SYNTHETIC GLASSES AS ANALOGS FOR INFRARED STUDIES OF PLANETARY SURFACES. A. Morlok[1], S. Klemme[2], I.Dittmar[3], A.Stojic[1], I.Weber[1], H.Hiesinger[1], M.Sohn[3], Joern Helbert[4] [1]Institut für Planetologie, Wilhelm-Klemm Strasse 10, 48149, Germany (morlokan@uni-muenster.de), [2]Institut für Mineralogie, Corrensstraße 24, 48149 Münster, Germany, [3]Hochschule Emden/Leer, Constantiaplatz 4, 26723 Emden, Germany, [4]Institute for Planetary Research, DLR, Rutherfordstrasse 2, 12489 Berlin, Germany.

Introduction: Infrared spectroscopy allows determining the mineralogical compositions of planetary surfaces via remote sensing [1]. To correctly interpret the remote sensing data, laboratory spectra of analog materials are beneficial [1,2]. Our work at the IRIS (InfraRed spectroscopy for Interplanetary Studies) laboratory produces spectra for the Berlin Emissivity Database (BED) for the MERTIS (Mercury Radiometer and Thermal Infrared Spectrometer) spectrometer onboard the future ESA/JAXA BepiColombo mission to Mercury. This unique mid-infrared spectrometer allows us to map spectral features of the hermean surface in the 7-14 µm range, with a spatial resolution of ~500 m [1-5].

Material on the surface of Mercury (and the other terrestrial bodies) was exposed to heavy impact cratering in its history [4]. Therefore, understanding the effects of impact shock and heat on the mineral structure and the resulting corresponding change in the spectral properties is of high interest for the MERTIS project. This inspired the study of impact rocks such as suevites from the Nördlinger Ries crater [6].

In this part of our study, we present the first mid-infrared reflectance data for synthetic glasses. Glass lacks an ordered microstructure and represents the most amorphous phase of a material, typical for events generated by events involving high shock pressure and temperatures [7]. Using synthetic materials allows us to produce analogue materials close to the observed composition of planetary bodies, from which no material in form of meteorites is available.

For this reason, we produced synthetic glasses with the composition of the surface of Mercury, as well as the surface,along with compositions of the mantle and bulk compositions of otherfurther planetary bodies (such as the Moon). Here, we present spectral information on the first glass produced, based on the composition of the Ca- and Mg-rich and Al-poor G1 region identified on Mercury with the X-ray spectrometer on MESSENGER [8].

Techniques: *Preparation of Glass.* Starting material mixtures of oxides (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MgO and carbonates ($CaCO_3$) with the composition of the surface region G1 on Mercury (Table 1) were prepared. The finely ground powder was slowly heated to 1000°C to decarbonate and subsequently vitrified in a vertical furnace at 1500°C for 2 h and quenched immediately afterwards.

Characterization. The resulting glass was embedded in resin and polished to a thin section. The amorphous character was confirmed by optical petrological microscopy.

The chemical composition of the glass was analyzed using a JEOL 6610-LV Scanning electron microscope equipped with an Oxford silicon drift electron dispersive EDX system. A fully standardized quantitative analysis was performed using ASTIMEX™ mineral standards.

FTIR Analyses. For in-situ mid-infrared specular reflectance analyses we used a Bruker Hyperion 1000/2000 System at the Hochschule Emden/Leer. We used a 1000*1000 (μm^2) sized aperture, for each spectrum; 128 scans were added.

A Bruker Vertex 70 infrared system with a MCT detector at the Institut für Planetologie was applied for analyses of areas >>1 mm under near vacuum. To ensure high signal to noise ratio, we accumulated 512 scans for each size fraction.

For background calibration, we used a well calibrated gold standard.

Results and Discussion:

Optical polarization microscopy shows a glass with abundant small crystalline incusions showing spinifex textures (Fig.1).

The normalized composition of the glass is very close to the literature data data on Mercury surface composition (Table 1). The micro-FTIR reflectance data (Fig.2a) of two regions with low abundance of inclusions shows a smooth feature peaking between 10.0 and 10.5 µm. Such features are typical for amorphous materials. Only very weak sharper crystalline bands occur on top of the feature at 10.1-10.2µm and 10.5-10.6 µm. These bands are probabaly the result of little crystallites. The Christiansen feature, a characteristic low point of reflectance, is at 8.2 µm.

The spectrum obtained of a larger area is essentially a 'bulk' spectrum including small crystalline inclusions (Fig.2b). Obtained under near-vacuum, the spectrum shows essentially similar characteristics, only with the Christiansen Feature slightly shifted to 8.3µm. Also, due to higher abundance of crystillites, the features on top of the amorphous feature are slightly more intense.

The crytalline bands at 10.1 and 10.5 µm are characteristic for nearly pure forsterite [9].

Future plans: Future work includes a systematic study of powdered grain size fractions of glasses with the composition of further planetary bodies and their surfaces, as well as complementary electron microprobe and micro-Raman studies.

	G1 Mercury [7]	Glass 1
SiO_2	53.6	53.3
TiO_2	0.42	0.64
Al_2O_3	8.3	8.7
Fe_2O_3	1.60	2.58
MgO	25.9	23.8
CaO	10.3	10.95
	100.1	100.0

Table 1: Chemical composition of the Mercury G1 region [8] compared to the produced synthethic analog "Glass 1". The main oxides were mixed, ground and melted to produce the glass. "Glass 1" is the chemical composition of the synthetic glass (in wt%). It was normalized to 100wt% owing to the low totals of the melt possibly due to porosity of the starting materials.

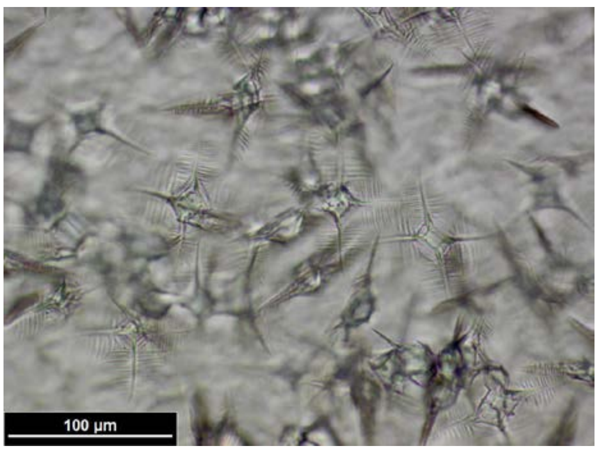

Figure 1: Optical microscope image of small crystallites in the glass, forming a spinifex texture.

References:

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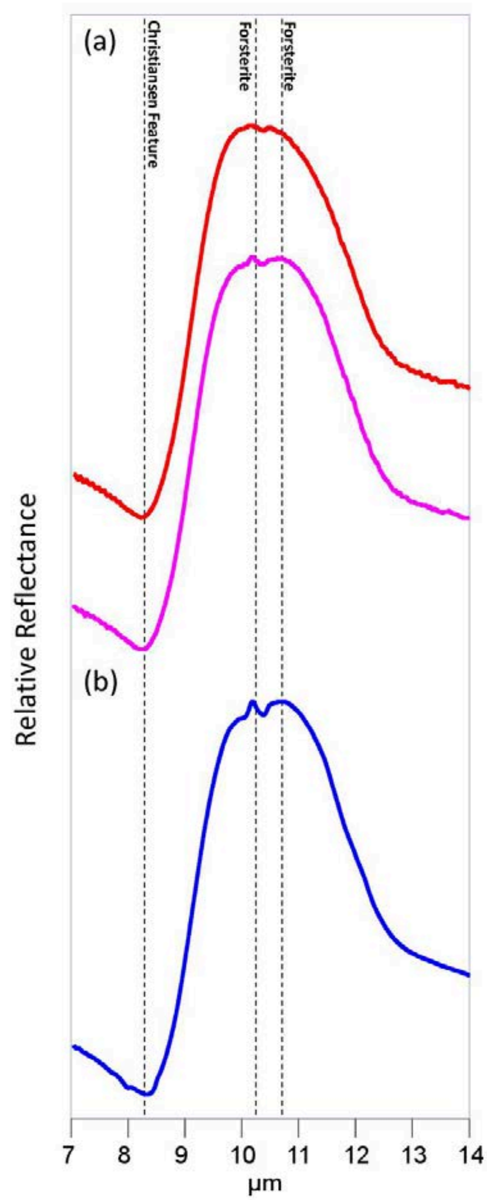

Fig.2: Specular reflectance spectra of synthetic glass with the composition of the G1 area on Mercury [7] (a) Spectra obtained from region with few crystalline inculsions using a micro-FTIR show mainly a smooth, amorphous feature (b) A spectrum obtained under vacuum of a larger area shows slightly stronger crystalline olivine features at ~10.1 and 10.5 µm [8].