodyne system.

Keywords: Mars, Micro-satellite/lander, THz-band remote sensing, Planetary atmosphere, Heterodyne spectroscopy

