

# Planetary Spectroscopy Laboratory (PSL)

Location: *Institute for Planetary Research, DLR, Berlin, Germany*

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Quick Look:

Conditions	Values
Measurement Types	Bidirectional reflectance, Hemispherical reflectance, emissivity, Transmittance
Sample Sizes	fine powder to granular to compact minimum 2 and maximum 5cm
Environmental Conditions (T, P, atmosphere)	vacuum, purged air or inert gas atmosphere T: ambient to 480°C
Facility Data Products	Sample temperature monitoring, sample imaging
Open to external users? If so, what is the mechanism and funding for external use?	Yes; Europlanet facility

<sup>1</sup>-any notes

## Additional description/notes

The Planetary Spectroscopy Laboratory (PSL) of the German Aerospace Center (DLR, in Berlin, Germany), has been operating in support of planetary missions for almost two decades. PSL currently operates three Bruker VERTEX 80V FTIR spectrometers, a Bruker Hyperion 2000 microscope for micro-spectroscopy, and a Terra In-Xitu XRD system for sample characterization. Sample preparation and analysis tools and experimental sub-systems are also available.

The Bruker Vertex80V FTIR instruments allow to measure emissivity, bidirectional and hemispherical reflectance and transmittance spectra of various types of planetary materials (fine powder to granular to compact) over a very wide spectral range under vacuum, purged air or inert gas atmosphere.

Bi-directional reflectance measurements cover the UV to FIR spectral range (0.2 to 150  $\mu\text{m}$ ) and can be performed at varying incident and emission angles. Hemispherical reflectance measurements can be performed using a gold coated and a spectralon coated lab sphere, in the same spectral range of UV to FIR. Transmittance measurements of pressed pellets and optical filters or windows are measured thanks to a parallel beam accessory in the whole 0.2 to 150  $\mu\text{m}$  spectral range.

At PSL an emissivity setup allows to measure the emissivity of heated samples. VNIR emissivity spectra of Venus analogues are routinely acquired at relevant Venus surface temperatures (400°C, 440°C, and 480°C) in a vacuum (0.7 mbar) environment.

The emissivity chamber is attached to a Bruker Vertex 80V FTIR spectrometer and allows to measure the emissivity of solid and granular samples. Samples are heated in custom-made sample cups using a very powerful induction system. To avoid glowing of steel in the VNIR we use a hot ceramic cups with a steel disk (the heater) enclosed. The hot ceramic is opaque in the VNIR and the emitted radiance does not affect the measurements. Several temperature sensors are located in the emissivity chamber and allow monitoring the sample temperature as well as the chamber temperatures.

Hemispherical reflectance measurements are performed in parallel to emissivity for comparison to emissivity measurements on all fresh and processed samples.

The PSL emissivity setup plays a key role in the calibration campaign for the flight instruments for VERITAS and Envision.

