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Data Article

Spectral data of specular reflectance, narrow-angle transmittance and angle-resolved surface scattering of materials for solar concentrators

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ABSTRACT

The spectral specular reflectance of conventional and novel reflective materials for solar concentrators is measured with an acceptance angle of 17.5 mrad over the wavelength range 300 – 2500 nm at incidence angles 15–60° using a spectroscopic goniometry system. The same experimental setup is used to determine the spectral narrow-angle transmittance of semi-transparent materials for solar collector covers at incidence angles 0–60°. In addition, the angle-resolved surface scattering of reflective materials is recorded by an area-scan CCD detector over the spectral range 350–1050 nm. A comprehensive summary, discussion, and interpretation of the results are included in the associated research article “Spectral reflectance, transmittance, and angular scattering of materials for solar concentrators” in Solar Energy Materials and Solar Cells.

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Specifications Table

Subject area	Optics
More specific subject area	Spectroscopy
Type of data	Table

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How data was acquired	Spectroscopic goniometry system
Data format	Raw, analyzed
Experimental factors	none
Experimental features	Specular reflectance/narrow-angle transmittance at a detector acceptance half-angle of 17.5 mrad, wavelengths 300–2500 nm, and incidence angles 15°/0–60°. Angle-resolved surface scattering at wavelengths 350–1050 nm.
Data source location	Zurich, Switzerland
Data accessibility	With this article

Value of the data

- These data are a complete set of optical properties of representative solar concentrator materials and can serve as a benchmark for other researchers in the field of solar energy for the accurate simulation of solar concentrators.
- The spectral data is valuable for the optimization of solar concentrating systems such as improving selective and (anti-)reflective coatings and solar cell tuning for concentrated photovoltaics.
- The angle-resolved surface scattering data is useful for the accurate simulation of the solar flux distribution on the receiver and the optical design of solar collectors with small acceptance angles such as far-distant heliostats.

1. Data

Spectral data of specular reflectance of solar reflector materials and narrow-angle transmittance of semi-transparent materials for solar collector covers are experimentally measured at an acceptance half-angle of 17.5 mrad, wavelengths 300–2500 nm, and incidence angles 0–60°. The angle-resolved surface scattering of reflective materials is characterized by the parameters of a superposition of two Gaussian distributions over the spectral range 350–1050 nm and incidence angles 15–60°.

2. Experimental design, materials and methods

2.1. Materials

Three types of specular reflective materials (back-silvered glasses, metallized polymer films and metallized aluminum sheets) and two types of semi-transparent materials (glasses and polymeric films) are characterized. An overview of the materials is given in Table 1. A comprehensive description of materials is included in Chapter 2 of the associated research article [1].

2.2. Experimental design

Spectral measurements are performed using a spectroscopic goniometry system [15]. The experimental design for measuring specular reflectance and narrow-angle transmittance is shown schematically in Fig. 1. Following the light path, the setup comprises a xenon-arc light source (1), aspherical Czerny–Turner type double monochromator (2), mechanical beam chopper (3), collimating MgF_2 lens (4), calcite Glan–Thompson polarizer (5), iris (aperture stop) (6), sample (7), focusing MgF_2 lens (4), adjustable mechanical slit (field stop) (8), integrating sphere (9), thermoelectrically cooled photodiode detector (Si: 300 – 1000 nm, PbS: 1000 – 2800 nm) (10), lock-in amplifier (11), and computer based data acquisition system (12). The source divergence and detector acceptance

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