New Laboratory Spectra of Cosmic Dust Analogs

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Laboratory spectroscopic studies of cosmic dust analogs at micron- to submicron-scale sizes and wavelengths across the electromagnetic spectrum are vital not only to properly correcting astronomical light budgets for the amount of light extinction by dust but also to understanding the composition and physical nature of dust in many space environments. This invited review discusses recent laboratory work by the author and others in the astrophysics and planetary science dust community on the far-infrared to ultraviolet wavelength spectra (transmission, reflectance, emissivity) and optical functions of the dust species commonly encountered by both groups, e.g.,

Silicates & Glasses: Until the *Infrared Space Observatory* discovery of crystalline silicates around evolved intermediate mass stars in the far-infrared, extra-solar silicates were believed to be almost exclusively amorphous. Crystalline silicates have since been detected in young stellar objects, comets, ultraluminous infrared galaxies, stars with debris discs, and Herbig Ae/Be stars. Within our Solar System, the composition of silicates provides clues to survival of stardust through the interstellar medium (ISM). By determining the spectral properties of both crystalline and glassy silicates, astronomers may be able to distinguish whether the ISM silicate is truly glass and thus determine whether ISM dust is formed in situ.

Silicon carbide (SiC): SiC is an important laboratory cosmic dust analog because (1) SiC particles were the first presolar dust grains found in meteorites, (2) SiC dust is important to radiatively-driven mass loss from evolved stars, and (3) the presence of and variations in the Si-C stretching band at $\lambda = 11$ μm provide useful diagnostics for inferring the physical conditions in circumstellar dust shells. Laboratory spectroscopic studies of SiC have furthered the understanding of the physical properties of cosmic SiC dust (crystal structure, size, and shape). Recent trends in laboratory measurements for SiC include determining the transmission and reflectance properties of different SiC polytypes (to better infer temperature and gas pressure within star forming regions), obtaining grain-size-independent data, and maximizing the wavelength coverage of spectra and optical functions.

Advances for additional dust species (atmospheric dust proxies, hydrated sulfates and phyllosilicates for Mars, outer Solar System satellites) will also be discussed.

Keywords: Dust; laboratory spectroscopy; optical constants; infrared; ultraviolet; planetary (atmosphere, regolith); interstellar; circumstellar; presolar.