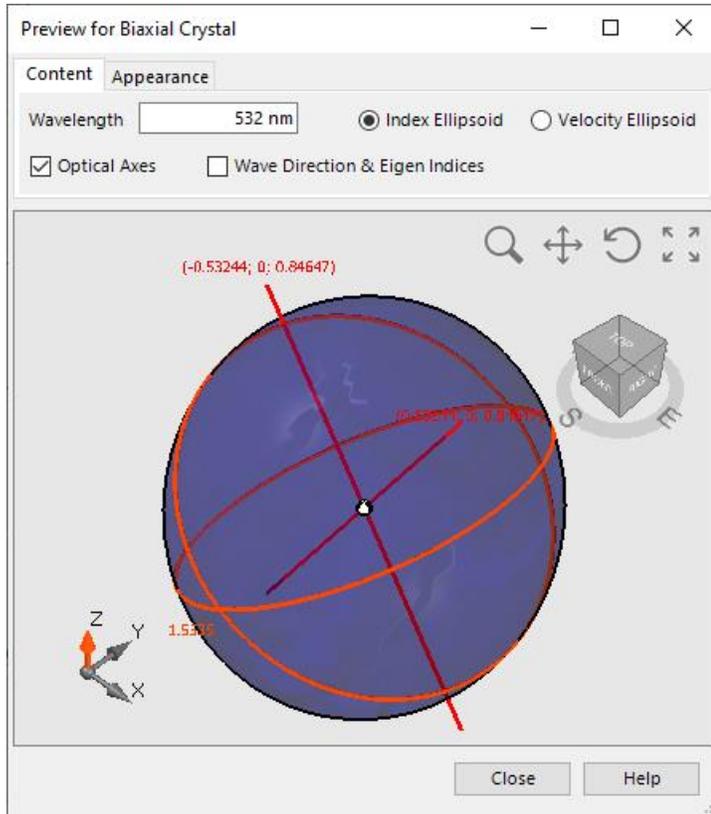


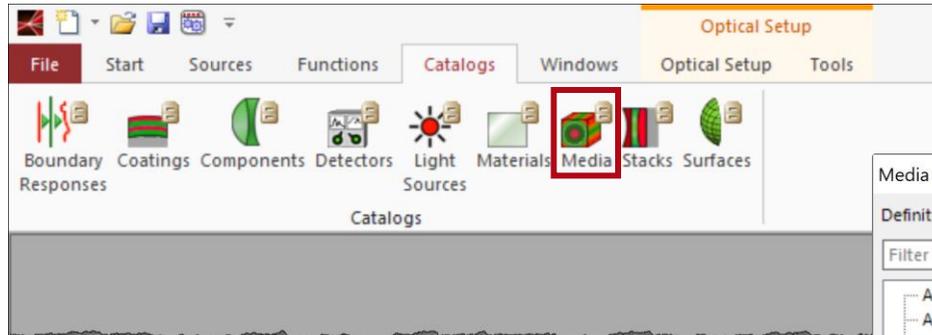
Optically Anisotropic Media in VirtualLab Fusion

Abstract



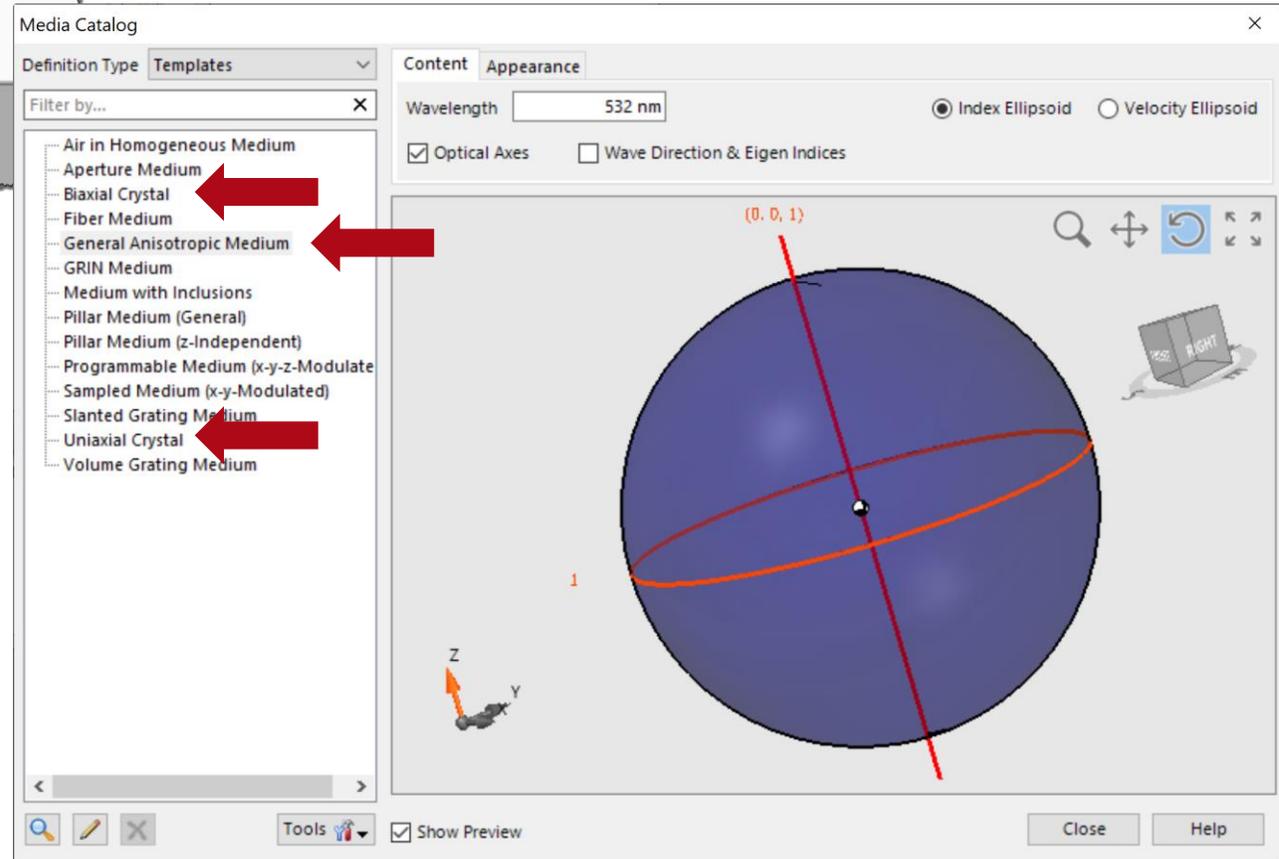
Optical anisotropy, also known as birefringence, is the reason for various optical phenomena and the related applications. VirtualLab Fusion provides a fast and rigorous field tracing analysis algorithm which applies an S-matrix solver and works in the k-domain. In this use case, the basic configuration of an anisotropic medium is introduced.

Anisotropic Media in Catalog

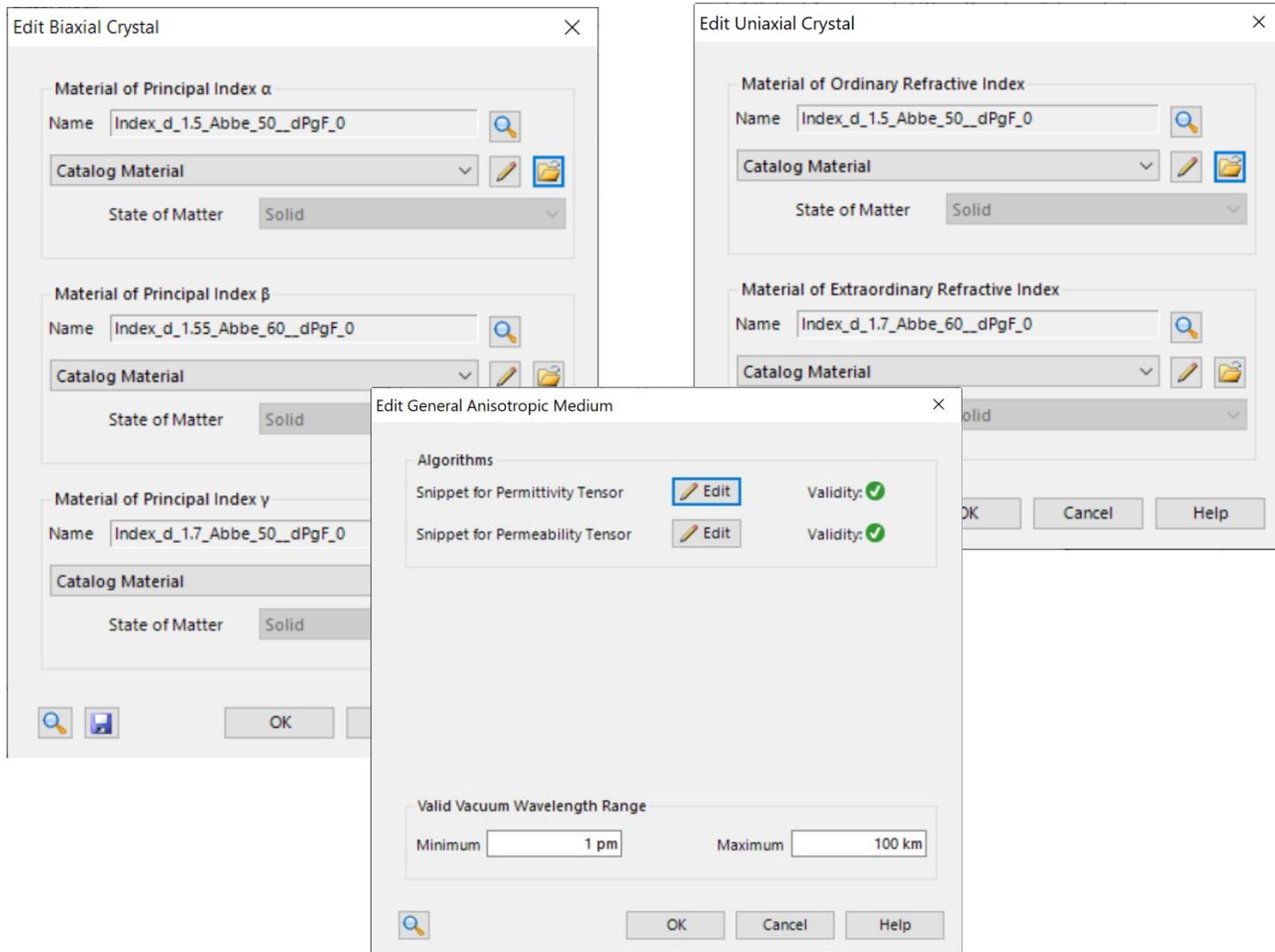


In the new version three different kind of anisotropic media can be found in the media catalog:

- Uniaxial Crystal
- Biaxial Crystal
- General Anisotropic Media



Defining the Anisotropic Media



- The Biaxial Crystal is defined by the principal indices of three directions
- The Uniaxial Crystal is defined by the ordinary and extraordinary refractive indices
- General Anisotropic Media can be set up by directly defining the permittivity tensor

Preview of the Anisotropic Medium

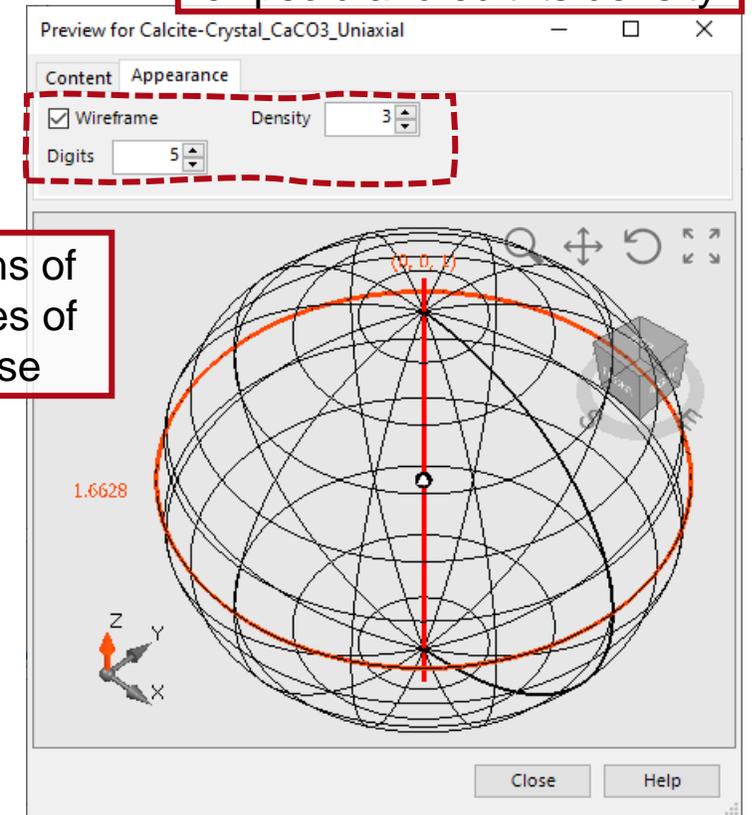
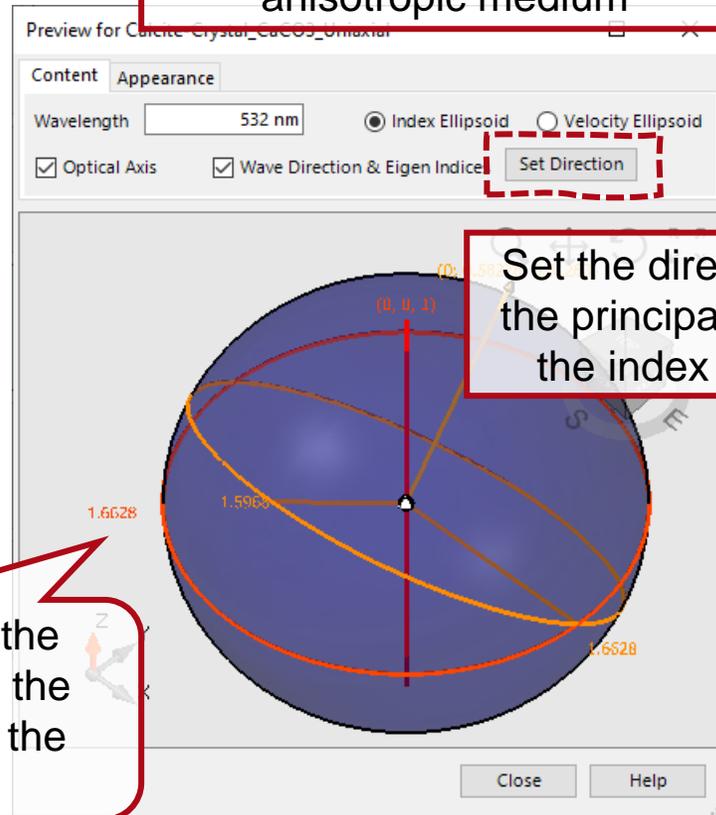
The preview of an anisotropic medium can be displayed through index ellipsoid or velocity ellipsoid, which makes it easy and intuitive to study the properties of the media.

In the Content tab, the user can select between the index/velocity ellipsoid of the anisotropic medium

In the Appearance tab, the user can show the wireframe of the selected ellipsoid and edit its density

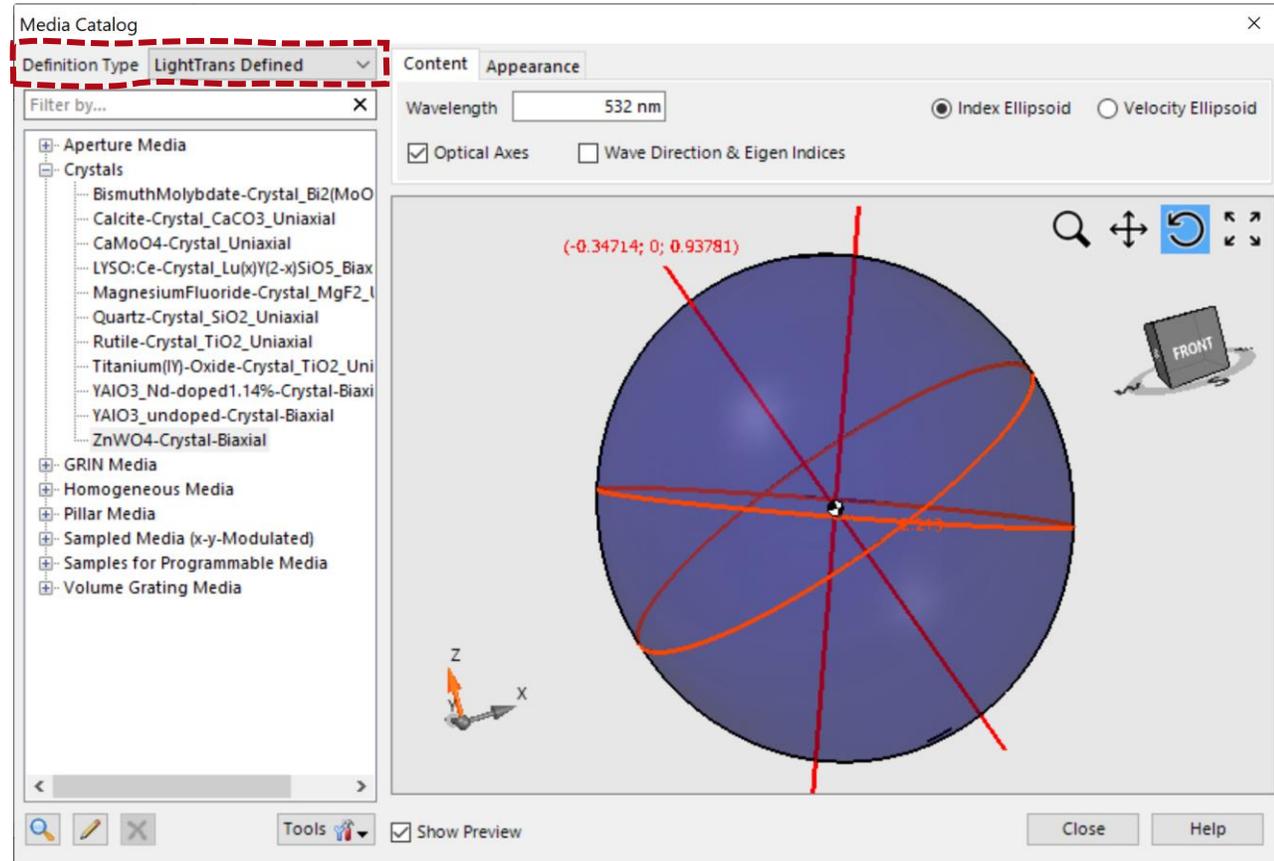
Set the directions of the principal axes of the index ellipse

The half-lengths of the principal axes equal the refractive indices of the normal modes



Preconfigured Crystals

VirtualLab Fusion comes with a series of pre-configured crystal media which can be accessed from the media catalog. The user also can import & export his own defined media to the catalog.



Anisotropic Coatings

Anisotropic coatings can be found in the coating catalog and applied to all optical surfaces in VirtualLab Fusion.

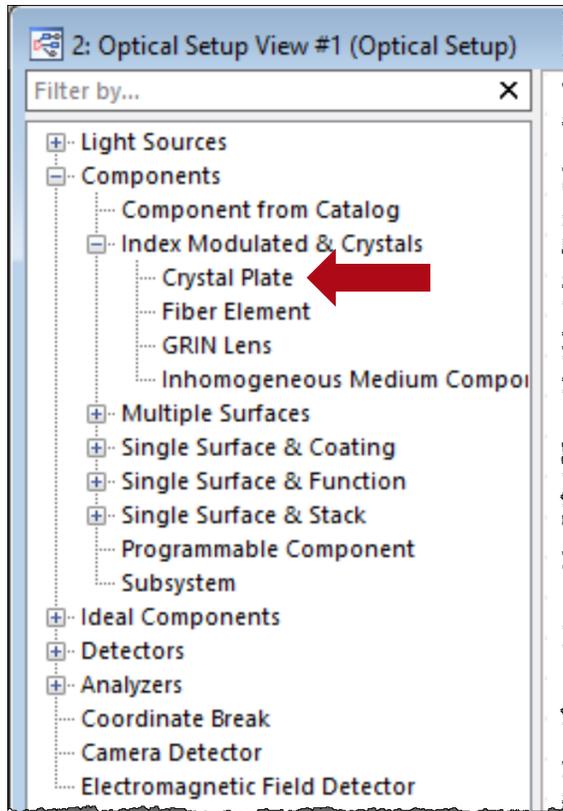
The image shows the 'Coatings Catalog' window with 'Anisotropic Layer Stack' selected. A graph plots Reflectance [%] against Wavelength [nm] from 0.4 to 1.4. The 'Define Stack of Anisotropic Layers' dialog is open, showing a cross-section of a substrate and coating layers. A table below lists the layers:

Index	Thickness	Distance	Medium	Orientation
1	0 mm	0 mm	Biaxial Crystal	$([\varphi=0^\circ; \theta=0^\circ]; \zeta=0^\circ)$
2	0 mm	0 mm	Air in Homogeneous	N/A

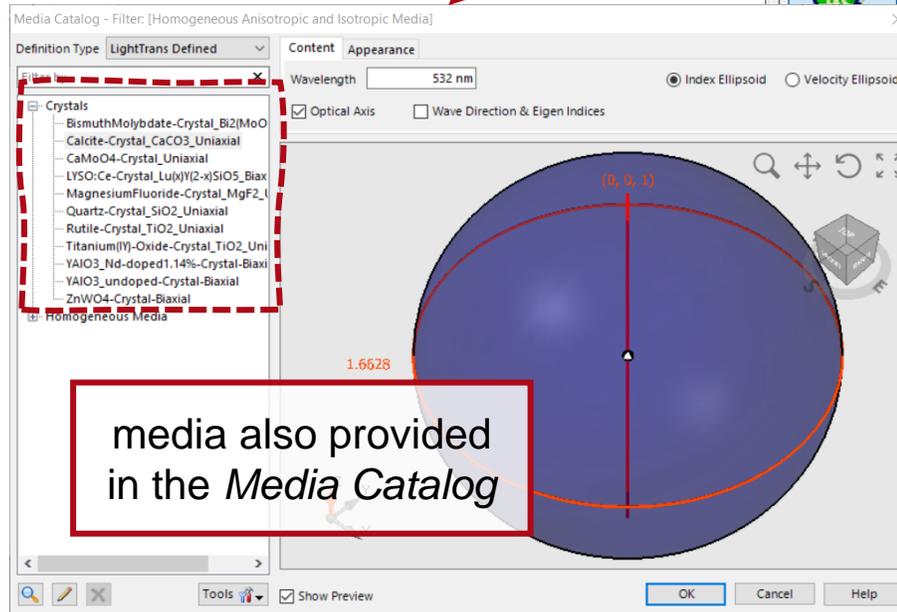
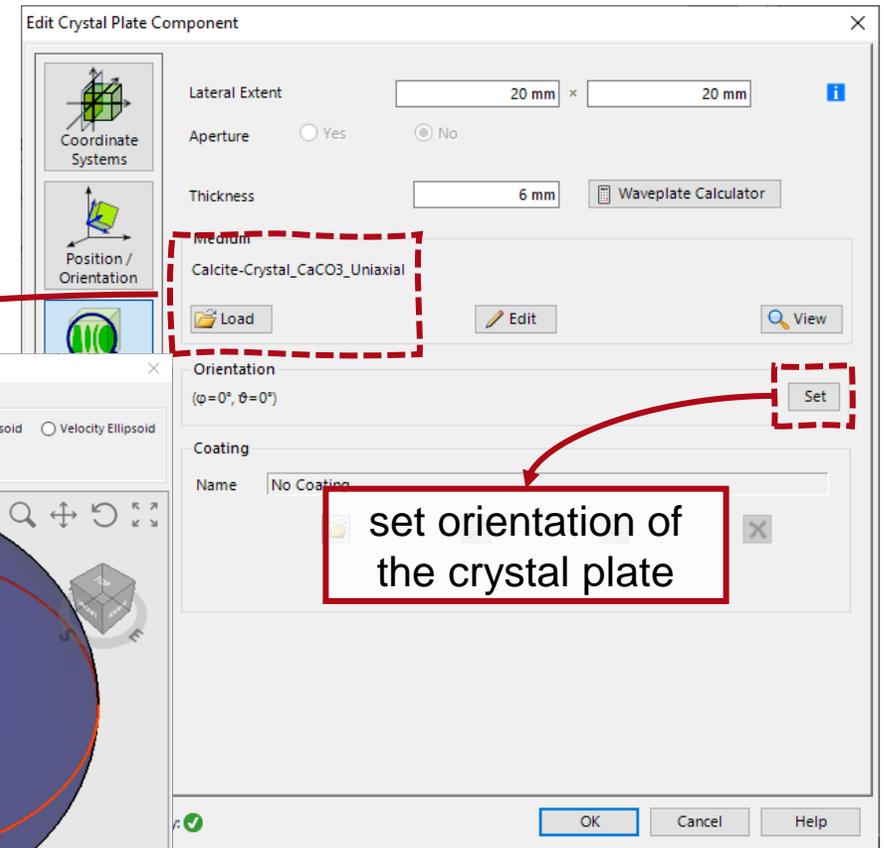
A text box at the bottom left states: "A coating can alternate layers of isotropic or anisotropic homogeneous media".

The image shows the 'Media Catalog' window with a filter for 'Homogeneous Anisotropic and Isotropic Media'. A list of media is shown, with 'Biaxial Crystal' highlighted. A 3D visualization of a biaxial crystal is shown on the right, with axes labeled (x, y, z) and (ξ, η, ζ) . A text box at the bottom right states: "choose from the predefined anisotropic media, a previously defined media from the catalog or use a template medium and customize the parameters; the preview of the medium is shown on the right".

Anisotropic Crystal Plate



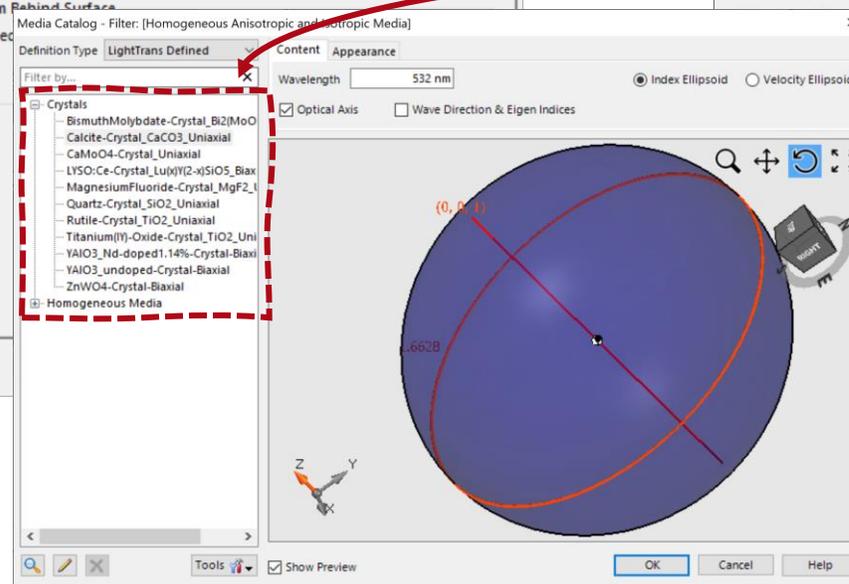
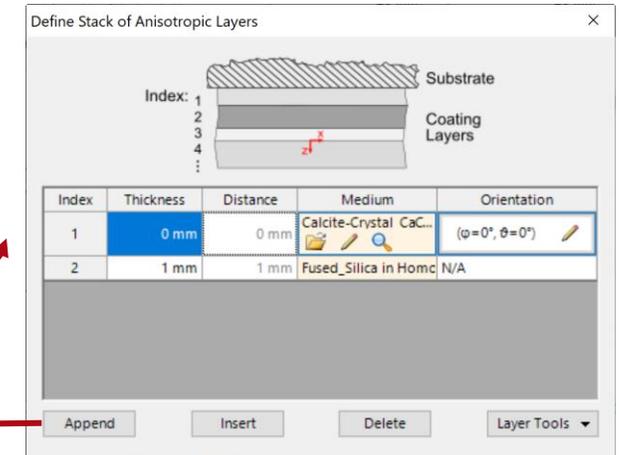
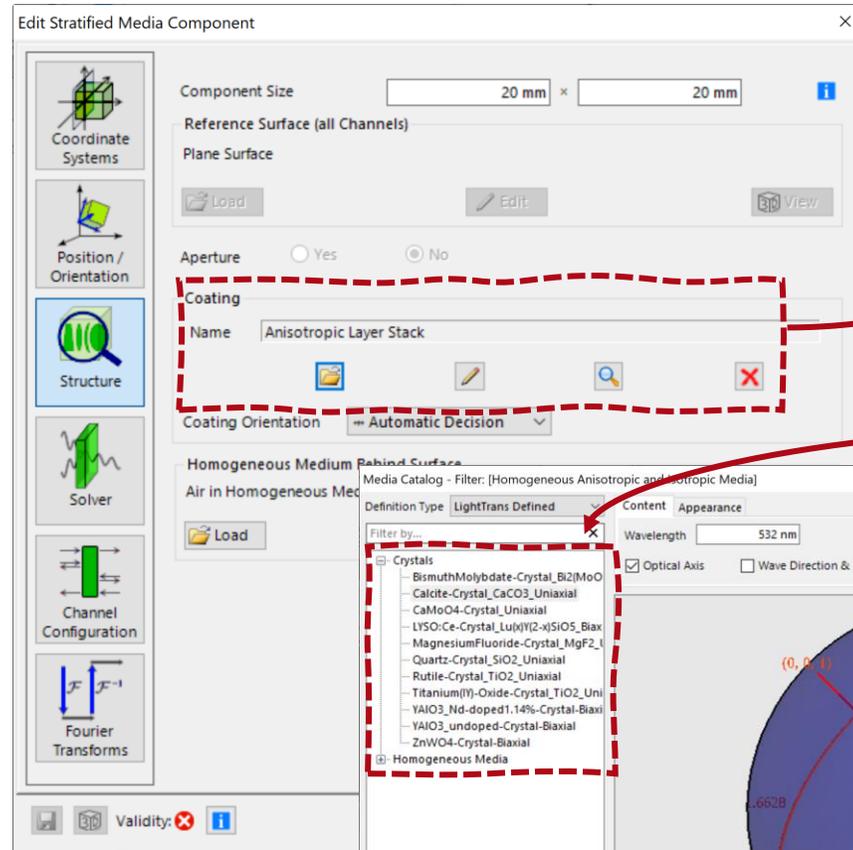
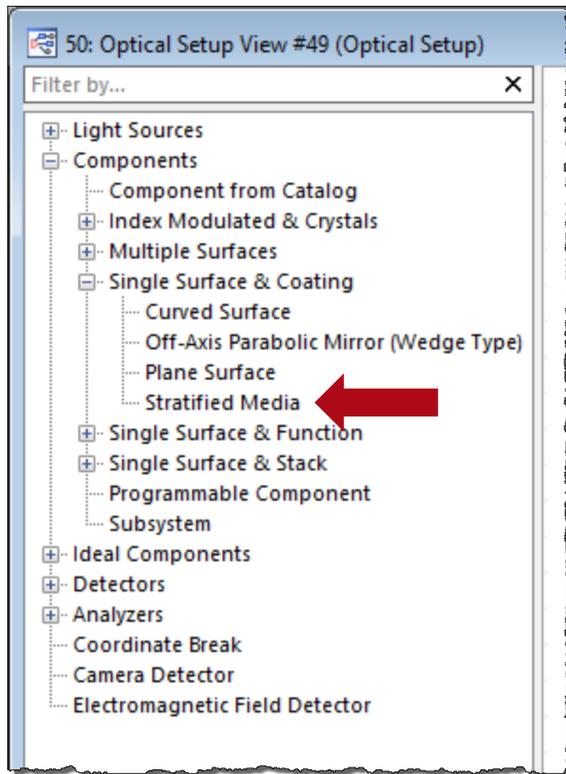
The *Crystal Plate* component can be found in *Components* → *Index Modulated & Crystals* → *Crystal Plate*



media also provided in the *Media Catalog*

set orientation of the crystal plate

Anisotropic Stratified Media Component



Anisotropic and isotropic layers can be defined in the same component

The *Stratified Media* component can be found in *Components* → *Single Surface&Coating* → *Stratified Media*

Anisotropic Surfaces

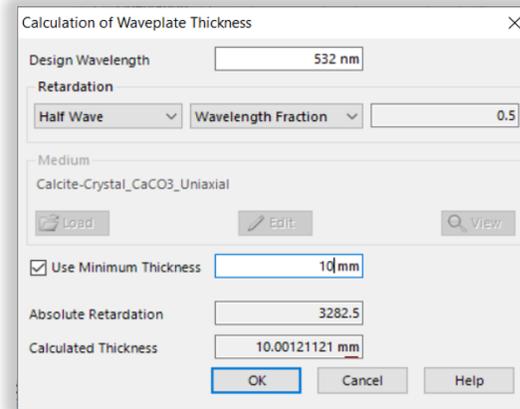
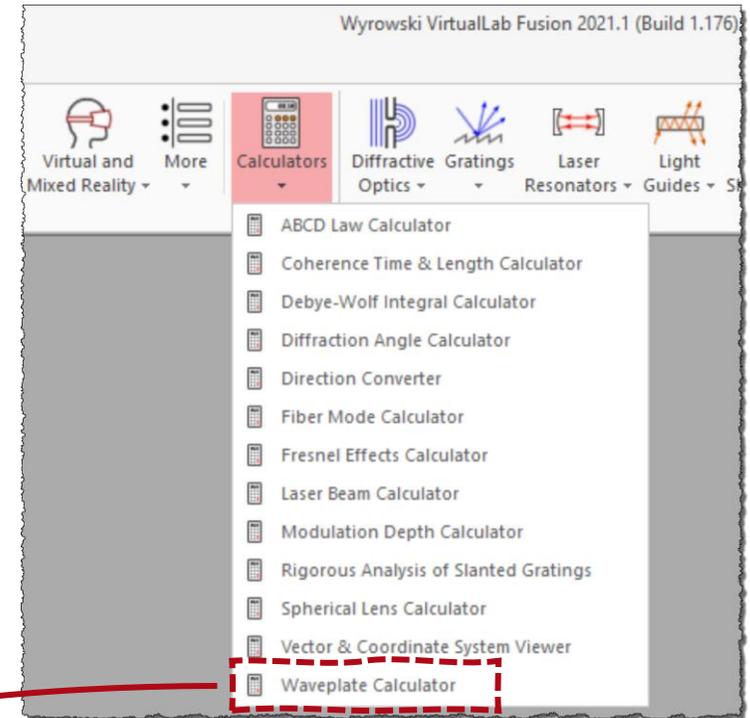
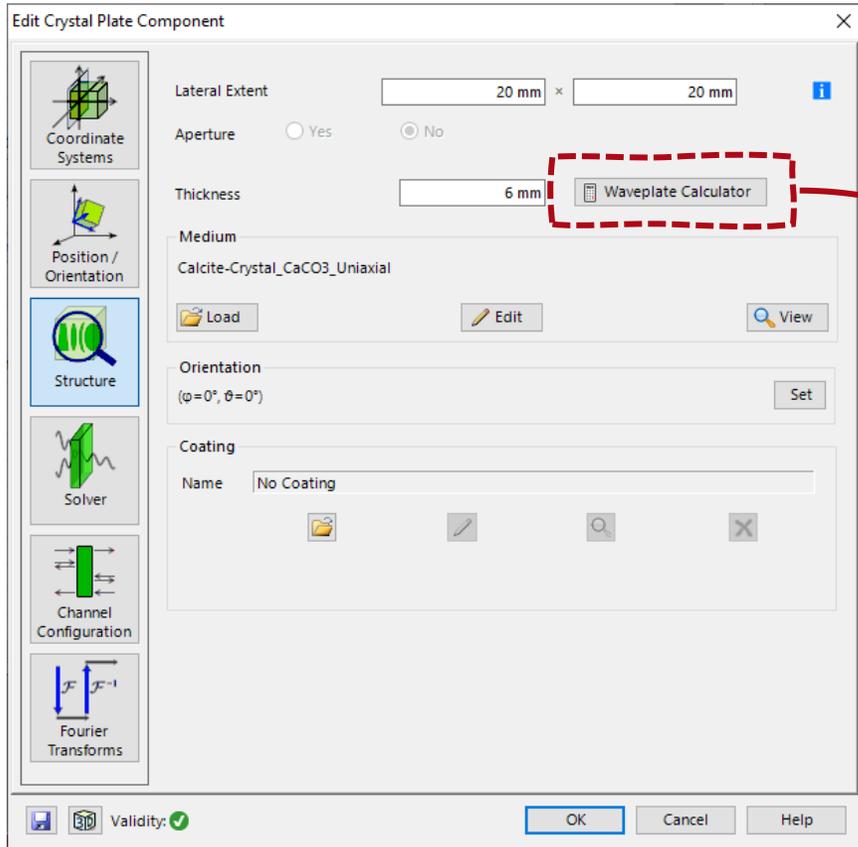
The image displays a sequence of three software windows illustrating the process of attaching an anisotropic coating to a surface:

- Left Window:** A component library titled "2: Optical Setup View #1 (Optical Setup)*". The "Single Surface & Coating" category is expanded, with red arrows pointing to "Curved Surface", "Off-Axis Parabolic Mirror (Wedge Type)", and "Plane Surface".
- Middle Window:** "Edit Curved Surface Component". The "Surface Specification" section shows "Conical Surface" selected. The "Edit" button is highlighted with a red dashed box. A red arrow points from this button to the next window.
- Right Window:** "Edit Conical Surface". The "Coating" tab is active. The "Name" field contains "Anisotropic Layer Stack", which is also highlighted with a red dashed box. A red arrow points from this field to the "Coatings Catalog" below. The catalog shows "Anisotropic Layer Stack" and "Standard Coating" as available options. A graph on the right shows a curve for "Anisotropic Layer Stack" with a y-axis labeled "ance [%]" and a value of 4.

The anisotropic coatings can also be attached to the surfaces.

Waveplate Calculator

The *Crystal Plate Component* as well as the *Calculator* Section of the Main Window allows access to the *Waveplate Calculator* which can be used to determine the thickness and retardation of a waveplate with given characteristics.



Document Information

title	Optically Anisotropic Media in VirtualLab Fusion
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edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.176)
category	Feature Use Case
further reading	<ul style="list-style-type: none">- <u>Conical Refraction in Biaxial Crystals</u>- <u>Polarization Conversion in Calcite Crystal</u>- <u>Multilayer Birefringent Reflective Polarizer</u>