Package 'photobiologyFilters'

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Type Package

Title Spectral Transmittance and Spectral Reflectance Data

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Description Spectral 'transmittance' data for frequently used filters and
similar materials. Plastic sheets and films; photography filters;
theatrical gels; machine-vision filters; various types of window glass;
optical glass and some laboratory plastics and glassware. Spectral
reflectance data for frequently encountered materials. Part of the
'r4photobiology' suite, Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

License GPL (>= 2)

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R **topics documented:**

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photobiologyFilters-package

photobiologyFilters: Spectral Transmittance and Spectral Reflectance Data

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Description

Spectral 'transmittance' data for frequently used filters and similar materials. Plastic sheets and films; photography filters; theatrical gels; machine-vision filters; various types of window glass; optical glass and some laboratory plastics and glassware. Spectral reflectance data for frequently encountered materials. Part of the 'r4photobiology' suite, Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

Details

This package contains transmission spectra for different types of optical filters and filter-like objects. These spectral data are NOT normalized. In most cases they have been obtained from sheets of the standard thickness supplied by sellers. Metadata is stored together with the spectral data, when available, it includes thickness, an approximate estimate of Rfr and whether attenuation by the filter is based on reflection, absorption or both. Beware that when attenuation is by absorption in the body of the filter, thickness has a strong effect on the wavelengths at which Tfr = 0.5 is reached for a given material. Be also aware that some of the data are for total transmittance and some for internal transmittance. Depending on the type of filter, spectral transmittance depends more or less strongly on the angle of incidence of radiation. All measurements included have been done with a angle of incidence that deviates at most by a 10 degrees from zero (light beam perpendicular to the surface of the filter). Additional data is provided in the documentation for different objects, and metadata is also stored as attributes in the individual spectral objects. When metadata are available, estimates of spectral transmittance for different thicknesses can be usually computed. The same is true for the conversion between total and internal transmittance.

In addition to transmittance for semitransparent materials, the package also contains data on the refractive index as a function of wavelength, for several different materials. These data allow the estimation of spectral reflectance for these materials.

Spectral reflectance data is included for some common metals and for natural and man-made surfaces relevant to remote sensing.

Transmittance data are included for:

- The whole catalogue of Schott optical filters (official data supplied by Schott for inclussion in this package).

- Most of the catalogue of MIDOPT filters (official data extracted from dowloaded files from supplier, reproduced with permission).

- Clear glass as used in windows (as used by CIE, from data file downloaded from CIE's server.)

- Several types of Plexiglas from Evonik measured at our lab.

- Other types of plastic sheets supplied by Foiltek Oy and Etola Oy, measured at our lab.

- Plastic films from McDermit and Courtaulds, measured at our lab.

- Several types of theatrical 'gels' from Lee, Rosco, and Formmatt. Some measured at our lab and others data digitized from manufacturers' catalogues.

- Films used as greenhouse cladding from BPI Agri/Visqueen, XL-horticulture and generic, measured at our lab.

- Various filters used in UV, VIS and IR imaging and photography.

Warning!

Except for those from Schott and MIDOPT, none of the spectral data included in this package are "official" specifications. In all cases data are only for information, as even suppliers refer to the data provided as typical. Spectral transmittance depends on the measurement conditions, and, even more importantly, among individual production batches of filter materials. Spectral specifications are usually given as reference values. Both glass and plastic filters also age: their spectral properties change as a result of exposure to radiation or the gases in the atmosphere. Aging is in some cases fast. Another point to keep in mind is that some filter suppliers, for example Rosco, have

changed the spectral transmittance of some filters over the years without changing the code or name under which they are sold. In other words, the data provided here are not a substitute for actual measurements of transmission spectra of the filters actually used in a given piece of scientific research. For less demanding situations the data are in most cases useful, but perfect agreement with measurements on other batches of filters of the same exact type should not be expected.

Note

This package is part of a suite of R packages for photobiological calculations described at the [r4photobiology](https://www.r4photobiology.info) web site.

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References

Aphalo, Pedro J. (2015) The r4photobiology suite. UV4Plants Bulletin, 2015:1, 21-29. https://doi.org/10.19232/uv4pb.2015.1.14.

See Also

Useful links:

- https://docs.r4photobiology.info/photobiologyFilters/
- Report bugs at https://bitbucket.org/aphalo/photobiologyfilters

Examples

```
library(ggspectra)
library(photobiologyWavebands)

# Total number of spectra in the package
length(filters.mspct)

# SCHOTT filters example
schott_filters
filters.mspct$Schott_OG530
filters.mspct[["Schott_OG530"]]
getWhatMeasured(filters.mspct$Schott_OG530)
filter_properties(filters.mspct$Schott_OG530)
```

```
cat(comment(filters.mspct$Schott_OG530))

# combining name (index) vectors
# blue glass filters
intersect(optical_glass_filters, blue_filters)
# green plastic films
intersect(plastic_films, green_filters)

# A Plexiglas sheet
getWhatMeasured(filters.mspct$Evonik_Sky_Blue_5C01_GT)
autoplot(filters.mspct$Evonik_Sky_Blue_5C01_GT)
transmittance(filters.mspct$Evonik_Sky_Blue_5C01_GT, Orange())
transmittance(filters.mspct$Evonik_Sky_Blue_5C01_GT, NIR())

# Gold
autoplot(metals.mspct$gold, range = NIR(), w.band = NULL)

# Asphalt
autoplot(materials.mspct$construction.asphalt, range = NIR(), w.band = NULL)
```

---

acetate_filters	*Spectral data for filters made from different materials*

Description

Names of datasets containing the wavelengths and tabulated values for fractional spectral trabsmittance according to the material they are made off.

Usage

```
acetate_filters

acrylic_filters

polycarbonate_filters

plexiglas_filters

polystyrene_filters

polyester_filters

polyvynil_chloride_filters

optical_glass_filters

plastic_film_filters
```

```
plastic_films

plastic_sheet_filters

plastic_sheets
```

Format

A vector of character strings.

An object of class character of length 9.

An object of class character of length 2.

An object of class character of length 9.

An object of class character of length 3.

An object of class character of length 2.

An object of class character of length 1.

An object of class character of length 68.

An object of class character of length 31.

An object of class character of length 31.

An object of class character of length 14.

An object of class character of length 14.

See Also

filters.mspct

Examples

```
acrylic_filters

# select filters made from acrylic
filters.mspct[acrylic_filters]
```

---

all_filter_accessors   *Names of different accessors*

Description

The package makes available a collection of character vectors that can be used to extract spectral data for specific subsets of the filters. Some correspond to supplier names, other to materials, types, colours and typical uses. The data object described here lists the names of all these accesors, as a sort of index to this collection of data.

Usage

```
all_filter_accessors
```

Format

A vector of character strings.

Examples

```
all_filter_accessors
```

---

band_pass_filters   *Spectral data for filters of different types*

Description

Names of datasets containing the wavelengths and tabulated values for fractional spectral trabsmittance according to their type or optical properties. Band-pass filters transmit a range of wavelengths, but block shorter and longer ones. Long-pass filters absorb wavelengths shorter than their cut-off and short-pass filters absorb wavelengths longer than their cut-off.

Usage

```
band_pass_filters

long_pass_filters

short_pass_filters
```

Format

A vector of character strings.

An object of class `character` of length 56.

An object of class `character` of length 17.

Note

These vectors include only optical-glass filters with well defined characteristics.

See Also

filters.mspct

Examples

```
band_pass_filters

# select band-pass filters
filters.mspct[band_pass_filters]
```

---

bpi_visqueen_filters   *Filter spectra data for commercial grenhouse films from BPI Visqueen*

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for different films used as greenhouse cladding.

Usage

```
bpi_visqueen_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

https://www.rpc-bpi.com/sector/horticultural-solutions/

Instrument used: Shimadzu UV-2501 PC (Shimadzu Suzhou Instruments Manufacturing Co. Ltd, China) equiped with an integrating sphere.

Note

Idependent measurement of a single sample, not a specification.

Examples

```
bpi_visqueen_filters
```

---

clear_filters   *Spectral data for filters of different 'colors'*

Description

Names of datasets containing the wavelengths and tabulated values for fractional spectral trabsmittance for filters of given colours.

Usage

```
clear_filters

neutral_filters

uv_filters

blue_filters

blue_green_filters

green_filters

yellow_filters

orange_filters

red_nir_filters

heat_filters

uvir_cut_filters
```

Format

A vector of character strings.

An object of class character of length 30.

An object of class character of length 44.

An object of class character of length 9.

An object of class character of length 22.

An object of class character of length 6.

An object of class character of length 14.

An object of class character of length 8.

An object of class character of length 24.

An object of class character of length 4.

An object of class character of length 7.

See Also

filters.mspct

Examples

```
clear_filters

# select filters of amber, yellow, orange color ("blue absorbing")
filters.mspct[yellow_filters]
```

---

courtaulds_filters   *Filter spectra data for cellulose di-acetate film*

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for Courtaulds di-acetate films.

1) Films (0.115 mm thick) stretched 25 cm below lamps Q-Panel UVB313 and exposed to UV radiaition from different lengths of time per day. All films were installed and sampled at the same time. The digits give the number of minutes per day that the lamps were on.

2) New films of different thicknesses.

Usage

```
courtaulds_filters
```

Format

A vector of character strings.

Details

For each spectrum in the collection the variables are as follows:

- w.length (nm)
- Tfr (fraction)

Note

Instrument used: Hewlett-Packard 8453 diode array spectrophotometer without an integrating sphere.

Idependent measurement of a single sample, not a specification.

Examples

```
courtaulds_filters
```

---

etola_filters *PE films supplied by Etola Oy*

Description

Dataset containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for different filters supplied by Etola Oy (Finland).

Usage

```
etola_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Note

Idependent measurement of a single sample, not a specification.

Examples

```
etola_filters
```

---

evonik_filters *Total transmittance for PMMA sheets (Plexiglas) by Evonik*

Description

Total transmittance for Plexiglas sheets 3 mm think. Data are to be used as "reference values only" as values may change in time and production batch.

Usage

```
evonik_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Sample chips bought from the manufacturers website on 24.04.2014 https://www.plexiglas-shop.com/

Note

Data measured with an Agilent~8453 spectrophotometer (based on diode array).

Idependent measurement of a single sample, not a specification.

Examples

```
evonik_filters
```

---

filters.mspct   *Spectral irradiance for diverse optical filters*

Description

A collection of transmittance spectra for optical filters from different suppliers.

Usage

```
filters.mspct
```

Format

A "filter_mspct" object containing several "filter_spct".

Details

The "filter_mspct" object contains "filter_spct" objects with spectral transmittance data.

The variables in each member spectrum are as follows:

- w.length (nm)
- Tfr (transmittance expressed as a fraction of one)

Note

Please see the help corresponding to each supplier for details.

Examples

```
filters.mspct$Schott_UG11
filters.mspct[[1]]
names(filters.mspct)
```

---

foiltek_filters   *Spectral Transmittance for Plastic Sheets Supplied by Foiltek*

Description

Total transmittance for samples of clear plastic sheets. PC_UV is 3 mm thick Makrolife sheet manufactured by Arlaplast Ab (Sweden). PC is generic 3 mm thick polycarbonate, PS is 3 mm thick polystyrene PET_G is polyester approx 3 mm thick and PVC is polyvinylchloride approximately 1.5–2 mm thick all from unknown manufacturers but stock product in Foiltek's catalogue. Data are to be used as "reference values only" as values may change in time and production batch.

Usage

```
foiltek_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Sample chips supplied free of charge by Foiltek on 02.07.2014 <https://foiltek.fi/>

Note

Data measured with an Agilent 8453 spectrophotometer (based on diode array).

Idependent measurement of a single sample, not a specification.

Examples

```
foiltek_filters
```

---

glass_windows   *Spectral transmittance for glass windows*

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for glass windows as used by CIE.

Usage

```
glass_windows
```

Format

A vector of character strings.

Details

For each of the 26 spectra in the collection the variables are as follows:

- w.length (nm)
- Tfr (fraction)

Note

Data from file <http://files.cie.co.at/206.xls>, downloaded 2017-06-25. Abbreviated names from original .xls file used as member names. Full glass names, thickness and manufacturers names, retained and stored as metadata in attribute "what.measured".

Examples

```
glass_windows
```

---

materials.mspct   *Total reflectance of materials*

Description

Total reflectance of materials. Data are to be used as "reference values only" as actual values will vary.

Usage

```
materials.mspct
```

Format

A reflector_mspct object containing a collection of reflector_spct each with 491 rows and 2 variables.

Details

The variables for each spectrum are as follows:

- w.length (nm)
- Rfr (fraction)

Note

This is a small selection from the ASTER database. See: https://speclib.jpl.nasa.gov/. Reproduced from the ECOSTRESS Spectral Library through the courtesy of the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California. Copyright (c) 2017, California Institute of Technology. ALL RIGHTS RESERVED.

References

Meerdink, S. K., Hook, S. J., Roberts, D. A., & Abbott, E. A. (2019). The ECOSTRESS spectral library version 1.0. Remote Sensing of Environment, 230(111196), 1–8. ASTER spectral library.

Baldridge, A. M., S.J. Hook, C.I. Grove and G. Rivera, 2009.. The ASTER Spectral Library Version 2.0. Remote Sensing of Environment, vol 113, pp. 711-715.

Examples

```
library(ggspectra)

names(materials.mspct)
cat(comment(materials.mspct$black.loam))
autoplot(materials.mspct$black.loam, annotations = c("+", "title:what"),
         range = c(NA, 800))
```

---

mcdermit_filters   *Filter spectra data for McDermit Autostat CT5 "polyester" filter*

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for filter.

Usage

```
mcdermit_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

http://autotype.macdermid.com/

Note

Instrument used: Shimadzu UV-2501 PC (Shimadzu Suzhou Instruments Manufacturing Co. Ltd, China) equiped with an integrating sphere.

Examples

```
mcdermit_filters
```

---

metals.mspct   *Total reflectance of metals at 294 K*

Description

Total reflectance of metals at 294 K, measured using an integrating sphere. Data are to be used as "reference values only" as actual values will depend on the state of the metal surface and its polish.

Usage

```
metals.mspct
```

Format

A reflector_mspct object containing a collection of reflector_spct each with 47 rows and 2 variables.

Details

The variables for each spectrum are as follows:

- w.length (nm)
- Rfr (fraction)

Note

Data extracted from a published report by OCR.

References

Ernie W. Spisz, Albert J. Weigund, Robert L. Bowmun, and John R. Juck (1969) SOLAR AB-SORPTANCES AND SPECTRAL REFLECTANCES OF 12 METALS FOR TEMPERATURES RANGING FROM 300 TO 500 K NASA TN D-5353, Technical Note, Washington DC, 22 pp. (Data from Table II (a))

Examples

```
library(ggspectra)

names(metals.mspct)
cat(comment(metals.mspct$gold))
autoplot(metals.mspct$gold, annotations = c("+", "title:what"))
```

---

midopt_filters   *Total transmittance for MidOpt filters*

Description

Internal transmittance for MidOpt machine-vision optical glass, acrylic and interference filters. Data extracted from MidOpt's pdf data files with help of R package 'tabulizer'. MidOpt is a trade name of Midwest Optical Systems, Palatine, IL 60067 USA

Usage

```
midopt_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

DISCLAIMER from MidOpt

data are typical values and may vary by plus/minus 10 nm. To interactively comparing filter spectra, please visit https://midopt.com/tools/curve-compare/.

Note

Examples

```
midopt_filters
```

---

petri_dishes   *Total transmittance for Petri dishes*

Description

Total transmittance for the covers of Petri dishes. Data are to be used as "reference values only" as values may change in time and production batch.

Usage

```
petri_dishes
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Note

Data measured with an Agilent 8453 spectrophotometer (based on diode array). Supplier of the Petri dishes: Thermo Fisher Scientific.

Idependent measurement of a single sample, not a specification.

Examples

```
petri_dishes
```

---

photography_filters   *Total transmittance for photography filters*

Description

Total transmittance for filters intended for use on camera lenses from various suppliers: Formatt Hitech, Haida, Heliopan, Hoya, Rocolax and Zomei. Data are to be used as "reference values only" as values may change in time and production batch.

Usage

```
photography_filters

hoya_filters

firecrest_filters

haida_filters

zomei_filters

fake_unbranded_filters

baader_filters

uvroptics_filters

tiffen_filters

bw_filters

heliopan_filters

zeiss_filters

kenko_filters

rocolax_filters

kolarivision_filters

fotga_filters
```

Format

A vector of character strings.

An object of class character of length 11.

An object of class character of length 7.

An object of class character of length 1.

An object of class character of length 10.

An object of class character of length 5.

An object of class character of length 1.

An object of class character of length 1.

An object of class character of length 3.

An object of class character of length 3.

An object of class character of length 7.

An object of class character of length 1.

An object of class character of length 1.

An object of class character of length 3.

An object of class character of length 1.

An object of class character of length 1.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Supplier's web sites

https://www.baader-planetarium.com/en/, https://www.formatt-hitech.com/, https://www.fotga.com/, https://www.haidaphoto.com/en/, http://www.heliopan.de/, https://hoyafilter.com/, https://kenkoglobal.com/, https://kolarivision.com/, https://schneiderkreuznach.com/en/photo-optics, https://tiffen.com/, https://www.uvroptics.com/, https://www.zomei.com/.

Note

Data measured with an Agilent 8453 spectrophotometer (based on diode array).

Idependent measurement of a single sample, not a specification.

Examples

```
photography_filters
```

---

refractive_index.mspct

Refractive-index spectra for materials

Description

A collection of refractive-index spectra for some materials.

Usage

```
refractive_index.mspct
```

Format

A "generic_mspct" object containing multiple "generic_spct" objects.

Details

The "generic_mspct" object contains "generic_spct" objects with refractive index data.

The variables in each member spectrum are as follows:

- w.length (nm)
- n
- k

Note

Data labeled "for unrestricted use" originate from the Filmmetrics Refractive Index Database at
<https://www.filmetrics.com/refractive-index-database> where primary sources are provided. The names in refractive_index.mspct are the same as in the downloaded files, except for
the '.txt' tag.

Examples

```
length(refractive_index.mspct)
names(refractive_index.mspct)
refractive_index.mspct$Acrylic
refractive_index.mspct[["Acrylic"]]

# Compute spectral reflectance for an interface between acrylic and air
# incidence angle of colimated light 60 degrees.
Rfr_from_n(angle_deg = 60, n = refractive_index.mspct[["Acrylic"]])
```

---

schott_filters   *Internal transmittance for Schott filters*

Description

Internal transmittance for Schott optical glass filters. Data from manufacturer-provided excel filter tool.

Usage

```
schott_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

DISCLAIMER from Schott

This data collection is protected by federal copyright law and international treaty. The copyright holder retains title to and ownership of the data collection.

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SCHOTT reserves the right to change the optical and non-optical data without prior notice. This calculation tool renders all previous filter glass catalogs obsolete

This data collection was composed with utmost care.

Note

Data supplied by the manufacturer for inclussion in this package. Version 1 st June 2015. Reproduced with permission. https://www.schott.com/advanced_optics

Examples

```
schott_filters
```

---

theatrical_gels   *Filter spectra data for theatrical filter*

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for different filters used on light sources as spectral modifiers. Frequently called "theatrical gels".

Usage

```
theatrical_gels

lee_filters

lee_gels

rosco_filters

rosco_gels
```

Format

A vector of character strings.

An object of class `character` of length 7.

An object of class `character` of length 7.

An object of class `character` of length 8.

An object of class `character` of length 8.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

Note

Instruments used: Shimadzu UV-2501 PC (Shimadzu Suzhou Instruments Manufacturing Co. Ltd, China) equiped with an integrating sphere for Rosco filters except no. 299 which was measured with an Agilent 8453 array spectrophotometer and while spectra for Lee gels have been digitized from the spectra in the Lee filters catalogue.

References

<https://www.leefilters.com/lighting/colour-details.html>, <https://emea.rosco.com/en/products/family/filters-and-diffusions>

Examples

```
theatrical_gels
```

---

uqg_filters   *Total transmittance for UQG filters*

Description

Total transmittance for UQG optical glass absorptive and interference (dichroic) filters. Data measured by P. J. Aphalo with an Agilet 8453 array spectrophotometer. Some of the filters are Schott glass and we have retained the Schott type names.

Usage

```
uqg_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

DISCLAIMER

These spectral transmittance data are based on the measurement of a single filter of each type. Filters from other production batches may differ in their spectral properties, specially for wavelengths outside the range described in the manufacturer's published specifications. The characterisitics of some types of glass filters may change with time through surface oxidation or by effect of exposure to radiation including solar radiation. The data provided is to be used only as a coarse guide. When filter properties are important the filter actually used should be measured.

Note

Filter supplier: UQG Ltd. The Norman Industrial Estate, Milton, Cambridge, England. `https://www.uqgoptics.com/`

Examples

```
uqg_filters
```

```
xl_horticulture_filters
```
Filter spectra data for commercial grenhouse films from XL Horticulture

---

Description

Datasets containing the wavelengths at a 1 nm interval and tabulated values spectral transmittance for different films used as greenhouse cladding.

Usage

```
xl_horticulture_filters
```

Format

A vector of character strings.

Details

The variables are as follows:

- w.length (nm)
- Tfr (fraction)

https://www.xlhorticulture.co.uk/

Instrument used: Shimadzu UV-2501 PC (Shimadzu Suzhou Instruments Manufacturing Co. Ltd, China) equiped with an integrating sphere.

Note

Idependent measurement of a single sample, not a specification.

Examples

```
xl_horticulture_filters
```

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