OPTICAL TRANSMISSION OF AN ALLENDE METEORITE THIN SECTION AND SIMULATED REGOLITH

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Introduction: A method of deflecting Earth-threatening asteroids, the Solar Collector (SC), would concentrate sunlight upon an asteroid to energize a trajectory-altering jet [1]. It is one of the few methods of asteroid diversion that might allow steering a small asteroid into Earth orbit for resource utilization. Optical properties of the asteroid regolith or surface will influence the SC's efficacy. A significant optical property, electromagnetic (EM) penetration depth, is the depth in asteroid material to which concentrated solar EM radiation will penetrate [2]. This property is related to transmission and is about 100 μm for several tested terrestrial soils [3].

A glass-slide-mounted, ~1.4-cm dimension, 30- μm thin section of the Allende meteorite (a CV carbonaceous chondrite [4]) was supplied by Dr. Denton Ebel (AMNH Meteorite Curator), who also provided powdered simulated regolith from Allende.

Using 532 nm and 650 nm lasers, optical transmission of the Allende samples was studied using various beam sizes. This allowed for discrimination between Allende matrix and chondrule material. In this experiment, the bulk specific gravity of the Allende samples = 2.97 [5] and reflectivity in both wavebands = 0.07 [6].

Results: In performing the thin-section transmission measurements, it was necessary to correct for laser power absorbed by the glass and epoxy, between which the Allende-meteorite sample was sealed in. Error sources included diffuse reflections at the glass/meteorite interface and scattering in the epoxy. For three tests at various beam sizes and input powers, 532-nm and 650-nm transmission was respectively 8.02% -- 9.57% and 7.84—8.57%.

Investigation of a microphotograph provided by Dr. Ebel revealed that most of the thin section is matrix. The laser spot size was stepped down to 0.7 mm and transmission of 12 selected spots was measured at 650 nm. For chondrule-rich spots, transmission varied 46-78%. Matrix-rich spot transmission was 7-13%. On-going research concentrates on transmission measurements for the powdered simulated regolith.

Conclusions: Most solar EM radiation will be absorbed within the upper 100 microns of solid Allende-meteorite material. Because chondrule transmission is high, the SC will be less effective in diverting chondrule-rich asteroids. However, the dramatic matrix-chondrule transmission difference could be applied in in-space asteroid exploration. Transmission results for the simulated regolith sample will be reported.

References: [1] Melosh, H. J. et al, 1994. In *Hazards Due to Comets & Asteroids*, pp. 1111-1134. [2] Matloff, G. L., 2008. *Acta Astronautica* 62: 334-337. [3] Giant, K.-U., 2005 .*Euro. J. Soil Sci*., 56: 561-574. [4] Bevin, A., and De Laeter, J., 2002, *Meteorites: A Journey Through Space and Time*, p. 84. [5] Smith, D. L. et al, 2005. 36th Lunar and Planetary Sci. Conf. Abstract 1372. [6] Remo, J. L., 1994. In *Hazards Due to Comets & Asteroids*, pp. 551-596.