Cryogenic Reflectance Spectra in Support of Planetary Missions

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Present understanding of planetary composition is based primarily on remotely-sensed data, and in particular upon ultraviolet, visible, and infrared spectroscopy. Spectra acquired by telescopic and spacecraft instruments are compared to laboratory measurements of pure materials in order to identify surface components based on characteristic absorption features.

The advent of imaging spectrometers such as the Galileo Near-InfraRed Imaging Spectrometer (NIMS) and Cassini Visible and Near-Infrared Imaging Spectrometer (VIMS) heralds a phase of exploration wherein the distributions of surface (and atmospheric) components may be determined with relative ease once the components have been identified. Furthermore, high spatial resolution enables scientists to study the composition of individual deposits and other features of a planet or satellite.

Cryogenic spectral measurements are necessary for the study of worlds beyond the Earth's orbit. While some materials exhibit only small spectral changes as a function of temperature (Roush and Dalton, 2002), many others are strongly temperature-dependent (Dalton and Clark, 1998). For example, hydrated salts exhibit different spectral behavior under conditions appropriate to Europa (Dalton, 2000) than at terrestrial temperatures (Crowley, 1991). Measurements of ammonia and ammonia hydrate ices (Dalton *et al.*, 2001) are important for investigating the Saturnian satellites even though these ices do not even exist at room temperature and pressure.

A comprehensive spectral database of ices and minerals covering a wide temperature range will have applications ranging from comets and Kuiper Belt objects to outer planet satellites and the polar regions of Mars. Efforts are presently underway at NASA-Ames to develop capabilities which will contribute to such a database. Advanced spectrometers have been proposed for the Mars 2005 and Europa Orbiter missions. As spacecraft instruments feature increasing spatial and spectral resolution, appropriate laboratory reference spectra become increasingly critical to accurate interpretation of the spacecraft data.

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