SAND2015-9261C

Ideal-System Morphology and Reflectivity Measurements For Radiative-Transfer Model Development and Validation

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Summary (97/100) Granular solids (e.g. packed powders on planetary surfaces) are important targets for optical remote sensing. We present the results of an effort to develop "ideal" granular-solid systems with well-characterized morphological and optical properties. This work contributes to the generation and validation of radiative transfer models that predict material reflectance spectra. Morphology is being characterized at the individual-particle (size and shape distributions) and aggregate (pair-correlation function) scales. Optical properties being measured include spectral refractive indices (obtained from Pacific Northwest National Laboratories) and hemispherical diffuse reflectance. Results from this work will be presented, with discussion of their relative accuracy.

Abstract (249/250) A detailed understanding of light reflectance from granular solids (e.g., soils, minerals) is critical to the remote sensing of such materials by hyperspectral imaging. The reflectance spectrum of a packed solid is determined by radiative transfer among its constituent grains, a process that includes both optical scattering and absorption by the intimately contacted particles. The nature of the transfer is determined by the complex refractive indices of the material, as well as by the morphology of the system. The latter includes the size and shape distribution of the particles, as well as the manner in which they are arranged.

We present the results of an effort to develop "ideal" granular-solid systems with well-characterized morphological and optical properties. This work is contributing to the generation and validation of radiative transfer models and/or electromagnetic scattering computations. It is being pursued because available reflectance data, such as the ASTER database, is often lacking in precise description (e.g., the particle shape distribution) of the material system measured. To date, two materials have been used –sieved fused silica and α-alumina created by aluminum alkoxide hydrolysis. The individual-particle size and shape distributions are measured by laser scattering and automated single-particle imaging. Their packing is characterized by micro-scale x-ray tomography, which generates three-dimensional images of the packed solid and allows calculation of density distributions, such as the pair-distribution function.

Model comparisons and validations are conducted using hemispherical diffuse reflectance spectra measured using these solids. In the future, this work will be extended to the measurement of angularly resolved polarized reflectance.