Minerals and Mixtures Under Simulated Lunar Environment

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Abstract. Remote sensing is an important tool for understanding the Moon and other airless Solar System bodies; however, remote mineral spectroscopy requires detailed laboratory validation. The Planetary and Asteroid Regolith Spectroscopy Environmental Chamber (PARSEC) at Stony Brook University is capable of measuring up to six samples at a time at lunar pressures and temperatures. Most importantly, PARSEC induces thermal gradients in samples similar to those that occur within lunar and asteroid regolith. Here we present mid-infrared (MIR) emissivity measurements obtained using PARSEC for several silicate minerals and several mixtures of these silicates.

We ground and sieved silicate samples into < 32 µm, 32-63 µm, 63-90 µm, 90-125 µm and >125 µm powders, and mixtures were in 1:1, 1:2, 1:4 ratios. Using PARSEC, we acquired spectra (400 – 2000 cm^{-1}) under ambient (AMB) conditions and under simulated lunar environment (SLE) conditions. SLE conditions for these measurements were defined as $\leq 10^{-6}$ mbar pressure and chamber temperature of < -130 °C. Samples were heated from below to 127 °C and above by a 75 W quartz halogen lamp. Black body measurements were taken at 107 °C and 137 °C using an internal black body to calibrate the MIR spectra. We calibrated the spectra using the Davinci open source software for AMB spectra[1] and for SLE spectra[2].

Each mineral shows marked variation in the MIR in the Christiansen Feature (CF) and Reststrahlen Bands (RB) under SLE conditions from ambient, and with grain size. The CF shifts to longer wavenumbers under SLE and narrows with decreasing particle size. RB have higher spectral contrast under SLE which generally increases with decreasing particle size.

These laboratory experiments are necessary to understand and interpret the spectral information returned from planetary surfaces like the Moon, and directly relate to the data acquired from the Diviner Lunar Radiometer Experiment currently in orbit[3,4,5,6].

We will continue to acquire the spectra of mineral mixtures and incorporate mixtures of different grain sizes. These experiments will give us a better understanding of the environmental conditions that complicate interpretations of infrared spectra of the Moon and asteroids, and enable more quantitative analysis of mineral assemblages on these bodies.

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