UV-VIS-NIR SPECTRAL MODELING OF METEORITES USING NOVEL MULTIPLE-SCATTERING METHODS

J. Martikainen[1] , A. Penttilä[1], M. Gritsevich[1,2], and K. Muinonen[1,3]

[1]Department of Physics, P.O. Box 64, FI-00014 University of Helsinki, Finland
[2]Institute of Physics and Technology, Ural Federal University (Mira St. 19, 620002 Ekaterinburg, Russia)
[3]Finnish Geospatial Research Institute FGI, P.O. Box 84, FI-00521 Helsinki, Finland

Introduction: Asteroids provide us information on the evolution of the Solar System. Meteorites and asteroids can be linked by matching their respective reflectance spectra. However, this is difficult because the spectral features depend strongly on the surface properties, and the surfaces of the meteorites are free of regolith dust present in the asteroids. To better interpret the spectra, we need to understand the surface differences better, for example whether the material is fresh or weathered, and gain more knowledge of the light-scattering physics involved.

Meteorite samples and Measurements: We have utilized the University of Helsinki UV-Vis-NIR (0.25-3.2 microns) integrating-sphere spectrometer to measure the reflectance spectra of the Osceola meteorite, three lithologies of the Chelyabinsk meteorite (light-colored, dark-colored, and impact-melt)[1], and 30 centimeter-sized meteorite pieces borrowed from the mineral cabinet of the Finnish Museum of Natural History. 23 of these samples are ordinary chondrites, four are HED meteorites, one is an aubrite and one is an enstatite. The spectral measurements were carried out using a wavelength range of 250 to 2500 nm with 5-nm sampling steps.

Spectral modeling: The reflectance spectra of meteorites can be modeled by combining the most common materials that dominate their spectral features, such as olivine, pyroxene, and iron. We utilize a new code that is based on SIRIS light-scattering code, which simulates light by Gaussian-random-sphere particles large compared to the wavelength of the incident light[2]. The new version models correctly the inhomogeneous nature of the wave due to the absorption in the media. For the computations, we need the complex refractive indices of the materials as input parameters. The refractive indices for olivine and iron are derived from [3], [4], and [5] (data retrieved from Jena Database for Optical Constants for Cosmic Dust and Refractiveindex.info, and further processed by A. Penttilä). The refractive indices for pyroxene were obtained by utilizing an optimization code that utilizes SIRIS-code and the measured reflectance spectrum of the material.

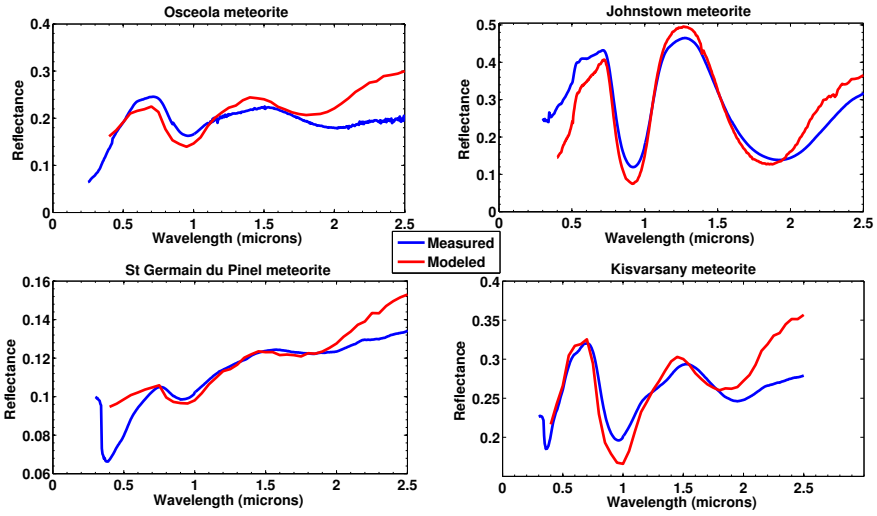

Figure 1: Modeled and measured reflectance spectra of four meteorite pieces.

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