

#### **Stratified Media Component**

#### Abstract



The Stratified Media component is intended for the functional description as well as the rigorous and fast analysis of a sequence of plane layers of homogeneous (isotropic or anisotropic) media. Such configurations are of particular interest in e.g. coating applications. In this use case we show how such structures can be defined in VirtualLab Fusion and provide an indepth look into its features.

#### Where to Find the Component?



The *Stratified Media* component can be found under *Components* > *Single Surface & Coating.* 

#### **Configuration of the Structure**





Stratified Media Component

The Stratified Media Component in VirtualLab Fusion is defined as an ideal plane surface separating two homogeneous isotropic media, on which an x, y-invariant layered structure can be applied in the form of a coating stack.

## **Configuration of the Structure**

The user can configure their own stratified medium. Here a coating of a polarizing beamsplitter is presented.

Coordinate Systems	Componer Reference Plane Surf	nt Size : Surface (all Ch ace	annels)	20 mm ×	20 mm	
1	🕞 Load			/ Edit		<b>W</b> View
Position / Orientation	Aperture	⊖ Ye	15 <b>O</b> N	o		
	Definition '	Type O St	ructural Definit ontains Anisotr	ion O Functiona	al Equivalent	
Structure		🔽 La	yer Index Incre	ases With Positive z-E	Direction i	
	Index	Thickness	Distance		Material	
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V						
	2	56.725 nm	227.53 nm	Ta2O5	7	
Solver	2	56.725 nm 104.3 nm	227.53 nm 331.83 nm	Ta2O5 SiO2(1)	7	
Solver	2 3 4	56.725 nm 104.3 nm 42.96 nm	227.53 nm 331.83 nm 374.79 nm	Ta2O5 SiO2(1) Ta2O5	7	
Solver	2 3 4 5	56.725 nm 104.3 nm 42.96 nm 109.93 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1)		
Solver	2 3 4 5 6	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5		
Solver	2 3 4 5 6 7	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm 169.11 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm 725.21 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) SiO2(1)		
Solver	2 3 4 5 6 7 8	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm 169.11 nm 73.208 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm 725.21 nm 798.41 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5		
Solver	2 3 4 5 6 7 8 9	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm 169.11 nm 73.208 nm 127.12 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm 725.21 nm 798.41 nm 925.53 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) SiO2(1)		
Solver Solver Channel configuration $\mathcal{F} \mathcal{F}^{-1}$	2 3 4 5 6 7 8 9 10	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm 169.11 nm 73.208 nm 127.12 nm 47.124 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm 725.21 nm 798.41 nm 925.53 nm 972.66 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5		
Solver Solver Channel configuration $\mathcal{F} \mathcal{F}^{-1}$	2 3 4 5 6 7 8 9 10	56.725 nm 104.3 nm 42.96 nm 109.93 nm 71.372 nm 169.11 nm 73.208 nm 127.12 nm 47.124 nm	227.53 nm 331.83 nm 374.79 nm 484.73 nm 556.1 nm 725.21 nm 798.41 nm 925.53 nm 972.66 nm	Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5 SiO2(1) Ta2O5		

The user can set the material and thickness of each individual layer here.



### **Orientation of the Layer Sequence**



# **Coating Import**

The user can also employ our in-built off-the-shelf coatings from the catalog.



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Stack01\_632.8nm

(Category: Standard-HR)

Diagram Coefficients Calculator

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Coatings Catalog - Filter: [Structural Coatings]

Definition Type LightTrans Defined

Filter by...

### **Layer Matrix Solver**

The Stratified Media Component uses the layer matrix electromagnetic field solver. This solver works in the spatial frequency domain (**k domain**). It consists of

- 1. an eigenmode solver for each homogeneous layer and
- 2. an S-matrix for matching the boundary conditions at all the interfaces.

The eigenmode solver computes the field solution in the k-domain for the homogeneous medium in each layer. The S-matrix algorithm calculates the response of the whole layer system by matching the boundary conditions in a recursive manner. This is a method well-known for its unconditional numerical stability since, unlike the traditional transfer matrix, it avoids the exponentially growing functions in the calculation steps.



## **Configuration of the Functional Coating**





Stratified Media Component

> The Stratified Media Component also enables the functional description of a coating. In this way the desired response of the coating is applied to the input field, without taking the actual physical structure of the coating into account.

# **Configuration of the Functional Coating**

The desired transmittance and reflectance of the incident light can be directly defined. Here a functional coating of a polarizing beamsplitter is presented.









We integrated the coatings of the aforementioned polarizing beamsplitter into optical setups to calculate their transmittance. We can observe that the real coating does not perfectly split the input beam into its s- and ppolarized components, whereas the functional coating represents an idealized scenario.

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further reading	<ul> <li>Effects of Mirror Coating on Pulse Characteristics</li> <li>Absorption in a CIGS Solar Cell</li> </ul>			