

Description of measurement facility and measurement method

Laboratory: [NIST](#)

This table relates to NIST measurements during Steps 2 and 4.

Table A-1 Details of Measurement Setup

Make and Type of Spectrophotometer	Custom-made spectrophotometer. The monochromator is a 1 m, prism-grating system (McPherson 2051). Light from the source is focused by a spherical mirror onto the entrance slit of the monochromator. The entrance slit is 1 mm wide, while the exit aperture is a 1 mm diameter circle. The grating has 600 lines/mm and is blazed at 200 nm. The slit, aperture, and grating yield a triangular slit function with a nominal bandwidth of 1.5 nm. The light exiting the monochromator is collimated by an off-axis parabolic mirror, reduced in diameter by an iris, and is incident upon the sample plane. Light passing through the sample plane is focused by a spherical mirror into an averaging sphere attached to a detector. The current from the detector is amplified and read by a digital voltmeter.
Additional Stray Light Rejection	N/A
Source Drift Monitoring	At each wavelength, incident beam is measured in the clear position before and after measurement in the sample position. The average clear signal is used to minimize the effects of source drift and fluctuations on the timescale of a single transmittance measurement.
Source	150 W quartz-tungsten-halogen incandescent lamp
Detector	Silicon photodiode
Temperature	Temperature is monitored using a calibrated temperature probe (Fluke 1620A Thermo-hygrometer). The average temperature during the course of the transmittance measurements was 25.3 °C.
Humidity	Humidity is monitored using a calibrated hygrometer probe (Fluke 1620A Thermo-hygrometer). The ranged from 11.5 % RH to 29.5 % RH during the course of the transmittance measurements.
Beam Size	17 mm diameter

Beam Collimation	Collimated (maximum deviation from collimation at the sample is 0.2°)
Measurement Sequence	On a given day, the spectral transmittance of each sample was measured at two different orientations. In the first orientation, the filter was upright, with the identification number facing the incident beam and located at the upper right corner. In the second orientation, the filter rotated 90° about its normal so that its identification number was facing the incident beam and was located at the lower right corner. This was done to remove any effects from the slight polarization of the incident beam. In each orientation, the transmittance was measured two or three times at each wavelength and averaged. The resulting transmittance values for each orientation were then averaged to obtain the unpolarized transmittance values. These measurements were repeated on two or three different days for each sample over a period of 8 days.
Bandwidth	1.5 nm

Description of measuring technique (please include a diagram)

The transmittance measurements were performed on a custom-made spectrophotometer, which consists of a lamp-based source, a prism-grating monochromator, a sample carriage, and an optical detector attached to an integrating sphere. Details concerning the source, monochromator and detector are provided in Table A-1. A schematic of the instrument is provided in the figure below.

After cleaning with an air bulb, each sample was mounted in a holder on the sample carriage with the identification number facing the incident beam in one of two possible sample orientations (see Table A-1 Measurement Sequence). The sample was centered on the incident beam and aligned normal to the beam by retroreflecting a laser beam collinear with the axis of the incident beam. The maximum deviation from normal was 0.1°. The diameter of the incident beam was 17 mm.

The sample carriage consists of two incident positions for the beam: clear and sample. In each position, a shutter is used as a light trap for a dark signal. For each wavelength, the following signals were measured in this order: signal in the clear position, dark signal in the clear position, signal in the sample position, dark signal in the sample position, and signal in the clear position.

Net signals for the clear and sample positions are obtained by subtracting the dark signals, and the net clear signals, the first taken before the sample signal and the second taken after the sample signal, are averaged to minimize the effects of source drift and fluctuations on the timescale of a single transmittance measurement. The spectral transmittance of the sample was given by the net sample signal divided by the average net clear signal. Measurements were performed at wavelengths of 380, 400, 500, 600, 700, 800, 900, and 1000 nm.

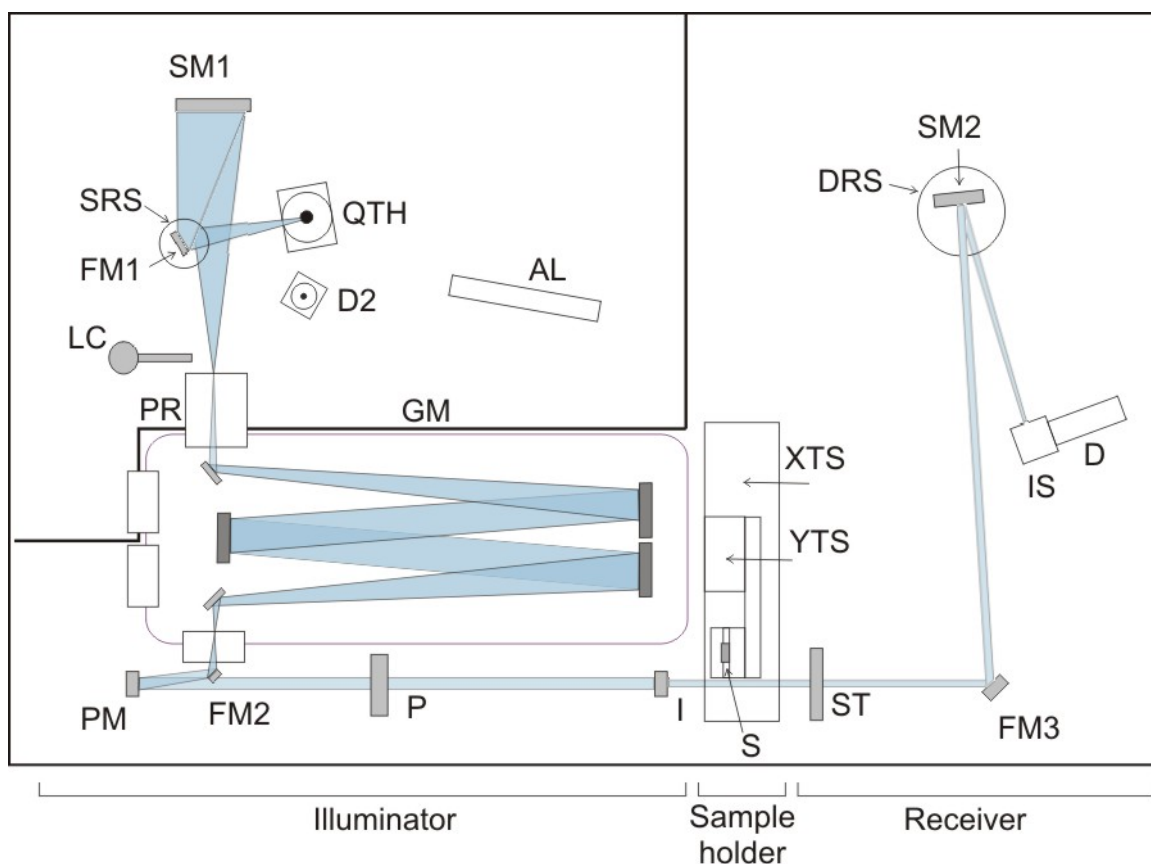


Figure. Schematic of the NIST Reference Transmittance Spectrophotometer with the systems and components labeled. The light path from the source to the detector is shaded. The Illuminator system consists of the QTH – quartz-tungsten-halogen lamp, the D2 – deuterium lamp, AL – alignment laser, FM1 – flat mirror, SRS – source rotation stage, SM1 – spherical mirror, LC – light chopper, PR – prism monochromator, GM – grating monochromator, FM2 – flat mirror, PM – parabolic mirror, P – polarizer, and I – iris. The Sample system consists of the S – sample holder, XTS – x-translation stage, and YTS – y-translation stage. The Receiver system consists of the ST – shutter, FM3 – flat mirror, DRS – detector rotation stage, SM2 – spherical mirror, IS – integrating sphere, and D – detector.

If any damage, contamination or cleaning of the filters was carried out, please give details.
N/A

Signature :

Date :