TRANSMITTANCE, REFLECTANCE, AND EMISSION SPECTROSCOPY OF METEORITES FROM THE UV TO THE IR SPECTRAL RANGE.

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Introduction: In the last decade the Planetary Emissivity Laboratory (PEL) of DLR in Berlin has provided spectral measurements of planetary analogues from the visible to the far-infrared range for comparison with remote sensing spacecraft/telescopic measurements of planetary surfaces [1-5]. Bi-directional reflection, transmission and emission spectroscopy are the techniques we used to acquire spectral data of target materials.

In fall 2015 we started upgrading our laboratory set-up, adding a new spectrometer, three external sources, and new detectors and beamsplitters to further extend the spectral range of measurements that can be performed in the laboratory. Reflecting the wider scope of measurement capabilities the facility was renamed to Planetary Spectroscopy Laboratory (PSL).

Two FTIR instruments are operating at PSL, in an air-conditioned room. The spectrometers are two Bruker Vertex 80V that can be evacuated to ~.1 mbar. One spectrometer is equipped with aluminum mirrors optimized for the UV, visible and near-IR, the second features gold-coated mirrors for the near to far IR spectral range. Apart from the mirrors the two instruments are identical, and can therefore share the collection of detectors and beamsplitters we have in our equipment to cover a very wide spectral range. The instruments and the accessory units used are fully automatized and the data calibration and reduction are made with software developed at DLR[4]. By using several pairings of detector+beamsplitter we can perform spectral measurements in the whole spectral range from 0.2 to 200 µm.

This paper illustrates the spectroscopic measurements we performed on a suite of six meteorites we acquired recently. This set includes NWA2860 H4 type chondrite, NWA869 L3-6 type, NWA6392 brecciated diogenite, Korra Korrabes (KORKOR) H3 chondrite, Dhofar1867 H4-5 melt breccia, and a second sample of NWA869 L4-6 type.

The samples were cut (Buehler IsoMet 1000 precision cutter) obtaining core-slices of 0.5- to 1-mm thickness. Obtained slices were embedded on glass slides and dried for several hours. Slices in glass slides were hand-polished to 30-µm thickness (thickness checked at polmic). Thin sections were observed at polmic, confirming the original classification of the Meteoritical Bulletin.

Thin sections were measured in transmittance in the spectral range from 0.2 to 16 µm. Transmittance was acquired for each sample with a first set of measurements, made setting the spot size as large as possible (12 mm aperture was set for the spectrometer in UV, 5mm aperture for VIS+IR spectral ranges). A second round of transmittance measurements with much smaller spot size (1 mm or 0.5 mm aperture) was performed on selected regions of the thin sections to distinguish different chondrules, hence different compositions in the matrix.

Reflectance measurements have been made on the specular face of the meteorite that was cut for creating the thin sections. We measured as first a spot as large as possible on the meteorite face to get an average spectra, then we reduced the aperture to 0.5 mm to measure reflectance from the same chondrules we selected before for measuring the transmittance spectra.

This study continued by collecting reflectance measurements with a large field of view (the same used when measuring the meteoritic faces) on some mineral analogues for those meteorites: we measured two olivines, diopside, hedenbergite, hyperstene, augite, and enstatite samples.

To conclude our spectral characterization of the meteorites, once all the reflectance measurements are completed, the samples will be crushed and reduced in powders, this allowing us to measure their emissivity for low surface temperatures (25°C to 100°C) in a vacuum environment.

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PSL website: http://www.dlr.de/pf/desktopdefault.aspx/tabid-10866/19013_read-44266/