Determination of Total Surface Reflectivity

Instrumentation and data analysis techniques to determine total reflectivity

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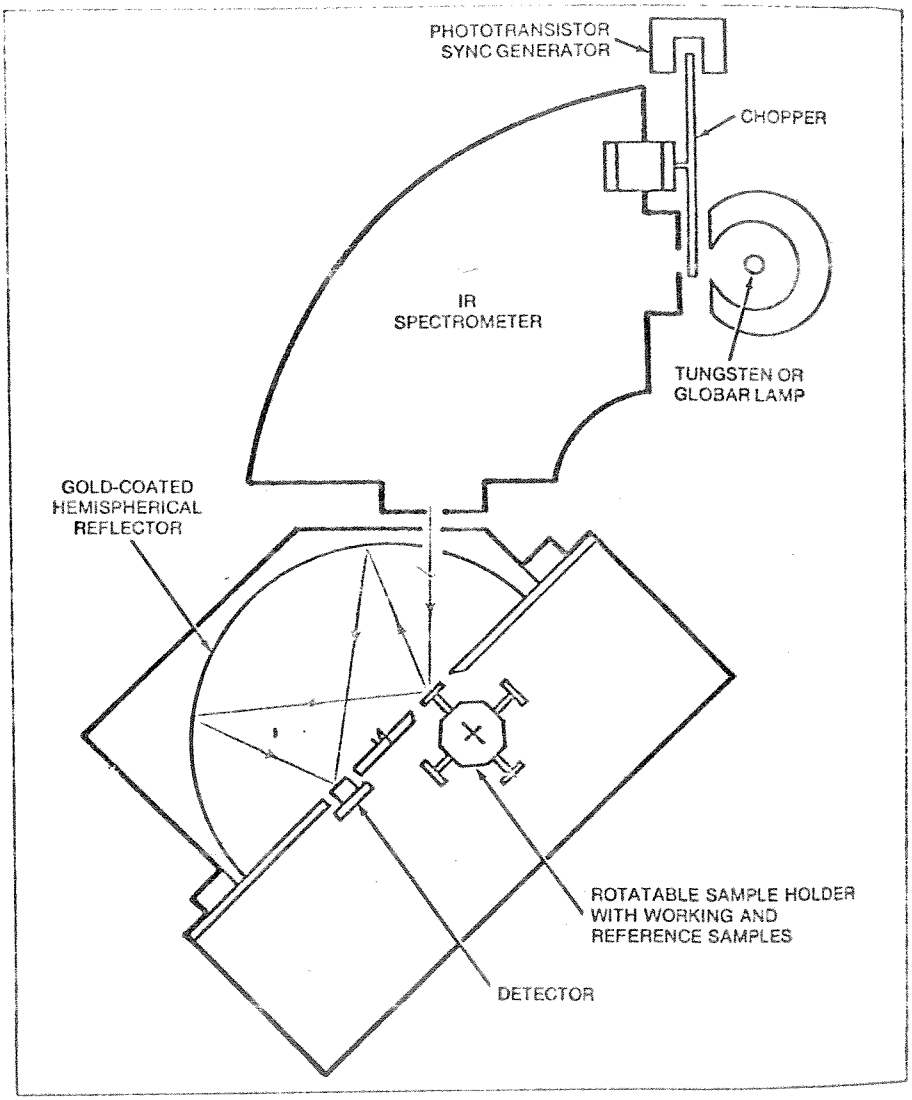
Conventional measurements of surface reflectivity are relatively accurate for specular surfaces. However, large errors can occur when measuring the surfaces exhibiting both specular and diffuse reflectances — for example, a microscopically faceted surface with both types of reflectances in a proportion that varies with the inclination and size of the facets and with the direction of incident light. A similar example is a dusty mirror that reflects both diffusely and specularly.

A recently proposed method of measuring total reflectance employs a relatively inexpensive reflectometer (see figure) with a gold-coated hemispherical reflector. The light sources may be a tungsten lamp for the visible region or a Globar lamp for the infrared (IR). A beam chopper is also incorporated with phototransistor sync-signal generator for synchronous detection of the light signal. The chopped IR beam is dispersed with a salt prism spectrometer covering a wavelength range of from 0.6 to 20 μm.

The chopped dispersed beam enters the gold-coated hemispherical reflector and is reflected by a sample or reference surface mounted on an indexed rotating holder. The holder carries four disk-shaped samples and positions each sample at a point off the hemisphere center and near a diametral plane. The reflected light is focused onto a 1-mm^2 triglycine-sulfate detector located at an optically conjugate point.

The sample holder contains two samples under investigation and two carefully-prepared reference disks. The diffuse-reflectance reference disk has an MgO surface. The second is a gold-coated glass disk that serves as a specular-reflectance standard. The reflectometer is adjusted so that: (1) readings for both the gold and MgO samples are independent of the holder on which the sample is mounted, and (2) mirror and detector positionings are such that readings do not depend on small deviations of the sample-holder shaft angle about index points.



Proposed Reflectometer for the measurement of diffuse and specular reflectances uses a rotatable sample holder with working and standard samples. A gold disk serves as a specular-reflectance reference, and an MgO-coated disk serves as a diffuse-reflectance standard. Reflectances are computed from the relative light intensities measured and data on the collection efficiency of the detector.

The detector records light intensities reflected from the sample surfaces. Reflectivities of the sample surfaces are obtained from the recorded intensities and by knowing the detector collection efficiency for both specular and diffuse components. The mathematical relationship can be solved either by hand or by computer.

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