INFRARED SPECTROSCOPY OF METEORITES USING ATTENUATED TOTAL REFLECTANCE

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Introduction: Infrared spectroscopy is diagnostic of the mineralogy of planetary materials, in particular silicate minerals and mineraloids that form the bulk of asteroids, comets, and terrestrial planet crusts. Key evidence regarding the origin and history of the solar system has arisen from astronomical observations that directly measure properties of extrasolar planetary systems of different age. In this project we seek to provide the mineralogical foundation for studying planetary materials produced in collisional events by measuring laboratory infrared spectra of a wide range of solar system materials produced in such event

Astronomical Motivation: Tremendous increases in sensitivity to extrasolar planetary systems have been made by mid-infrared spectroscopy (5-40 μm) with the *Spitzer* Space Telescope, and far-infrared advances are anticipated from *Herschel* and SOFIA. Contrasting mineralogies of planetary materials around HD 113766 and HD 172555 [1] were determined using a database of laboratory mineral emissivity spectra, indicating very different types of collisions: the former is "akin to an inner main-belt asteroid of S-type composition;" in contrast, the latter has abundant silica as well as SiO gas, indicating material that has been rapidly heated to high temperature after a fast (>10 km/s) collision (with a good match between the observed sharp peak at 9 um and the laboratory spectrum of a tektite). These remarkable results tie astronomical observations to events similar to the one that led to the formation of the Earth-Moon system.

Techniques: Attenuated total reflectance (ATR) allows a rapid and convenient method to measure the infrared spectrum of ~100 mg samples. We obtained a set of meteorites sampling all major types and with low terrestrial weathering from the Antarctic Meteorite collection at the NASA Astromaterials Curatorial Facility. The meteorite collection was supplemented by terrestrial crater rocks from Ries (Germany), 11 tektite samples, and for commissioning and technique development a wide range of meteorites from commercial vendors. The samples were hand-powdered and measured using a Pike ATR apparatus in a Nicolet Fourier Transform Spectrograph.

Results: First results from the experiment are presented at this conference. The mid-infrared ATR spectra of several meteorites were obtained, as well as spectra of well-known hand samples of terrestrial minerals. Comparing the ATR spectra of powders to theoretical predictions based on Mie theory for small particles with the index of refraction of the well-characterized quartz and montmorillonite samples, and comparison to refractive indices determined from reflectance measurements [3] have not yet yielded satisfactory agreement. We are continuing to collect the laboratory data and investigate the theoretical underpinnings of ATR and its application to predicting spectra of fine grains around other stars.

References: [1] Lisse, C. M. et al. 2009, *Astrophysical Journal*, 701, 2019. [2] Rossman, G. G. and Reach, W. T. 2010. *Spectroscopy* submitted. [3] Glotch, T. D., Rossman, G. R., Aharonson, O. 2007, *Icarus*, 192, 605.