One Spectrometer, Two Spectra: Complementary Hemispherical Reflectance and Thermal Emission Spectroscopy Using a Single FTIR Instrument

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Advantages of a Dual System

- Emission measurements
  - Directly comparable to remote sensing measurements
  - Can cover longer wavelengths using DTGS detector than reflectance
  - Directly comparable to hemispherical reflectance measurements via Kirchhoff's Law
  - But few laboratories make these measurements
- Reflectance measurements
  - More traditional
  - Covers shorter wavelengths than emission using MCT-A detector
  - Hemispherical reflectance comparable to emission via Kirchhoff's Law
- Both data sets can be collected nearly simultaneously
  - Set two data sets for comparison to multiple-spectral libraries
  - Avoids long-distance transport
  - Doesn’t disturb delicate samples
  - External attachments are not needed to acquire reflectance spectra
  - Short wavelength features in reflectance data may aid in spectral identification of low-albedo materials

Hemispherical Reflectance

- IR source inside spectrometer illuminates the sample via a path leading the viewing port on the left side of the spectrometer and exiting the top of the Au-coated LabSphere integrating sphere, which sits over sample holder (Salisbury et al., 1988)
- Spot size is ~1.5 cm diameter
- Reflected signal measured at an external, liquid N₂-cooled mercury cadmium telluride (MCT-A) detector from ~2.5 to 15.4 μm (~600 to 650 cm⁻¹) (see pictures above)
- Sample spectra relative to spectra of diffuse-reflecting gold plates (Johnson et al., 1998)
- Residual atmospheric components can be suppressed using spectrometer software (Figure R1)

Emission

- Configuration identical to that at Arizona State University (Ruff et al., 1997), hot sample is positioned in a double-walled, water-cooled Cu-chamber
- Chamber is maintained at constant T; above calculation of baseline-wavelength
- Spot size selectable from focal point to ~4.5 cm
- Sample energy enters spectrometer via right-hand port and is measured at the internal, TE-cooled DTGS detector from ~5 to 58 μm (~2000 to 200 cm⁻¹) (see pictures above)
- Sample calibration follows two-temperature method of (Ruff et al., 1997)
- Spectra shown here are qualitative; high-precision & accuracy blackbody calibration targets currently are being fabricated, with delivery anticipated Q3 of 2009


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