Package: planar (via r-universe)

October 24, 2024

Title Multilayer Optics

LinkingTo Rcpp, RcppArmadillo

Type Package

URL https://github.com/nano-optics/planar

BugReports https://github.com/nano-optics/planar/issues

LazyLoad yes

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Description Solves the electromagnetic problem of reflection and transmission at a planar multilayer interface. Also computed are the decay rates and emission profile for a dipolar emitter.

SystemRequirements GNU make

Version 1.7.0

Encoding UTF-8

VignetteBuilder knitr

LazyData true

Depends R (>= 3.5.0), methods, dielectric

Imports Rcpp, statmod, cubature, reshape2, plyr, ggplot2

Suggests Hmisc, grid, gridExtra, lattice, knitr, rmarkdown, testthat

RoxygenNote 7.1.2

Repository https://nano-optics.r-universe.dev

RemoteUrl https://github.com/nano-optics/planar

RemoteRef HEAD

RemoteSha 5d53d0aca8636a9b3e166b1213400fc379bbb2ec

Contents

`planar-package` *planar*

Description

Multilayer optics

Details

R/c++ implementation of the dipole emission near a planar multilayer stack

Author(s)

baptiste Auguie `<baptiste.auguie@gmail.com>`

References

Etchegoin, P. Le Ru, E., Principles of Surface-Enhanced Raman Spectroscopy, Elsevier, Amsterdam (2009).

L. Novotny, E. Hecht, Principles of Nano-optics Cambridge University Press, 2006

H. Raether. Surface Plasmons on Smooth and Rough Surfaces and on Gratings. Springer, 1988.

`classify` *classify*

Description

relabel factors

Usage

```
classify(d, id = NULL, vars = NULL, ...)
```

Arguments

`d`	data.frame
`id`	column id
`vars`	variables
`...`	passed on to melt

Details

Wide to long format data.frame with new factor variable(s) describing the original columns

Value

data.frame

Author(s)

Baptiste Auguie

See Also

Other helping_functions: `internal_field()`, `invert_stack()`, `lfief()`, `modify_levels()`

collection_ml *collection_ml*

Description

Light intensity from the transmission of a bunch of plane waves at a planar interface

Usage

```
collection_ml(
  xyz,
  wavelength = 632.8,
  omega = c(40, 50) * pi/180,
  psi = 0,
  epsilon = c(1.5^2, epsAg(wavelength)$epsilon, 1^2, 1^2),
  thickness = c(0, 50, 10, 0),
  maxEval = 3000,
  reqAbsError = 0,
  tol = 1e-04,
  progress = FALSE
)
```

Arguments

`xyz`	position matrix
`wavelength`	wavelength
`omega`	collection angle
`psi`	polarisation angle
`epsilon`	vector of permittivities
`thickness`	thickness corresponding to each medium
`maxEval`	passed to cubature
`reqAbsError`	passed to cubature
`tol`	passed to cubature
`progress`	logical display progress bar

Details

Integration is performed over the solid angle defined by omega

Value

data.frame intensity at the x, y, z position

Author(s)

Baptiste Auguie

`combine_layer` *combine_layer*

Description

combine layer

Usage

```
combine_layer(r1, r2, kd)
```

Arguments

`r1`	reflection coefficient
`r2`	reflection coefficient
`kd`	k*d

Details

reflection coefficient for a layer

Value

combined complex reflectivity

Author(s)

baptiste Auguie

dbr_analytic	*dbr_analytic*

Description

semi-infinite DBR

Usage

```
dbr_analytic(
  wavelength,
  lambda0,
  n1,
  n2,
  nleft,
  d1 = lambda0/4/n1,
  d2 = lambda0/4/n2,
  ...
)
```

Arguments

wavelength	in nm
lambda0	central wavelength of the stopband
n1	real refractive index for odd layers
n2	real refractive index for even layers
nleft	real refractive index for incident medium
d1	odd layer thickness in nm
d2	even layer thickness in nm
...	ignored

Details

periodic structure of dielectric layers

Value

data.frame with complex reflectivity

Note

issue at lambda0/2 needs investigating

Author(s)

baptiste Auguie

References

Amir and Vukusic, 2013, arXiv:1209.3776v2

`dbr_stack` *dbr_stack*

Description

DBR stack structure

Usage

```
dbr_stack(
  lambda0 = 630,
  n1 = 1.28,
  n2 = 1.72,
  d1 = lambda0/4/n1,
  d2 = lambda0/4/n2,
  N = 2 * pairs,
  pairs = 4,
  ...
)
```

Arguments

`lambda0`	central wavelength of the stopband
`n1`	real refractive index for odd layers
`n2`	real refractive index for even layers
`d1`	odd layer thickness in nm
`d2`	even layer thickness in nm
`N`	number of layers, overwrites pairs
`pairs`	number of pairs
`...`	ignored

Details

periodic structure of dielectric layers

Value

list of class ’stack’

Author(s)

baptiste Auguie

See Also

Other stack user_level: `embed_stack()`, `layer_stack()`, `tamm_stack_ir()`, `tamm_stack_porous()`, `tamm_stack()`

`dipole` *dipole*

Description

Dipole decay rates near a multilayer interface

Usage

```
dipole(
  d = 1,
  wavelength,
  epsilon = list(incident = 1^2),
  thickness = c(0, 0),
  qcut = NULL,
  rel.err = 0.001,
  Nquadrature1 = 1000,
  Nquadrature2 = 10000,
  Nquadrature3 = 10000,
  GL = FALSE,
  show.messages = TRUE
)
```

Arguments

`d`	distance in nm
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses
`qcut`	transition between regions 2 and 3
`rel.err`	relative error
`Nquadrature1`	maximum number of quadrature points in radiative region
`Nquadrature2`	maximum number of quadrature points in SPPs region
`Nquadrature3`	maximum number of quadrature points in dipole image region
`GL`	logical: use Gauss Legendre quadrature, or cubature::adaptIntegrate
`show.messages`	logical, display integration info

Details

dipole decay rates near a multilayer interface

Author(s)

baptiste Auguie

`dipole_direct` *dipole_direct*

Description

Dipole total decay rate near a multilayer interface

Usage

```
dipole_direct(
  d = 1,
  wavelength,
  epsilon = list(incident = 1^2),
  thickness = c(0, 0),
  Nquadrature1 = 50,
  Nquadrature2 = 200,
  Nquadrature3 = 50,
  qcut = NULL,
  qmax = Inf,
  show.messages = TRUE
)
```

Arguments

`d`	distance in nm
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses
`Nquadrature1`	quadrature points in radiative region
`Nquadrature2`	quadrature points in SPPs region
`Nquadrature3`	quadrature points in dipole image region
`qcut`	transition between regions 2 and 3
`qmax`	maximum q of region 3
`show.messages`	logical, display integration info

Details

direct application of the textbook formula using integrand_mtot; performs poorly compared to the transformed version in `dipole`

Author(s)

baptiste Auguie

embed_stack	*embed_stack*

Description

Embed stack structure

Usage

```
embed_stack(s, nleft = 1, nright = 1, dleft = 200, dright = 200, ...)
```

Arguments

`s`	stack (finite structure)
`nleft`	real refractive index on the left side
`nright`	real refractive index on the right side
`dleft`	dummy layer thickness in nm
`dright`	dummy layer thickness in nm
`...`	ignored

Details

embeds a stack in semi-infinite media

Value

list of class 'stack'

Author(s)

baptiste Auguie

See Also

Other stack user_level: `dbr_stack()`, `layer_stack()`, `tamm_stack_ir()`, `tamm_stack_porous()`, `tamm_stack()`

`epsilon_dispersion` *epsilon_dispersion*

Description

epsilon_dispersion

Usage

```
epsilon_dispersion(
  epsilon,
  wavelength = seq(400, 1000),
  envir = parent.frame()
)
```

Arguments

`epsilon`	list of real or complex values
`wavelength`	numeric vector
`envir`	environment to look for functions

Details

apply a function to a range of wavelength and return dielectric function

Value

list

Author(s)

baptiste Auguie

`epsilon_label` *epsilon_label*

Description

epsilon_label

Usage

```
epsilon_label(epsilon = list(3.5, 1, 3, 1, "epsAu", 3, 3.5), names = NULL)
```

Arguments

`epsilon`	list of real or complex values
`names`	optional unique character names in order of appearance

Details

characterise the layers of a structure with unique labels for metals and dielectrics

Value

factor

Author(s)

baptiste Auguie

`gaussian_near_field_layer`

gaussian_near_field_layer

Description

Electric field from the transmission of a gaussian beam at a planar interface

Usage

```
gaussian_near_field_layer(
  xyz,
  wavelength = 500,
  alpha = 15 * pi/180,
  psi = 0,
  w0 = 10000,
  epsilon = c(1.5^2, epsAg(wavelength)$epsilon, 1^2),
  thickness = c(0, 50, 0),
  maxEval = 3000,
  reqAbsError = 0,
  tol = 1e-04,
  progress = FALSE,
  field = FALSE
)
```

Arguments

`xyz`	position
`wavelength`	wavelength
`alpha`	beam incident angle
`psi`	beam polarisation angle
`w0`	beam waist radius
`epsilon`	vector of permittivities
`thickness`	thickness corresponding to each medium
`maxEval`	passed to adaptIntegrate
`reqAbsError`	passed to cubature
`tol`	passed to adaptIntegrate
`progress`	logical: display progress bar
`field`	logical: return the electric field (complex vector), or modulus squared

Details

Integration is performed over a spectrum of incident plane waves

Value

data.frame electric field at the x, y, z position

Author(s)

Baptiste Auguie

See Also

Other gaussian_beam: `gaussian_near_field_ml()`

`gaussian_near_field_ml`

gaussian_near_field_ml

Description

Electric field of a gaussian beam close to a planar interface

Usage

```
gaussian_near_field_ml(
  xyz,
  wavelength = 632.8,
  alpha = 15 * pi/180,
  psi = 0,
  w0 = 10000,
  epsilon = c(1.5^2, epsAg(wavelength)$epsilon, 1^2, 1^2),
  thickness = c(0, 50, 10, 0),
  maxEval = 3000,
  reqAbsError = 0,
  tol = 1e-04,
  progress = FALSE,
  field = FALSE
)
```

Arguments

`xyz`	position matrix
`wavelength`	wavelength
`alpha`	beam incident angle
`psi`	beam polarisation angle
`w0`	beam waist radius
`epsilon`	vector of permittivities
`thickness`	thickness corresponding to each medium
`maxEval`	passed to cubature
`reqAbsError`	passed to cubature
`tol`	passed to cubature
`progress`	logical display progress bar
`field`	logical: return the electric field (complex vector), or modulus squared

Details

Integration is performed over a spectrum of incident plane waves using integrand_gb2

Value

data.frame electric field at the x, y, z position

Author(s)

Baptiste Auguie

See Also

Other gaussian_beam: `gaussian_near_field_layer()`

integrand_mtot *integrand_mtot*

Description

Total decay rate of a dipole near a multilayer interface

Usage

```
integrand_mtot(
  d = 10,
  q,
  wavelength,
  epsilon = list(incident = 1.5^2, 1^2),
  thickness = c(0, 0)
)
```

Arguments

`d`	distance in nm
`q`	normalised in-plane wavevector in [0, infty)
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses

Details

Integrand without transformation of variables

Author(s)

baptiste Auguie

See Also

Other integrands dipole: `integrand_nr1()`, `integrand_nr2()`, `integrand_nr3()`, `integrand_rad()`

integrand_nr1 *integrand_nr1*

Description

Dipole decay rates near a multilayer interface

Usage

```
integrand_nr1(
  d = 10,
  u,
  wavelength,
  epsilon = list(incident = 1.5^2, 1^2),
  thickness = c(0, 0),
  GL = FALSE
)
```

Arguments

`d`	distance in nm
`u`	transformed normalised in-plane wavevector sqrt(1-q^2)
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses
`GL`	logical: result formatted for use with Gauss Legendre quadrature

Details

Integrand of the dipole decay rates near a multilayer interface. Transformed part I1 (radiative) from u=0 to 1

Author(s)

baptiste Auguie

See Also

Other integrands dipole: `integrand_mtot()`, `integrand_nr2()`, `integrand_nr3()`, `integrand_rad()`

integrand_nr2 *integrand_nr2*

Description

Dipole decay rates near a multilayer interface

Usage

```
integrand_nr2(
  d = 10,
  u,
  wavelength,
  epsilon = list(incident = 1.5^2, 1^2),
  thickness = c(0, 0),
  GL = FALSE
)
```

Arguments

`d`	distance in nm
`u`	transformed normalised in-plane wavevector sqrt(q^2 - 1)
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses
`GL`	logical: result formatted for use with Gauss Legendre quadrature

Details

Integrand of the dipole decay rates near a multilayer interface. Transformed part I2 from u=0 to ucut

Author(s)

baptiste Auguie

See Also

Other integrands dipole: `integrand_mtot()`, `integrand_nr1()`, `integrand_nr3()`, `integrand_rad()`

integrand_nr3 *integrand_nr3*

Description

Dipole decay rates near a multilayer interface

Usage

```
integrand_nr3(
  d = 10,
  u,
  ucut,
  wavelength,
  epsilon = list(incident = 1.5^2, 1^2),
  thickness = c(0, 0),
  GL = FALSE
)
```

Arguments

`d`	distance in nm
`u`	transformed normalised in-plane wavevector sqrt(q^2 - 1)
`ucut`	limit of the integral
`wavelength`	wavelength in nm
`epsilon`	list of dielectric functions
`thickness`	list of layer thicknesses
`GL`	logical: result formatted for use with Gauss Legendre quadrature

Details

Integrand of the dipole decay rates near a multilayer interface. Transformed part III from u=ucut to infinity

Author(s)

baptiste Auguie

See Also

Other integrands dipole: `integrand_mtot()`, `integrand_nr1()`, `integrand_nr2()`, `integrand_rad()`

integrand_rad *integrand_rad*

Description

Dipole decay rates near a multilayer interface

Usage

```
integrand_rad(
  d = 10,
  angle,
  wavelength,
  epsilon = list(incident = 1.5^2, 1^2),
  thickness = c(0, 0),
  GL = FALSE
)
```

Arguments

d	distance in nm
angle	angle in radians
wavelength	wavelength in nm
epsilon	list of dielectric functions
thickness	list of layer thicknesses
GL	logical: result formatted for use with Gauss Legendre quadrature

Details

Integrand of the radiative dipole decay rates near a multilayer interface.

Author(s)

baptiste Auguie

See Also

Other integrands dipole: integrand_mtot(), integrand_nr1(), integrand_nr2(), integrand_nr3()

internal_field *internal_field*

Description

Internal field in a ML stack

Usage

```
internal_field(
  wavelength = 500,
  angle = 0,
  psi = 0,
  thickness = c(0, 20, 140, 20, 0),
  dmax = 200,
  res = 1000,
  epsilon = c(1^2, -12, 1.38^2, -12, 1.46^2),
  field = FALSE,
  ...
)
```

Arguments

wavelength	wavelength
angle	angle
psi	polarisation angle (0 for TM)
thickness	vector of layer thickness
dmax	maximum distance to interface
res	resolution of sampling points
epsilon	permittivities
field	logical, return complex field vector, or modulus squared
...	further args ignored

Details

returns the electric field as a function of distance inside and outside of the structure

Value

data.frame with position and electric field vector

Author(s)

baptiste Auguie

References

Principles of surface-enhanced Raman spectroscopy and related plasmonic effects

Eric C. Le Ru and Pablo G. Etchegoin, published by Elsevier, Amsterdam (2009).

See Also

Other helping_functions: `classify()`, `invert_stack()`, `lfief()`, `modify_levels()`

`invert_stack` *invert_stack*

Description

invert the description of a multilayer to simulate the opposite direction of incidence

Usage

```
invert_stack(p)
```

Arguments

`p`	list

Details

inverts list of epsilon and thickness of layers

Value

list

Author(s)

Baptiste Auguie

See Also

Other helping_functions: `classify()`, `internal_field()`, `lfief()`, `modify_levels()`

`layer_stack` *layer_stack*

Description

Single-layer stack structure

Usage

```
layer_stack(epsilon = "epsAu", thickness = 50, ...)
```

Arguments

`epsilon`	dielectric function (numeric, character, or complex)
`thickness`	layer thickness in nm
`...`	ignored

Details

returns a stack describing a single layer

Value

list of class 'stack'

Author(s)

baptiste Auguie

See Also

Other stack user_level: `dbr_stack()`, `embed_stack()`, `tamm_stack_ir()`, `tamm_stack_porous()`, `tamm_stack()`

`lfief` *lfief*

Description

Local field intensity enhancement factors in a multilayer

Usage

```
lfief(
  wavelength = 500,
  angle = 0,
  polarisation = "p",
  thickness = c(0, 20, 140, 20, 0),
  dmax = 200,
  res = 1000,
  res2 = res/10,
  epsilon = list(1^2, -12, 1.38^2, -12, 1.46^2),
  displacement = FALSE,
  ...
)
```

Arguments

`wavelength`	wavelength
`angle`	angle
`polarisation`	polarisation
`thickness`	vector of layer thickness
`dmax`	maximum distance to interface, if > layer thickness
`res`	resolution of sampling points
`res2`	resolution of sampling points outside stack
`epsilon`	list of permittivities
`displacement`	logical, Mperp corresponds to displacement squared (D=epsilon x E)
`...`	further args passed to multilayer

Details

returns the LFIEFs as a function of distance inside and outside of the structure

Value

long format data.frame with positions and LFEF (para and perp)

Author(s)

baptiste Auguie

References

Principles of surface-enhanced Raman spectroscopy and related plasmonic effects

Eric C. Le Ru and Pablo G. Etchegoin, published by Elsevier, Amsterdam (2009).

See Also

Other helping_functions: `classify()`, `internal_field()`, `invert_stack()`, `modify_levels()`

modify_levels *modify_levels*

Description

relabel factors

Usage

```
modify_levels(f, modify = list())
```

Arguments

f	factor
modify	named list

Value

factor

Author(s)

Baptiste Auguie

See Also

Other helping_functions: classify(), internal_field(), invert_stack(), lfief()

multilayer *multilayer*

Description

Multilayer Fresnel coefficients

Usage

```
multilayer(
  wavelength = 2 * pi/k0,
  k0 = 2 * pi/wavelength,
  angle = asin(q),
  q = sin(angle),
  epsilon = list(incident = 1.5^2, 1.33),
  thickness = c(0, 0),
  polarisation = c("p", "s"),
  d = 1,
  dout = d,
  ...
)
```

Arguments

`wavelength`	[vector] wavelength in nm
`k0`	[vector] wavevector in nm^-1
`angle`	[vector] incident angles in radians
`q`	[vector] normalised incident in-plane wavevector
`epsilon`	list of N+2 dielectric functions, each of length 1 or length(wavelength)
`thickness`	vector of N+2 layer thicknesses, first and last are dummy
`polarisation`	[character] switch between p- and s- polarisation
`d`	vector of distances where LFIEF are evaluated from each interface
`dout`	vector of distances where LFIEF are evaluated outside the stack
`...`	unused

Details

solves the EM problem of a multilayered interface

Value

fresnel coefficients and field profiles

Author(s)

baptiste Auguie

References

Principles of surface-enhanced Raman spectroscopy and related plasmonic effects. Eric C. Le Ru and Pablo G. Etchegoin, published by Elsevier, Amsterdam (2009).

`multilayercpp` *multilayercpp*

Description

Multilayer Fresnel coefficients

Usage

```
multilayercpp(
  wavelength = 2 * pi/k0,
  k0 = 2 * pi/wavelength,
  angle = asin(q),
  q = sin(angle),
  epsilon = list(incident = 1.5^2, 1.33),
  thickness = c(0, 0),
  ...
)
```

Arguments

`wavelength`	[vector] wavelength in nm
`k0`	[vector] wavevector in nm^-1
`angle`	[vector] incident angles in radians
`q`	[vector] normalised incident in-plane wavevector
`epsilon`	list of N+2 dielectric functions, each of length 1 or length(wavelength)
`thickness`	vector of N+2 layer thicknesses, first and last are dummy
`...`	unused

Details

solves the EM problem of a multilayered interface

Value

fresnel coefficients and field profiles

Author(s)

baptiste Auguie

Examples

```
library(planar)
demo(package="planar")
```

multilayerfull *multilayerfull*

Description

Multilayer Fresnel coefficients

Usage

```
multilayerfull(
  wavelength = 2 * pi/k0,
  k0 = 2 * pi/wavelength,
  angle = asin(q),
  q = sin(angle),
  epsilon = list(incident = 1.5^2, 1.33),
  thickness = c(0, 0),
  psi = 0,
  z = 0,
  ...
)
```

Arguments

`wavelength`	[vector] wavelength in nm
`k0`	[vector] wavevector in nm^-1
`angle`	[vector] incident angles in radians
`q`	[vector] normalised incident in-plane wavevector
`epsilon`	list of N+2 dielectric functions, each of length 1 or length(wavelength)
`thickness`	vector of N+2 layer thicknesses, first and last are dummy
`psi`	[numeric] polarisation angle
`z`	[vector] positions to calculate the electric field intensity
`...`	unused

Details

solves the EM problem of a multilayered interface

Value

fresnel coefficients and field profiles

Author(s)

baptiste Auguie

palette_dbr *Colour palettes for multilayer stacks*

Description

Custom palettes for DBR stacks

Custom palette for Tamm stacks

Alternative palette for Tamm stacks

Format

Colour palette (vectors of colours)

Colour palette (vectors of colours)

Colour palette (vectors of colours)

Source

See RColorBrewer package

raman_shift *sort_factor*

Description

raman_shift

Usage

```
raman_shift(laser = c(514, 632.8), shift = c(520, 610))
```

Arguments

`laser`	vector of laser wavelengths in nm
`shift`	vector of Raman shifts in cm-1

Details

converts Raman shift to wavelength

Value

matrix of shifted wavelengths (all combinations)

Author(s)

Baptiste Auguie

recursive_fresnel *recursive_fresnel*

Description

Multilayer Fresnel coefficients

Usage

```
recursive_fresnel(
  wavelength = 2 * pi/k0,
  k0 = 2 * pi/wavelength,
  angle = NULL,
  q = sin(angle),
  epsilon = list(incident = 1.5^2, 1.33^2),
  thickness = c(0, 0),
  polarisation = c("p", "s")
)
```

Arguments

wavelength	[vector] wavelength in nm
k0	[vector] wavevector in nm^-1
angle	[vector] incident angles in radians
q	[vector] normalised incident in-plane wavevector
epsilon	list of N+2 dielectric functions, each of length 1 or length(wavelength)
thickness	vector of N+2 layer thicknesses, first and last are dummy
polarisation	[character] switch between p- and s- polarisation

Details

computes the reflection coefficient of a multilayered interface

Value

fresnel coefficients and field profiles

Author(s)

baptiste Auguie

recursive_fresnelcpp *recursive_fresnelcpp*

Description

Multilayer Fresnel coefficients

Usage

```
recursive_fresnelcpp(
  wavelength = 2 * pi/k0,
  k0 = 2 * pi/wavelength,
  angle = NULL,
  q = sin(angle),
  epsilon = list(incident = 1.5^2, 1.33^2),
  thickness = c(0, 0),
  polarisation = c("p", "s")
)
```

Arguments

wavelength	[vector] wavelength in nm
k0	[vector] wavevector in nm^-1
angle	[vector] incident angles in radians
q	[vector] normalised incident in-plane wavevector
epsilon	list of N+2 dielectric functions, each of length 1 or length(wavelength)
thickness	vector of N+2 layer thicknesses, first and last are dummy
polarisation	[character] switch between p- and s- polarisation

Details

computes the reflection coefficient of a multilayered interface

Value

fresnel coefficients and field profiles

Author(s)

baptiste Auguie

rev.stack *rev.stack*

Description

invert the description of a multilayer to simulate the opposite direction of incidence

Usage

```
## S3 method for class 'stack'
rev(x)
```

Arguments

x	stack

Details

inverts list of epsilon and thickness of layers

Value

stack

Author(s)

Baptiste Auguie

See Also

Other helping_functions user_level stack: simulate_ff(), simulate_nf()

simulate_ff *simulate_ff*

Description

simultate the far-field response of a multilayer stack

Usage

```
simulate_ff(
  ...,
  s = NULL,
  fun = tamm_stack,
  wavelength = seq(400, 1000),
  angle = 0,
  polarisation = c("p", "s")
)
```

Arguments

`...`	further arguments passed to fun
`s`	stack (optional)
`fun`	function returning a stack
`wavelength`	numeric vector
`angle`	incident angle in radians
`polarisation`	p or s

Details

wrapper around recursive_fresnelcpp for a stack structure

Value

data.frame

Author(s)

Baptiste Auguie

See Also

Other helping_functions user_level stack: `rev.stack()`, `simulate_nf()`

`simulate_nf` *simulate_nf*

Description

simultate the internal field of a multilayer stack

Usage

```
simulate_nf(
  ...,
  s = NULL,
  fun = tamm_stack,
  wavelength = 630,
  angle = 0,
  polarisation = c("p", "s"),
  dmax = 0,
  res = 10000,
  field = FALSE
)
```

Arguments

`...`	further arguments passed to fun
`s`	stack (optional)
`fun`	function returning a stack
`wavelength`	numeric vector
`angle`	incident angle in radians
`polarisation`	p or s
`dmax`	maximum distance from stack boundary
`res`	number of points
`field`	logical, return the real electric field

Details

wrapper around multilayer_field for a stack structure

Value

data.frame

Author(s)

Baptiste Auguie

See Also

Other helping_functions user_level stack: `rev.stack()`, `simulate_ff()`

`tamm_stack` *tamm_stack*

Description

DBR-metal stack structure

Usage

```
tamm_stack(
  lambda0 = 630,
  n1 = 1.28,
  n2 = 1.72,
  d1 = lambda0/4/n1,
  d2 = lambda0/4/n2,
  N = 2 * pairs,
  pairs = 4,
  dx1 = 0,
  dx2 = 0,
  dm = 50,
  metal = "epsAu",
  position = c("after", "before"),
  incidence = c("left", "right"),
  nleft = 1.5,
  nright = 1,
  dleft = 200,
  dright = 200,
  ...
)
```

Arguments

`lambda0`	central wavelength of the stopband
`n1`	real refractive index for odd layers
`n2`	real refractive index for even layers
`d1`	odd layer thickness in nm
`d2`	even layer thickness in nm
`N`	number of layers, overwrites pairs
`pairs`	number of pairs
`dx1`	variation of last odd layer thickness in nm
`dx2`	variation of last even layer thickness in nm
`dm`	thickness of metal layer
`metal`	character name of dielectric function
`position`	metal position relative to DBR
`incidence`	direction of incidence
`nleft`	refractive index of entering medium
`nright`	refractive index of outer medium
`dleft`	distance from the left side for visualisation
`dright`	distance from the right side for visualisation
`...`	ignored

Details

periodic structure of dielectric layers against metal film

Value

list of class 'stack'

Author(s)

baptiste Auguie

See Also

Other stack user_level: `dbr_stack()`, `embed_stack()`, `layer_stack()`, `tamm_stack_ir()`, `tamm_stack_porous()`

`tamm_stack_ir` *tamm_stack_ir*

Description

DBR-metal stack structure

Usage

```
tamm_stack_ir(
  lambda0 = 950,
  n1 = 3,
  n2 = 3.7,
  d1 = lambda0/4/n1,
  d2 = lambda0/4/n2,
  N = 2 * pairs,
  pairs = 4,
  dx1 = 0,
  dx2 = 0,
  dm = 50,
  metal = "epsAu",
  position = "after",
  incidence = "left",
  nleft = n2,
  nright = 1,
  ...
)
```

Arguments

`lambda0`	central wavelength of the stopband
`n1`	real refractive index for odd layers
`n2`	real refractive index for even layers
`d1`	odd layer thickness in nm
`d2`	even layer thickness in nm
`N`	number of layers, overwrites pairs
`pairs`	number of pairs
`dx1`	variation of last odd layer thickness in nm
`dx2`	variation of last even layer thickness in nm
`dm`	thickness of metal layer
`metal`	character name of dielectric function

`position`	metal position relative to DBR
`incidence`	direction of incidence
`nleft`	refractive index of entering medium
`nright`	refractive index of outer medium
`...`	ignored

Details

periodic structure of dielectric layers against metal film

Value

list of class 'stack'

Author(s)

baptiste Auguie

See Also

Other stack user_level: `dbr_stack()`, `embed_stack()`, `layer_stack()`, `tamm_stack_porous()`, `tamm_stack()`

`tamm_stack_porous` *tamm_stack_porous*

Description

DBR-metal stack structure

Usage

```
tamm_stack_porous(
  lambda0 = 600,
  n1 = 1.72,
  n2 = 1.28,
  d1 = lambda0/4/n1,
  d2 = lambda0/4/n2,
  N = 2 * pairs,
  pairs = 4,
  dx1 = 0,
  dx2 = 0,
  dm = 20,
  metal = "epsAu",
  position = "before",
  incidence = "right",
  nleft = 1.5,
  nright = 1,
  ...
)
```

Arguments

`lambda0`	central wavelength of the stopband
`n1`	real refractive index for odd layers
`n2`	real refractive index for even layers
`d1`	odd layer thickness in nm
`d2`	even layer thickness in nm
`N`	number of layers, overwrites pairs
`pairs`	number of pairs
`dx1`	variation of last odd layer thickness in nm
`dx2`	variation of last even layer thickness in nm
`dm`	thickness of metal layer
`metal`	character name of dielectric function
`position`	metal position relative to DBR
`incidence`	direction of incidence
`nleft`	refractive index of entering medium
`nright`	refractive index of outer medium
`...`	ignored

Details

periodic structure of dielectric layers against metal film

Value

list of class ’stack’

Author(s)

baptiste Auguie

See Also

Other stack user_level: `dbr_stack()`, `embed_stack()`, `layer_stack()`, `tamm_stack_ir()`, `tamm_stack()`

`transmission` *transmission*

Description

transmission loss through a prism

Usage

```
transmission(n, external, polarisation = "p")
```

Arguments

`n`	prism refractive index
`external`	external incident angle in radians
`polarisation`	polarisation

Details

transmission loss through a prism

Value

transmission

Author(s)

baptiste Auguie

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