Raman Spectra of a Fine-Grained Labradorite Sample Heated to Typical Mercury Dayside Temperatures.

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Introduction

Analyzing the surface composition of Mercury's regolith from remote-sensing measurements is a challenging task. To support the interpretation of data of recent missions like MESSENGER (NASA) and to prepare future missions like BepiColombo (ESA) to Mercury measurements of surface material analogues must be performed on Earth.

Labradorite is considered as a Mercury surface analogue and is investigated for a better understanding the processes on the surface of Mercury. For this purpose mid-infrared and Raman measurements of labradorite were performed in the Institute of Planetary Research at DLR in Berlin. The mid-infrared-measurements were first presented by Helbert and Maturilli [1]. These spectra indicate significant changes of the spectral features in the mid-infrared region at high temperatures and some of these changes were still observable after cooling the sample to room temperature. This led Helbert and Maturilli [1] to the assumption that labradorite during the heating process undergoes an irreversible structural change. Here we present the first measurements of Raman spectra of the same samples of labradorite which are complementary to the mid-infrared measurements. In the Raman spectra a change is seen as well, which supports the assumption of the structural change.

The experimental setup and samples

Two samples of labradorite were investigated. The samples were powder like with a grain size less than 25 μm. The first sample was measured without any prior treatment. The second sample was heated for three days at a temperature of 420°C which corresponds to temperature on the dayside of Mercury. After heating it was cooled to room temperature and than analyzed.

The measurements were performed with a Raman microscope alpha300 system from Witec [2]. The excitation source is a Nd:Yag laser of 532 nm wavelength and a maximum power of 100 mW. The spectral resolution of the spectrometer is 3 cm^{-1}. The Raman microscope has imaging capability. 2500 spectra were taken over an area of 0.5 μm diameter. The measurement time for one spectrum was 1 second. The spectra were averaged and used for analysis.

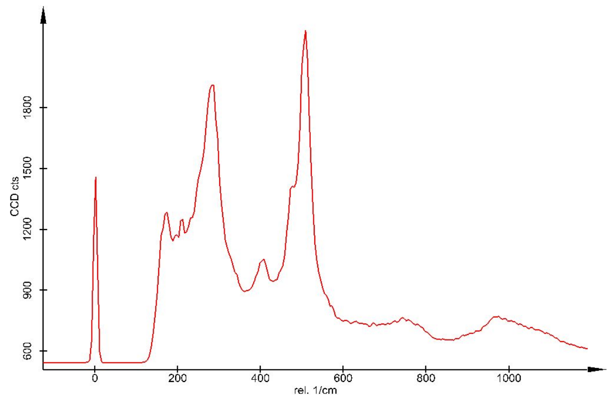

Figure 1: Raman spectrum of labradorite, powder grain size <25μm.

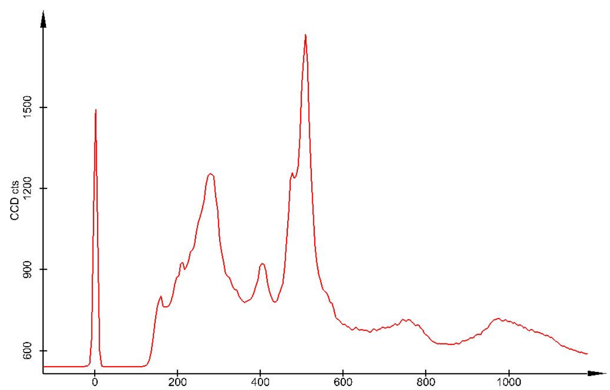

Figure 2: Raman spectrum of labradorite after heating and subsequent cooling procedure, powder grain size <25μm.

Results

The spectra of both labradorite samples are shown in the figures 1 and 2. As can be seen both samples have different spectra. The main feature is the change of ratio of the two main peaks of the spectrum around 511 cm^{-1} and 283 cm^{-1}. This change in the ratio will be analyzed. We suppose that structural changes induced by the heating and cooling caused the change.

References

[1] J. Helbert and A. Maturilli. The emissivity of a fine-grained labradorite sample at typical Mercury dayside temperatures, submitted. *EPSL*, 2009.

[2] WITec focus innovations. alpha300, 2008. URL `http://www.witec.de/en/products/raman/alpha300r/`.