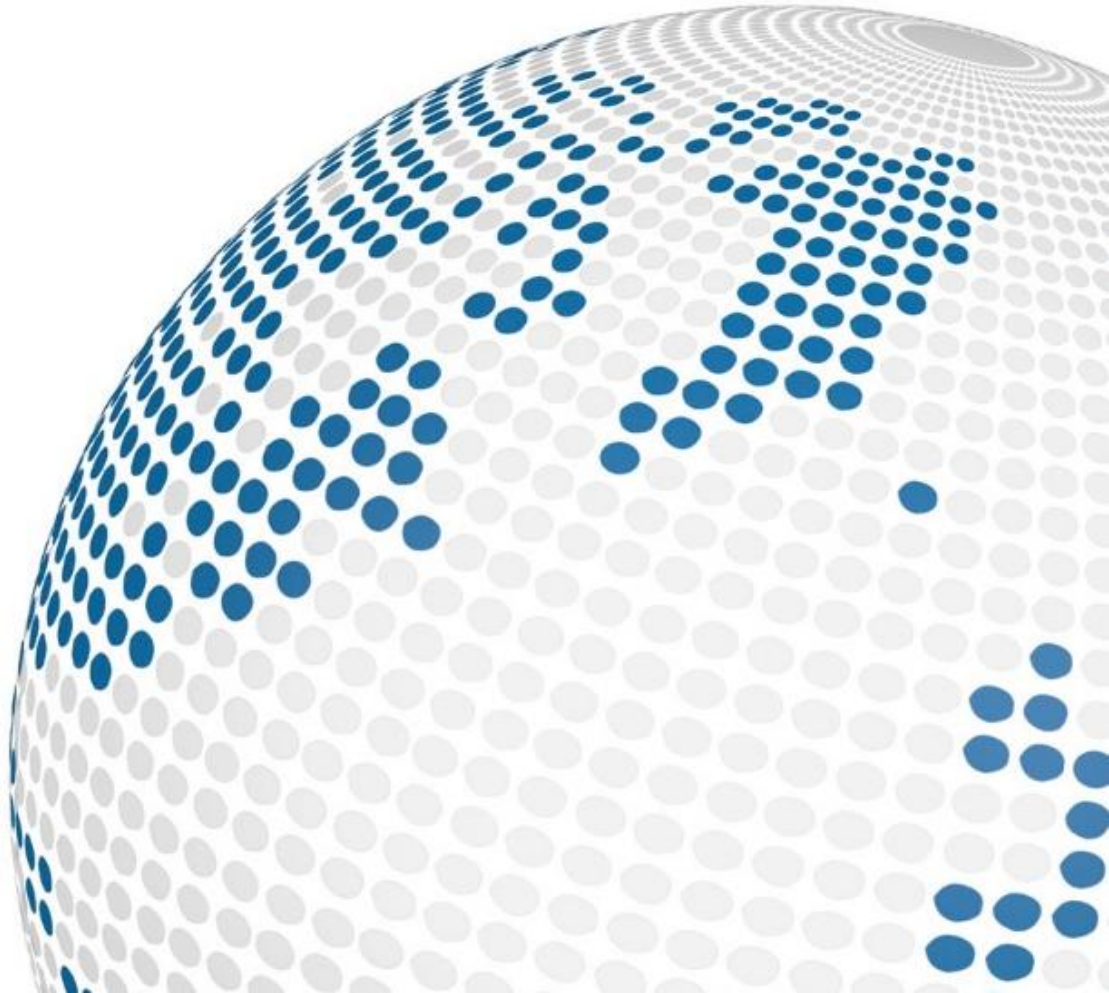
Shaping the Light - Precision Optical Sensors for Mobility

Bühler Networking Days 2019 –
The Future of Mobility – Customers' Perspective



Rainer Minixhofer, ams AG

Aug 27th, 2019

Outline

Shaping the Light – How and Why

Optical filter working principle

High performance Interference filter applications

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Optical filter working principle

High performance Interference filter applications

Example for light shaping from Photography

UV (Haze) Filters

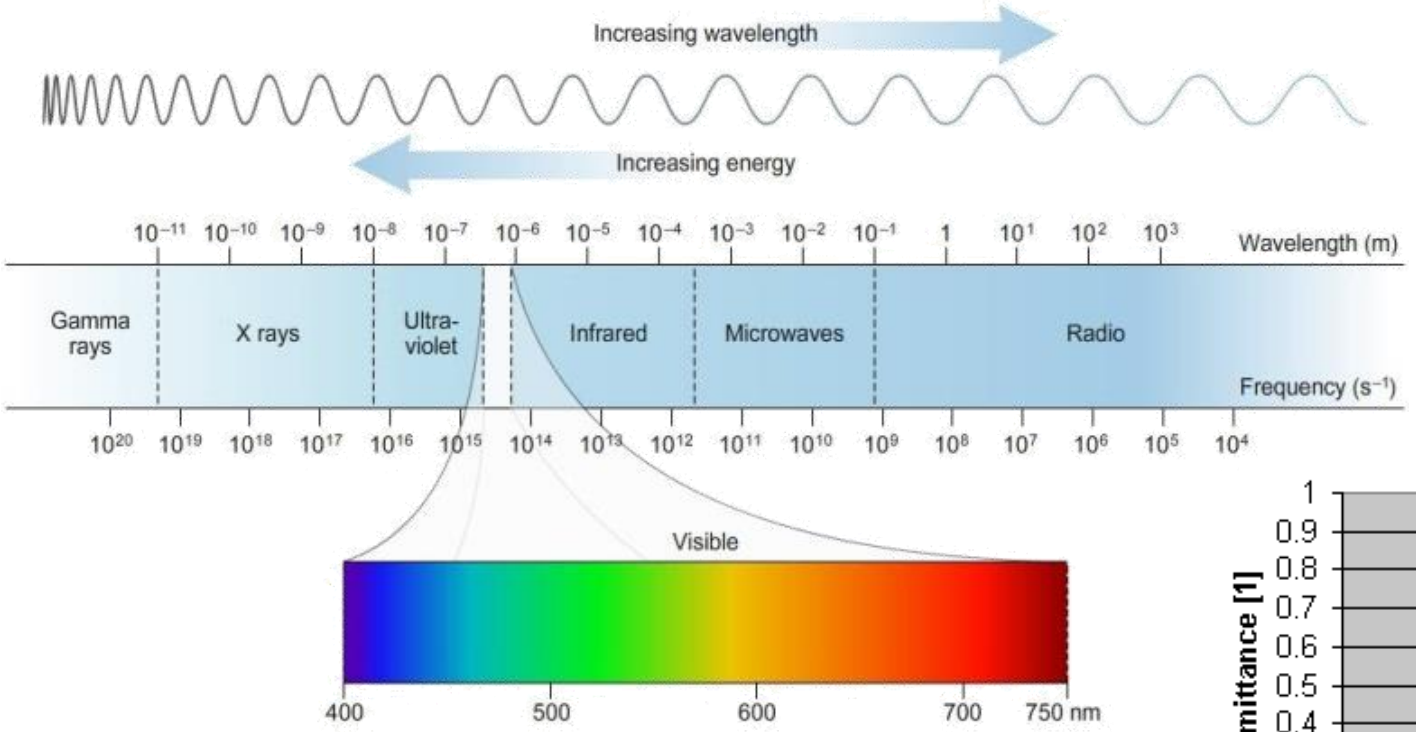
Example for light shaping from Photography

UV (Haze) Filters

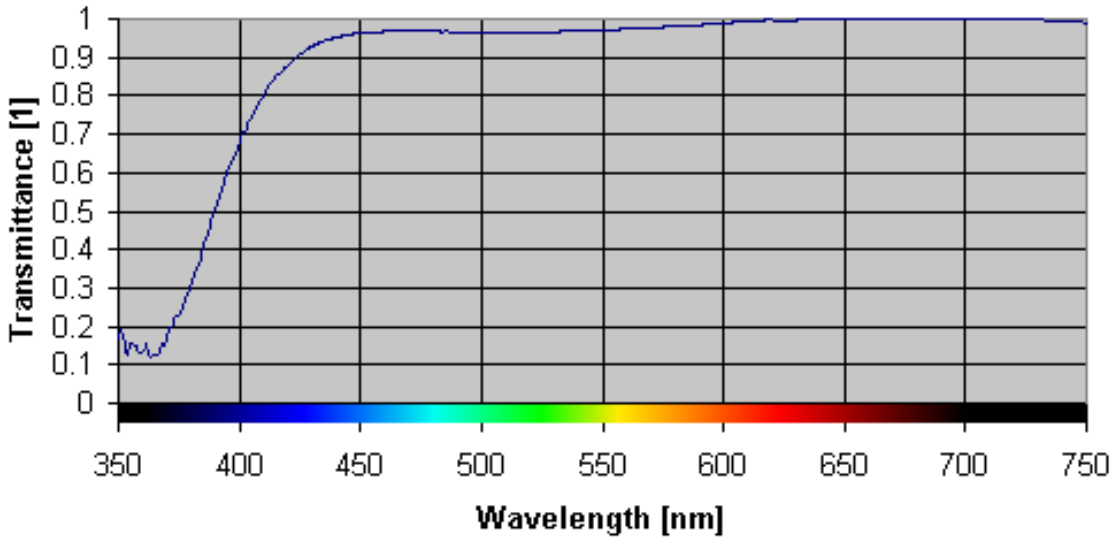
Filter on front side of DSLR-Camera Lens

What happens?

Light is a continuum of electromagnetic waves – A Filter shapes this light

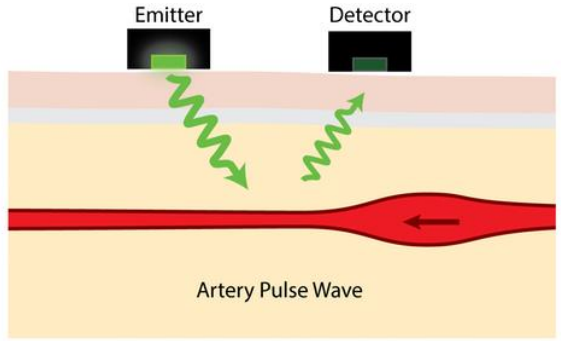


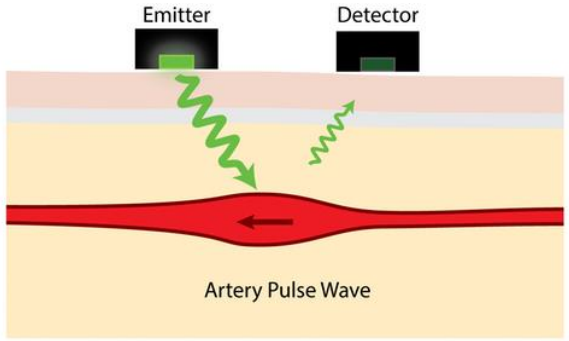
UV filter

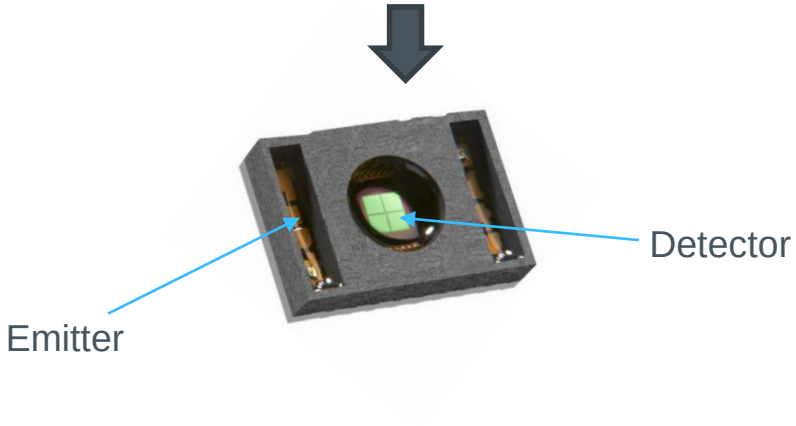


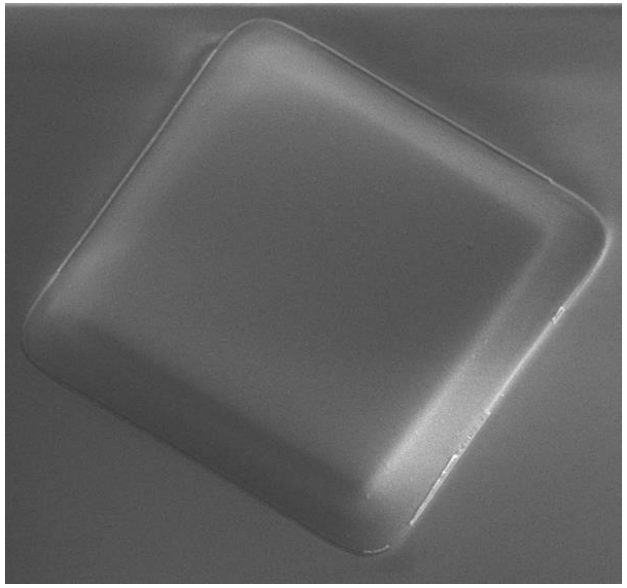
Key component in optical sensors

From product example (Biosensor) to optical filter component









Outline

Shaping the Light – How and Why

Optical filter working principle

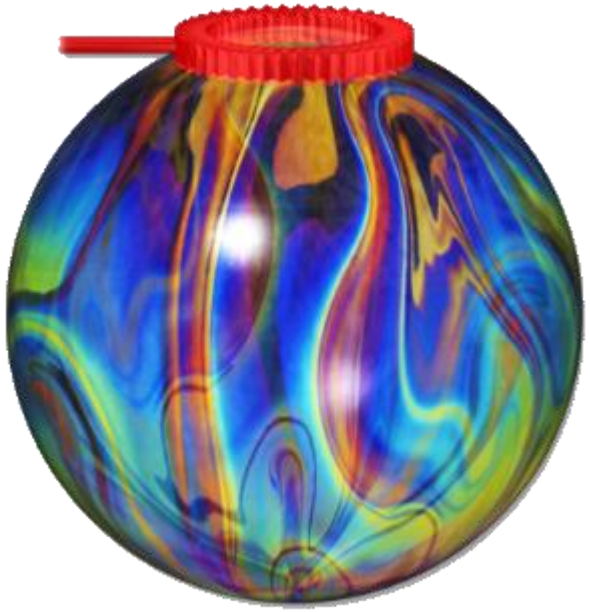
High performance Interference filter applications

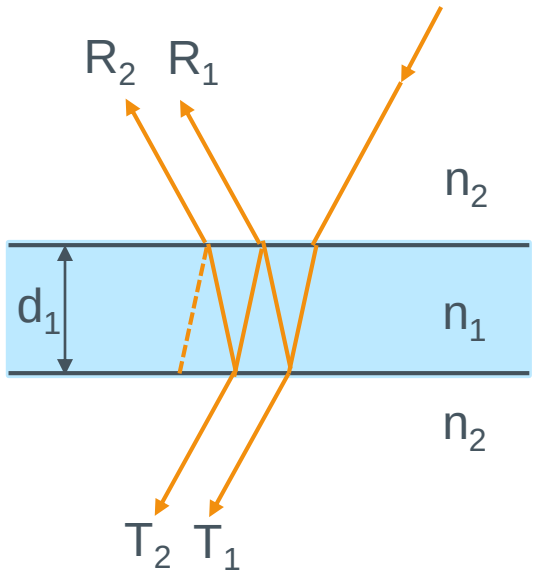
Filter Principles

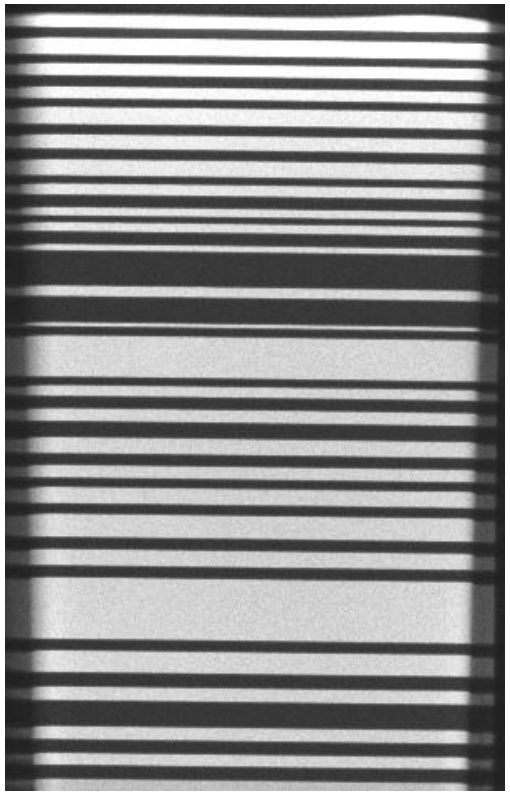
Organic Coating:
One (organic/ceramic) layer with pigments
Simple but limited tunability/performance

Interference Filter:
Many transparent layers of different refractive index
Complex but high tunability/performance

Interference filters – *how do they work?*







- Generally interference filters are stacks of two different materials, both highly transparent but different in their refractive index. This materials are called low index resp. high index material.

Shaping light with an interference filter

TS

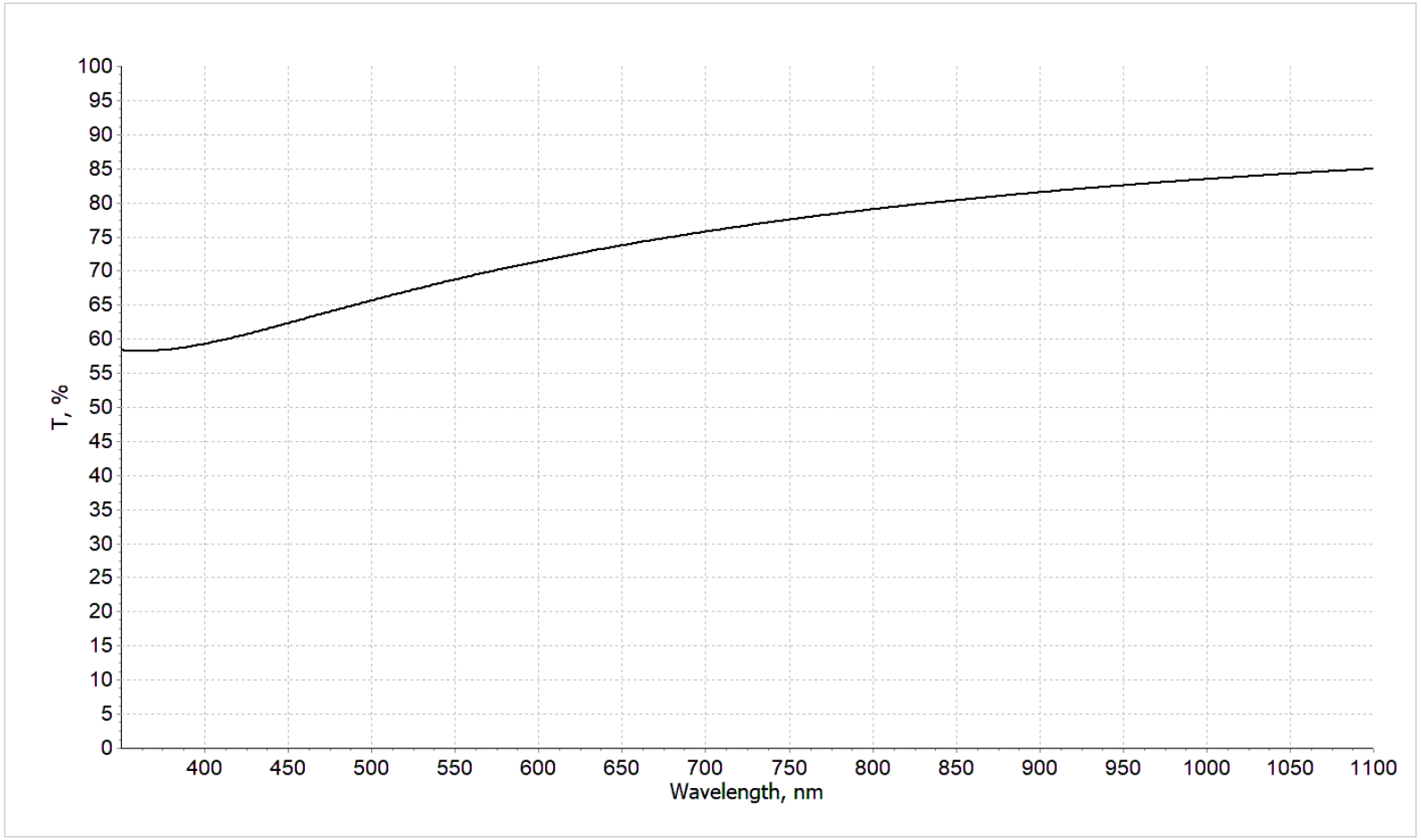
Incident angle: 0.0000

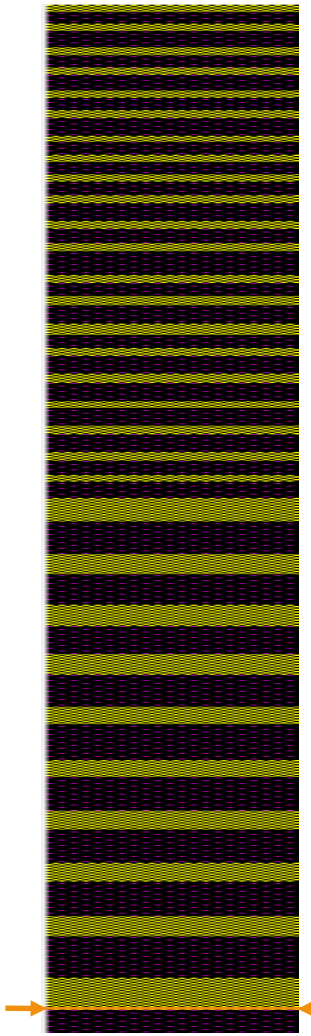
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
1
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

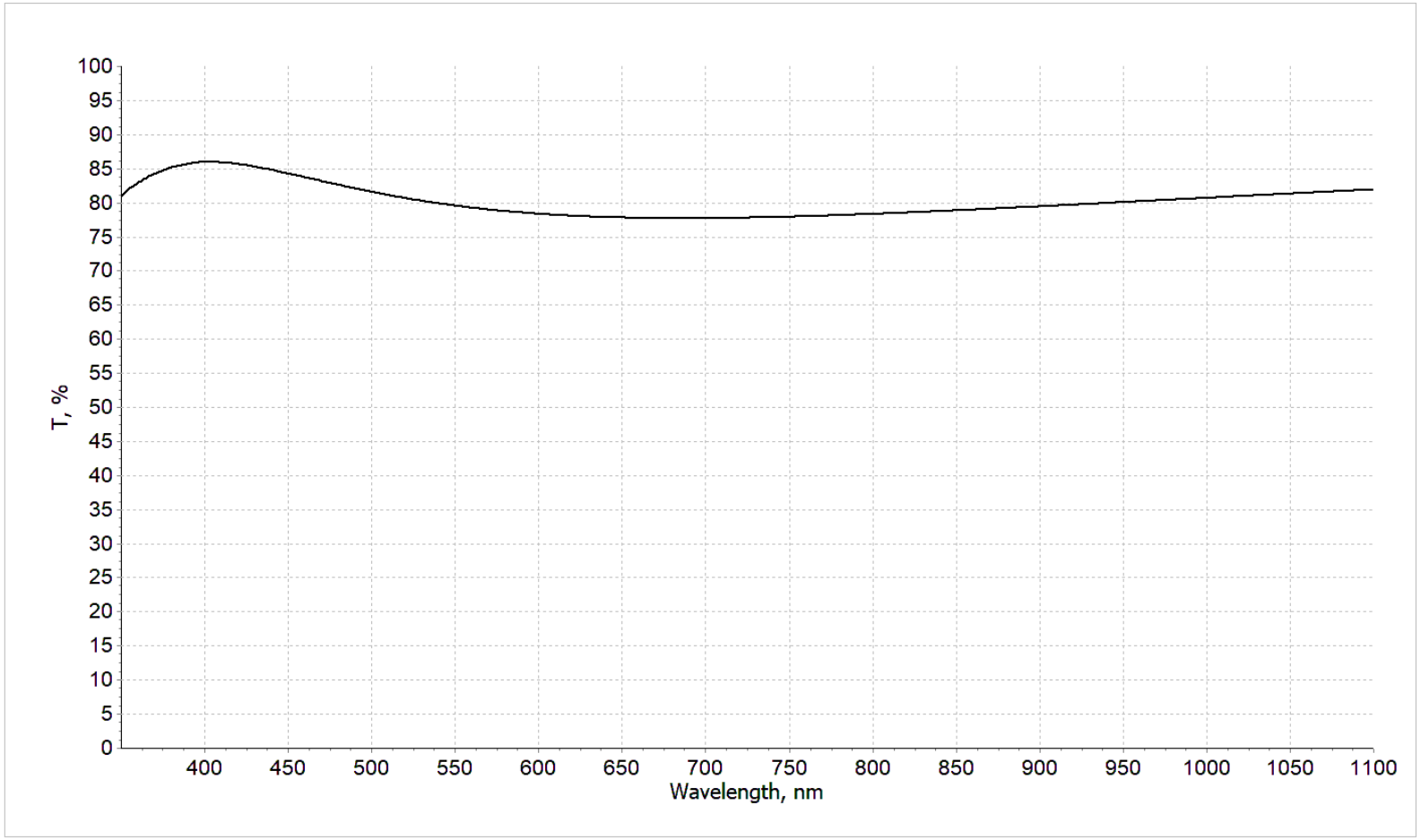
Wavelength max:
1100.000

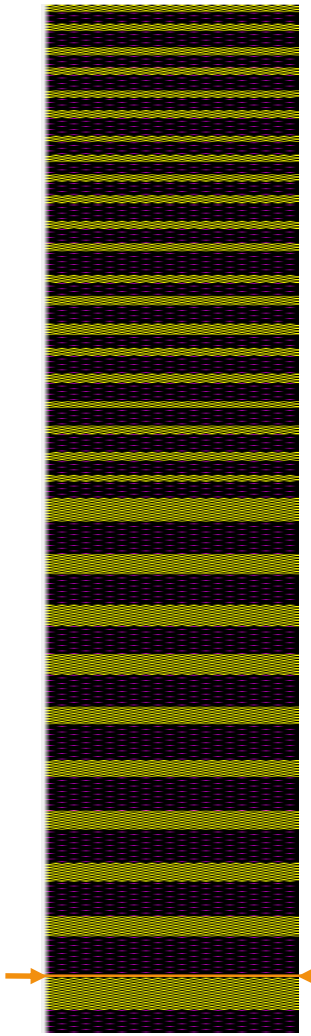
Points: 501

Preview Layer:
2

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

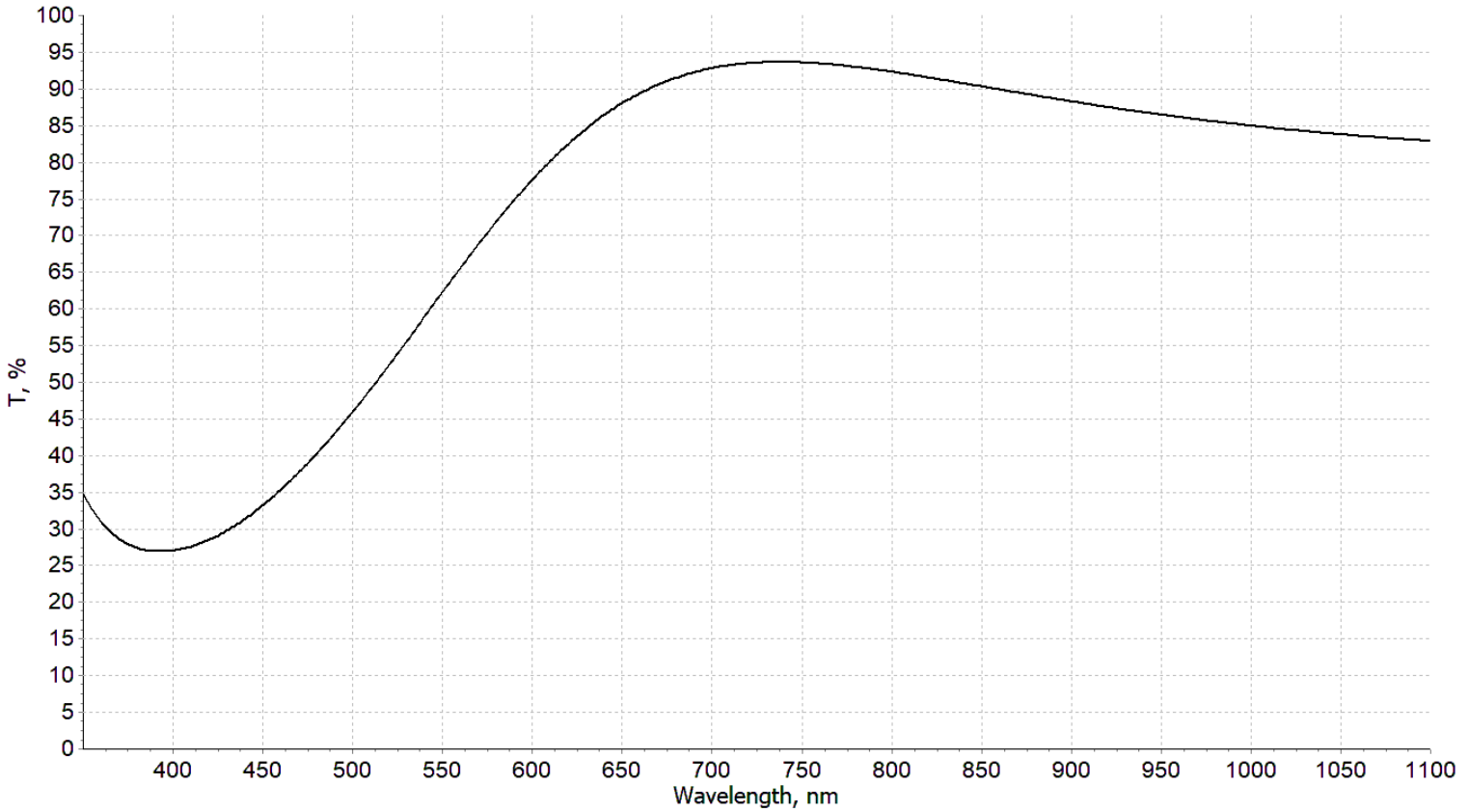
Incident angle: 0.0000

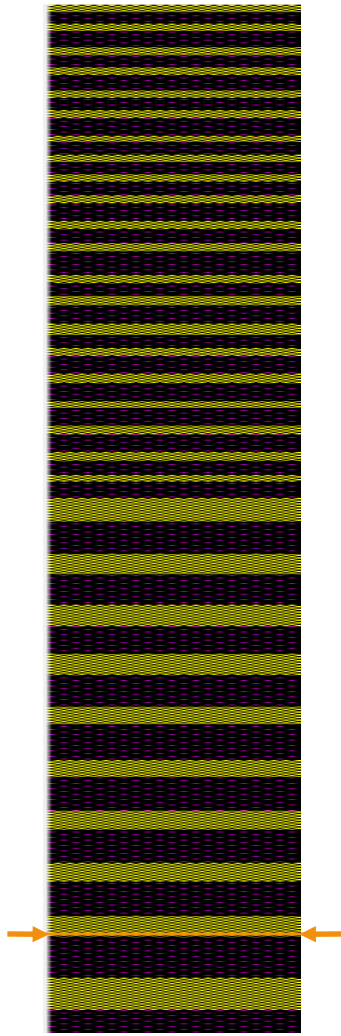
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 3
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

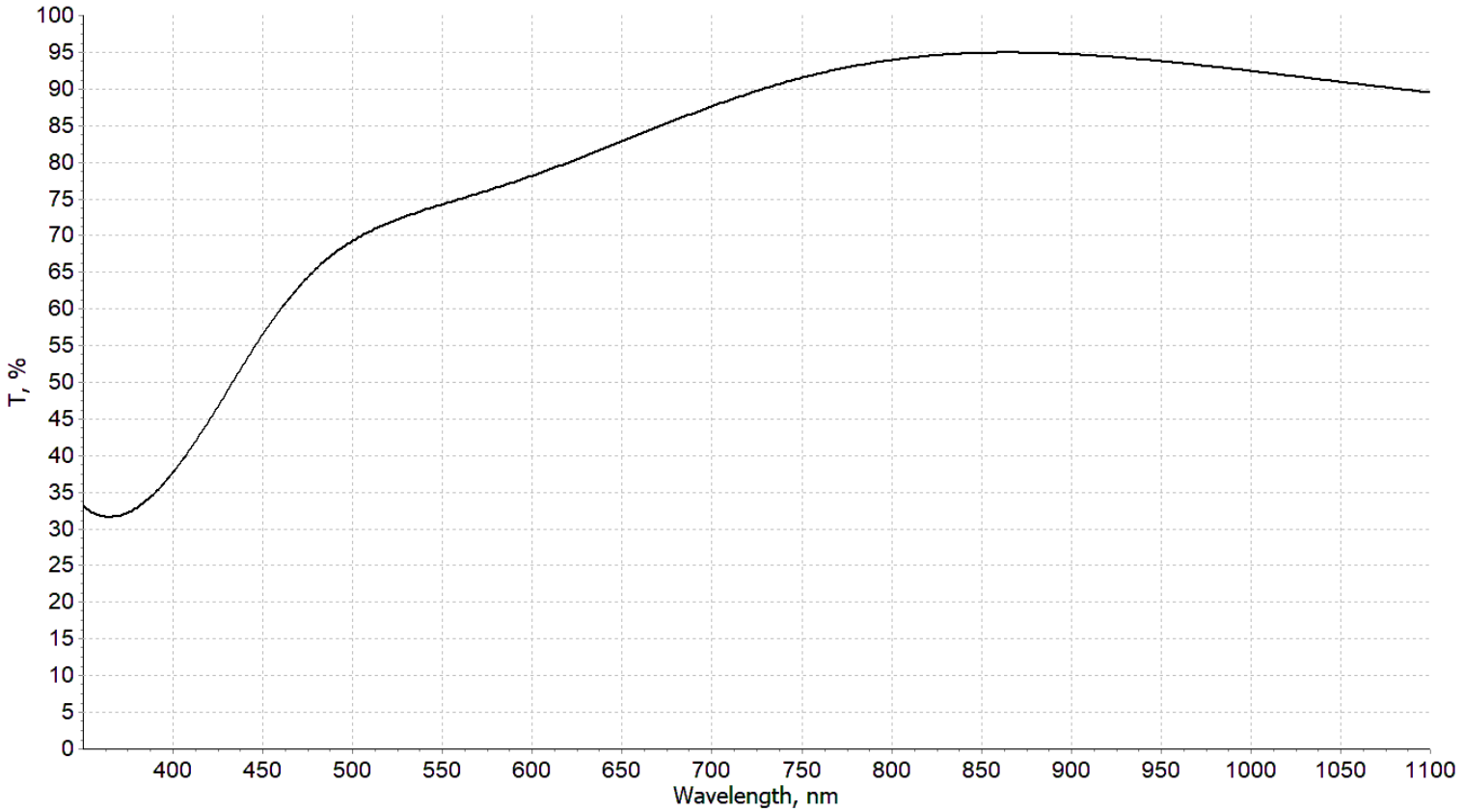
Incident angle: 0.0000

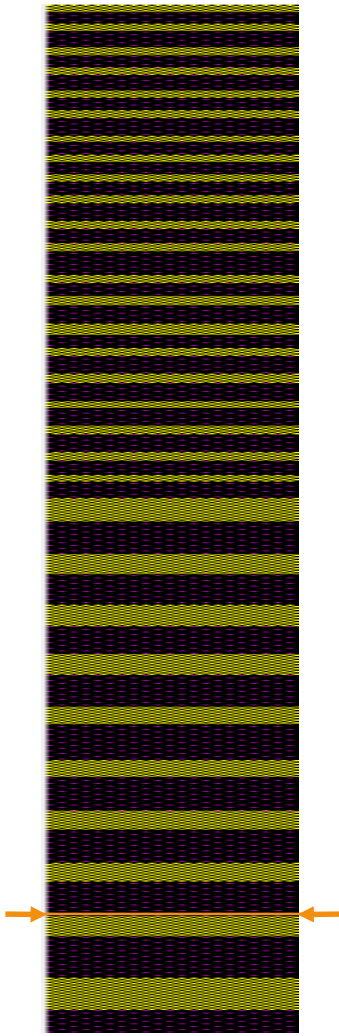
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 4
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

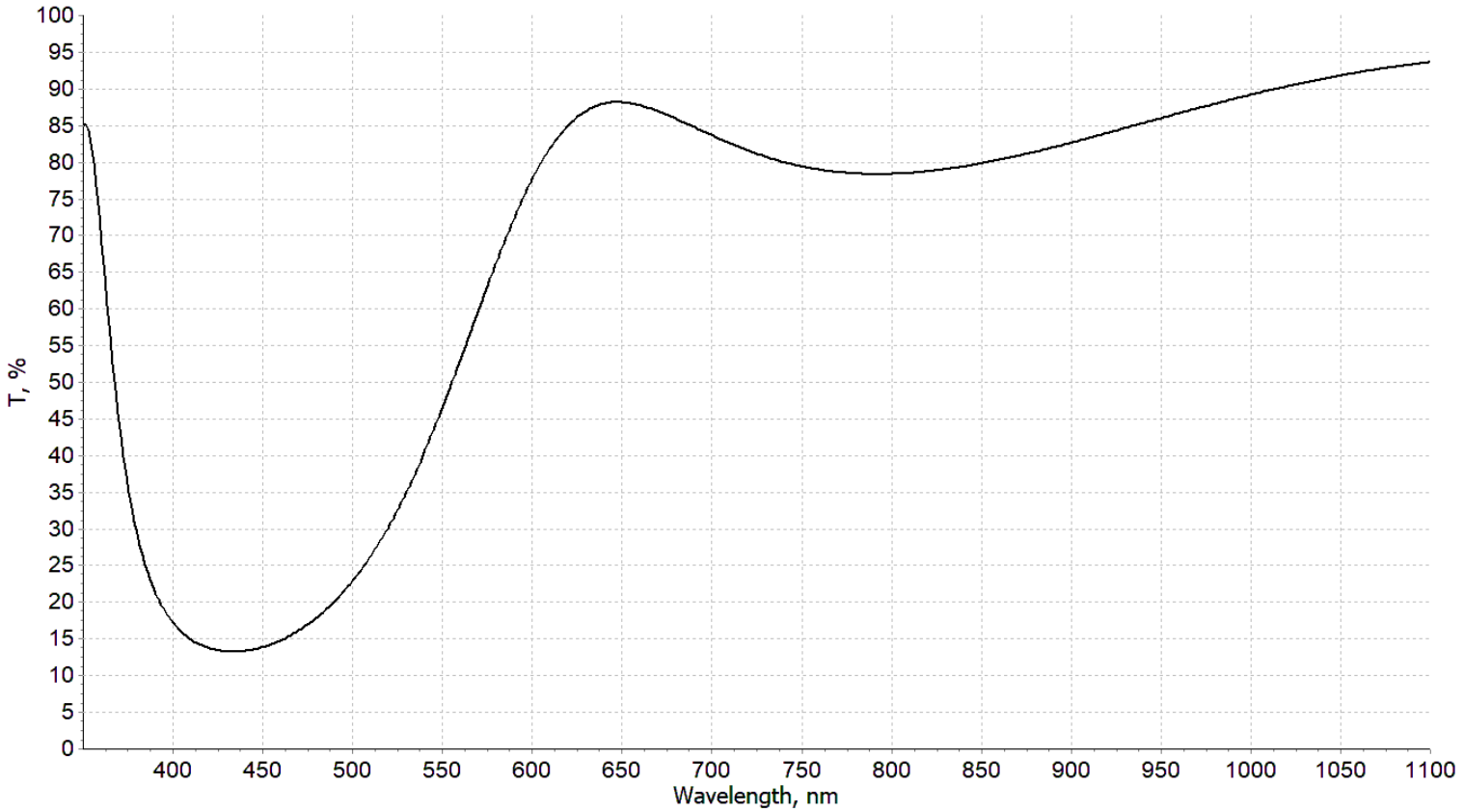
Incident angle: 0.0000

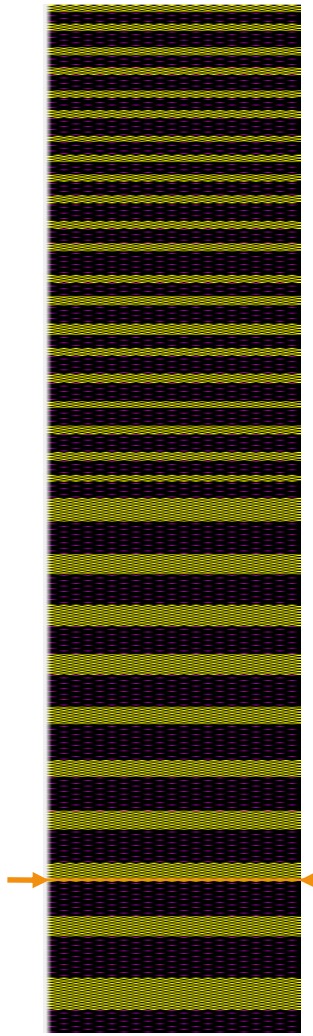
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 5
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

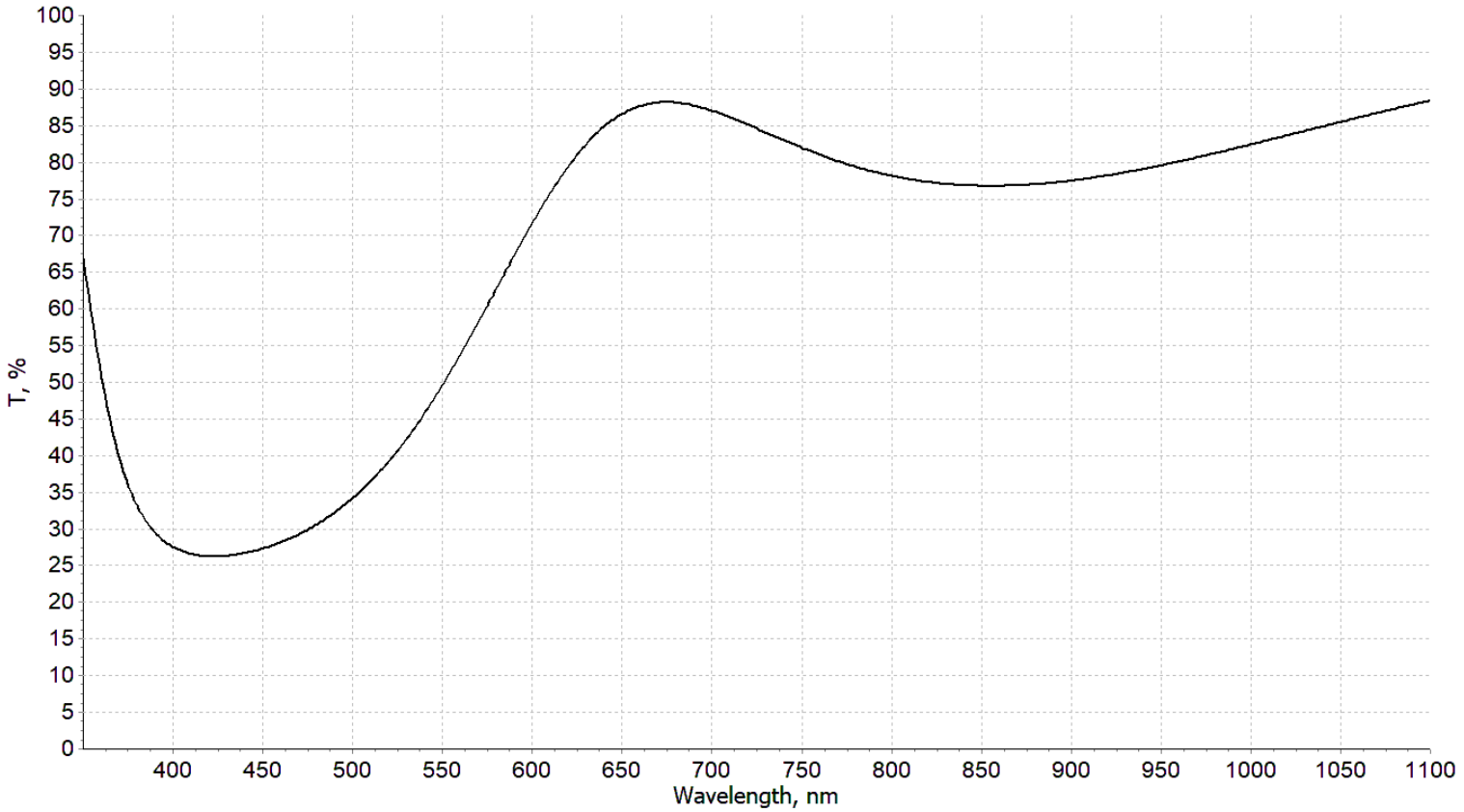
Incident angle: 0.0000

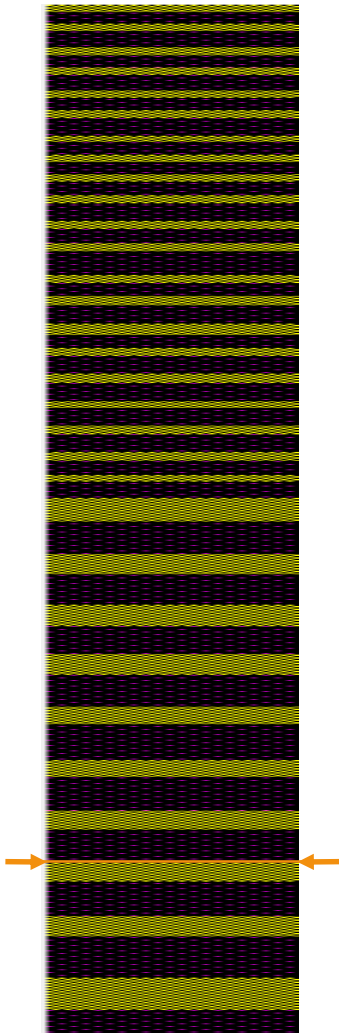
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 6
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

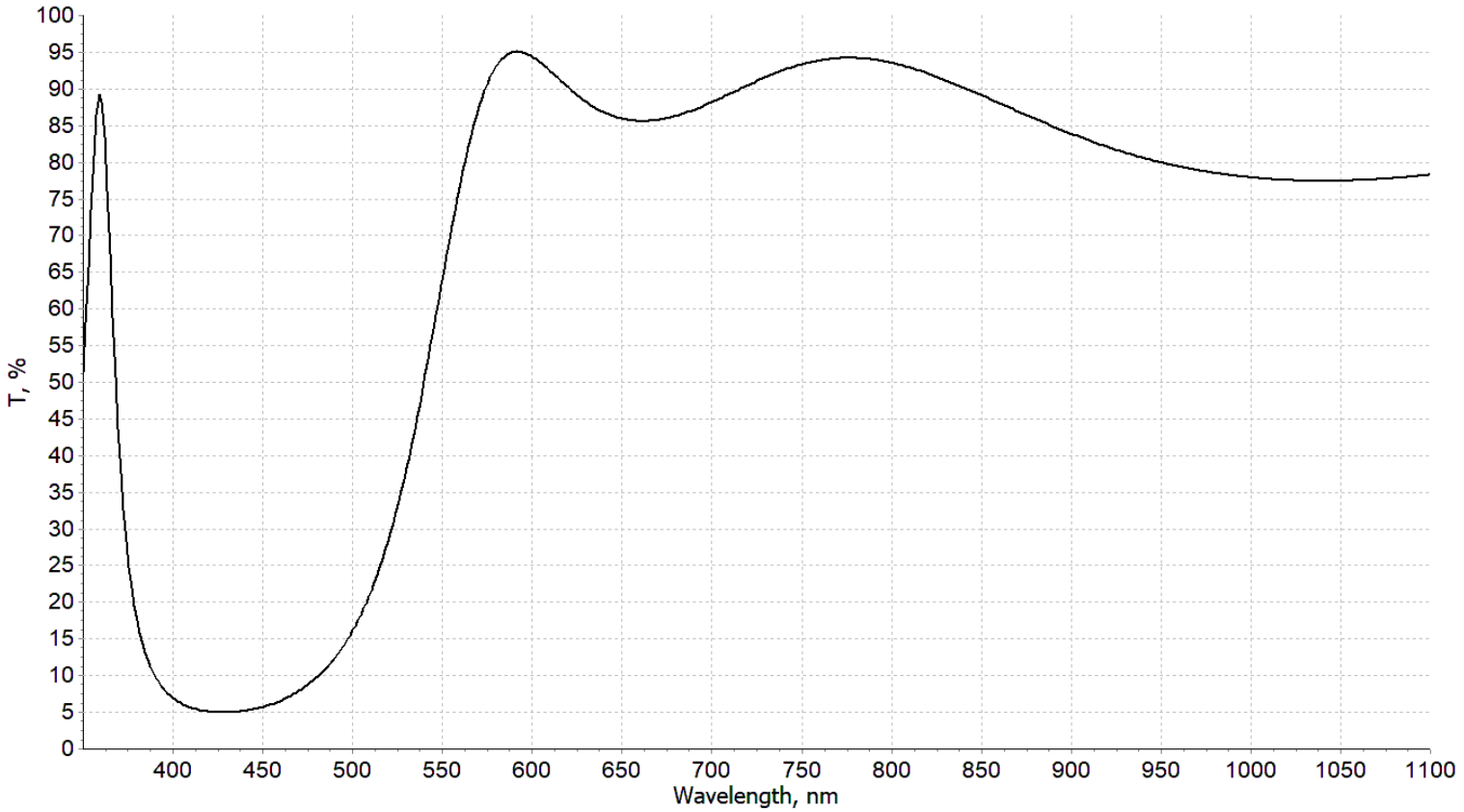
Incident angle: 0.0000

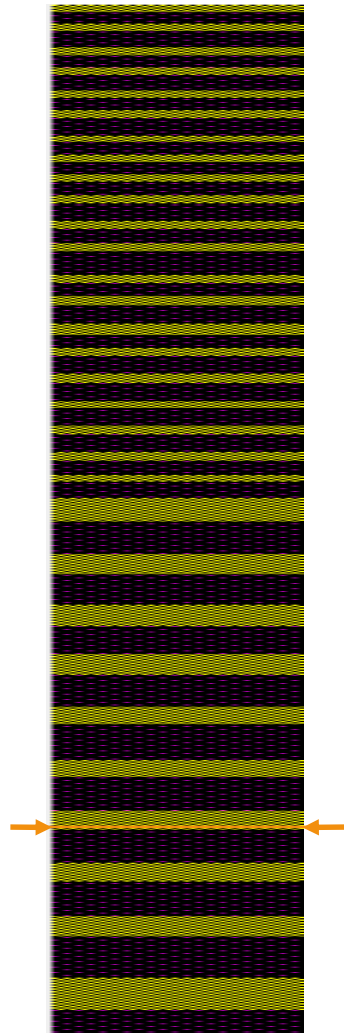
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 7
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

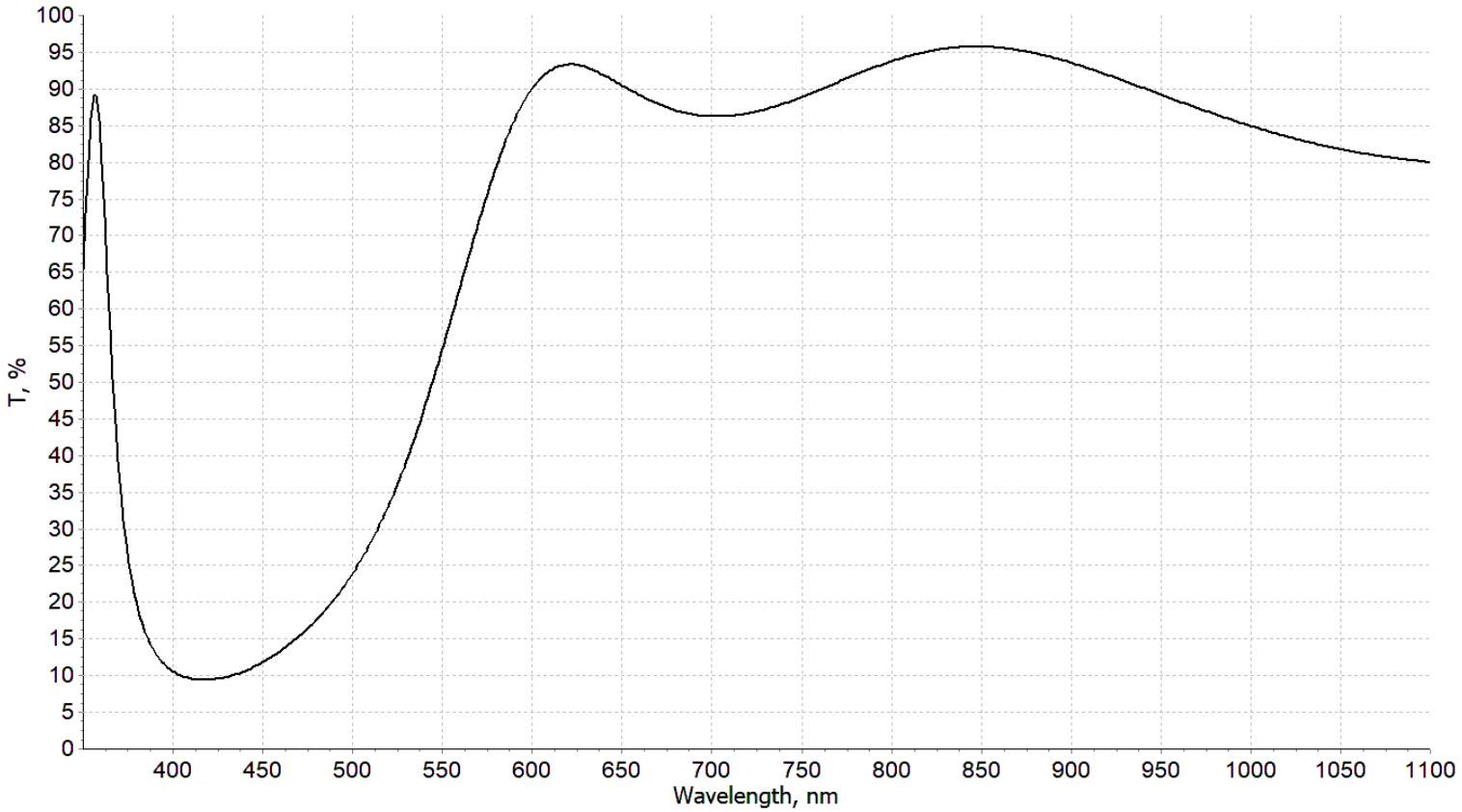
Incident angle: 0.0000

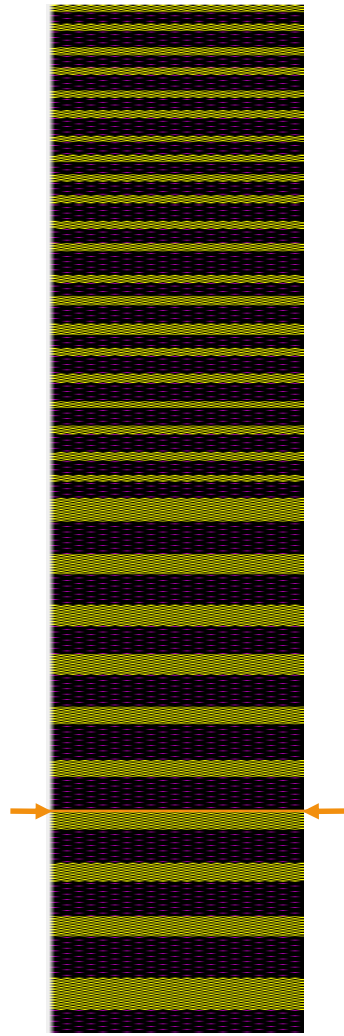
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 8
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

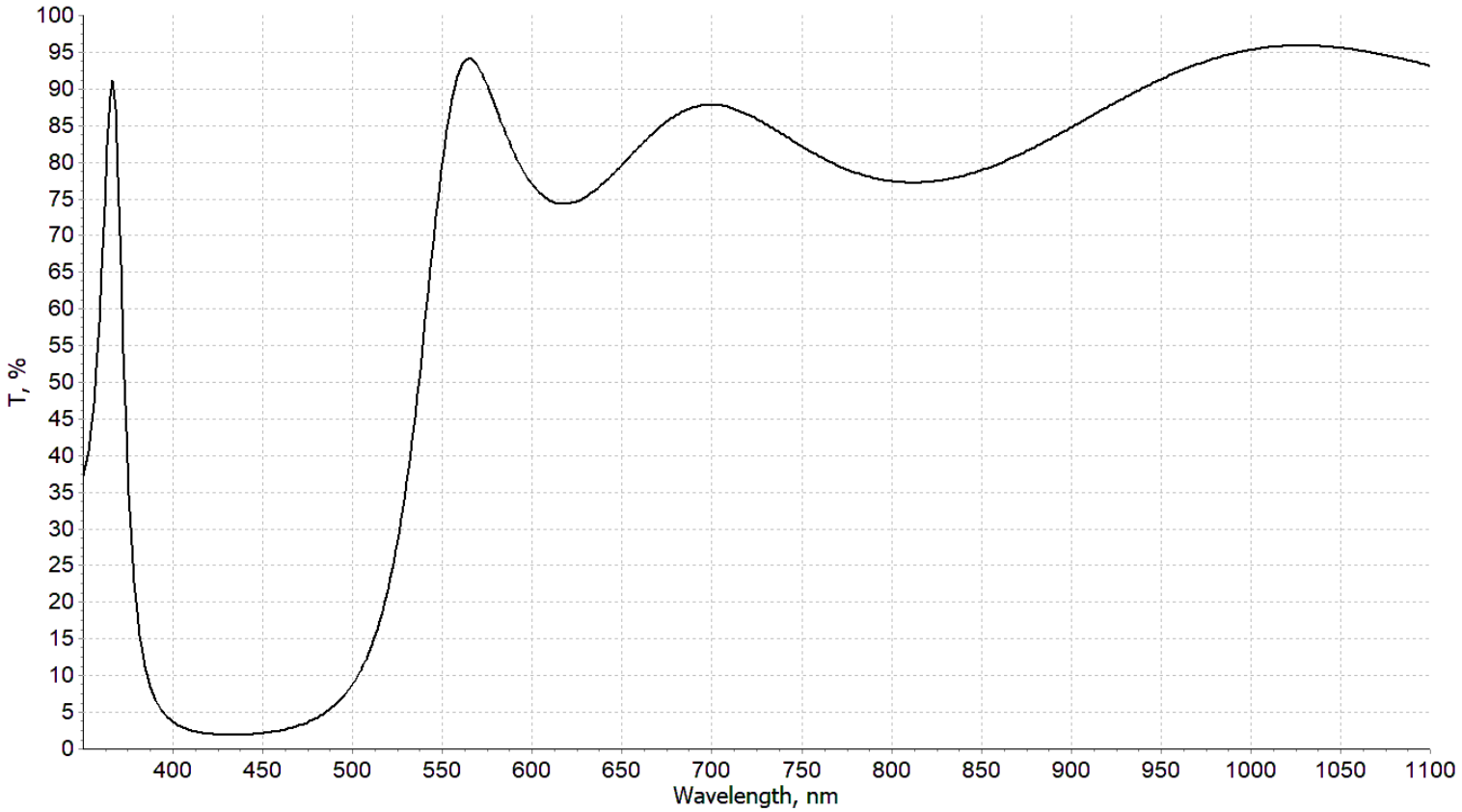
Incident angle: 0.0000

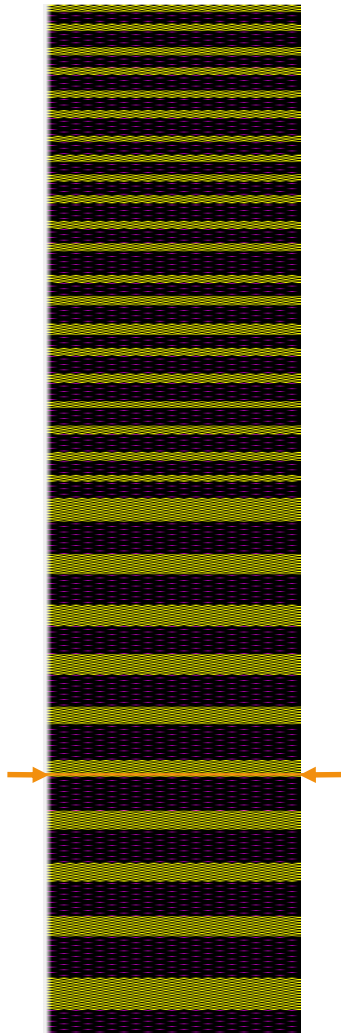
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 9
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

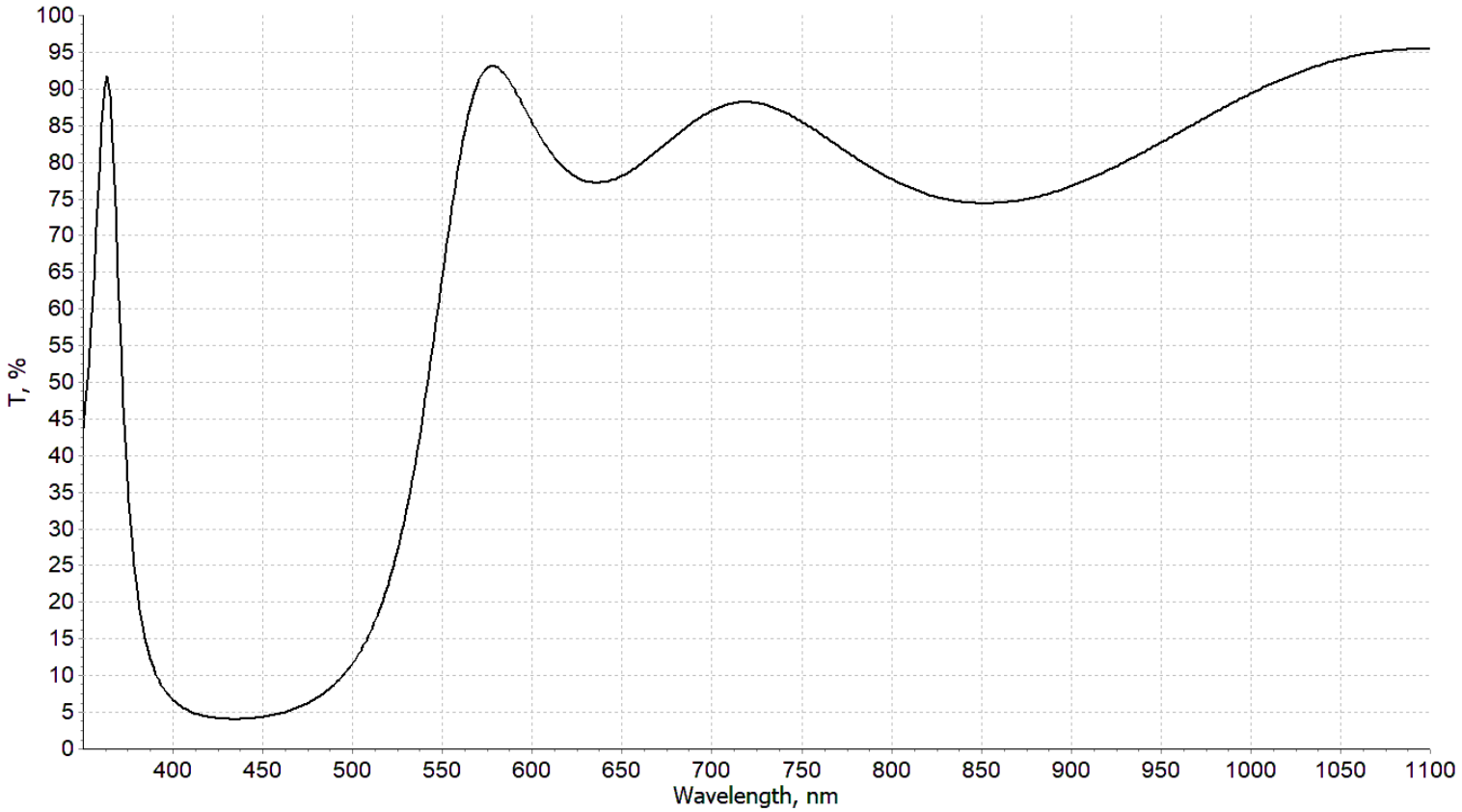
Wavelength max:
1100.000

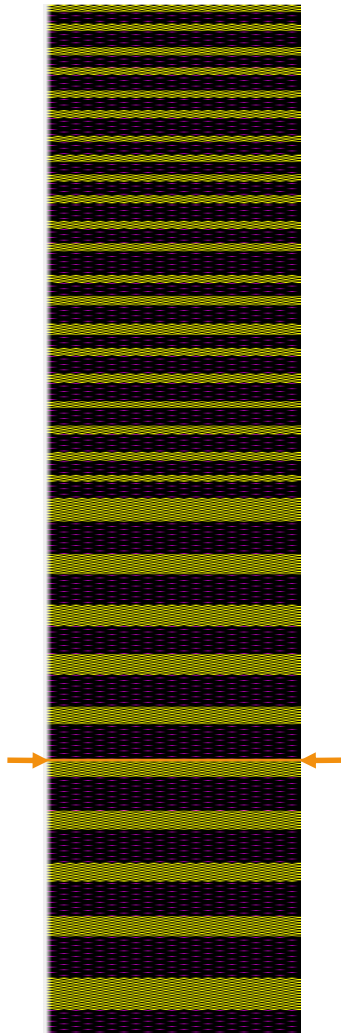
Points: 501

Preview Layer:
10

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

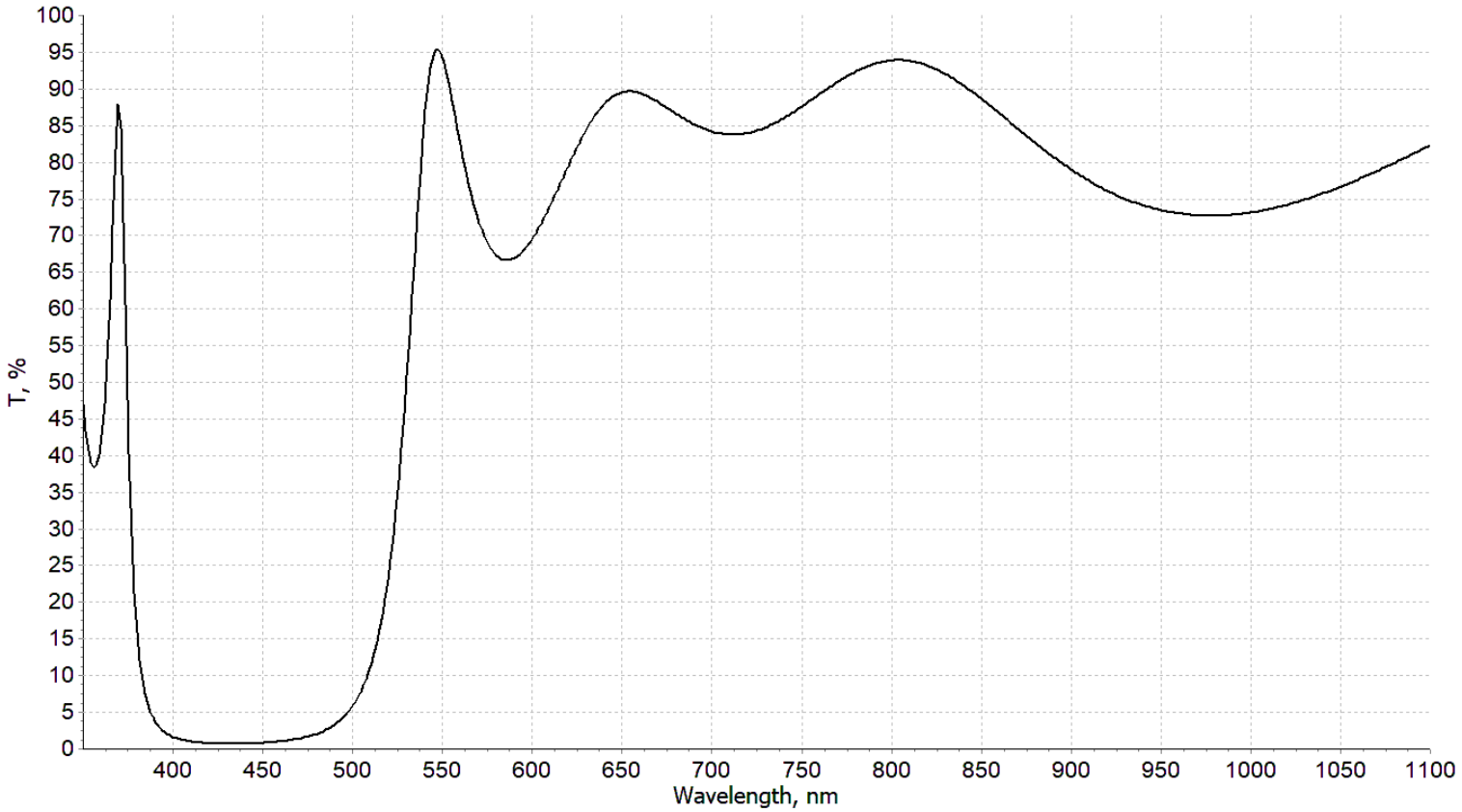
Incident angle: 0.0000

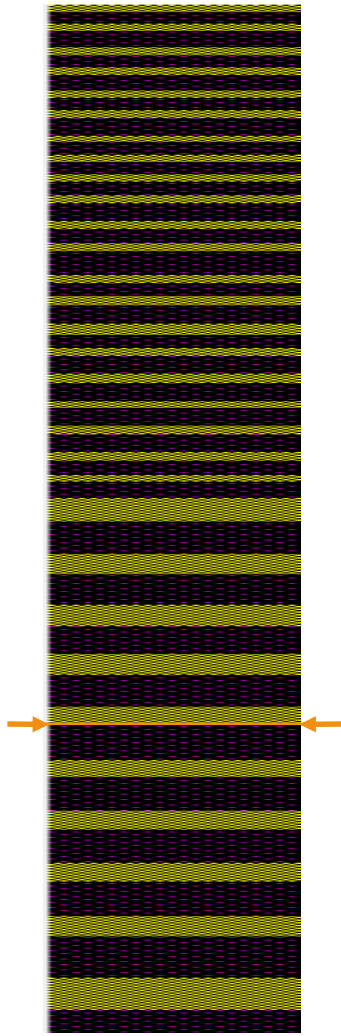
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 11
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

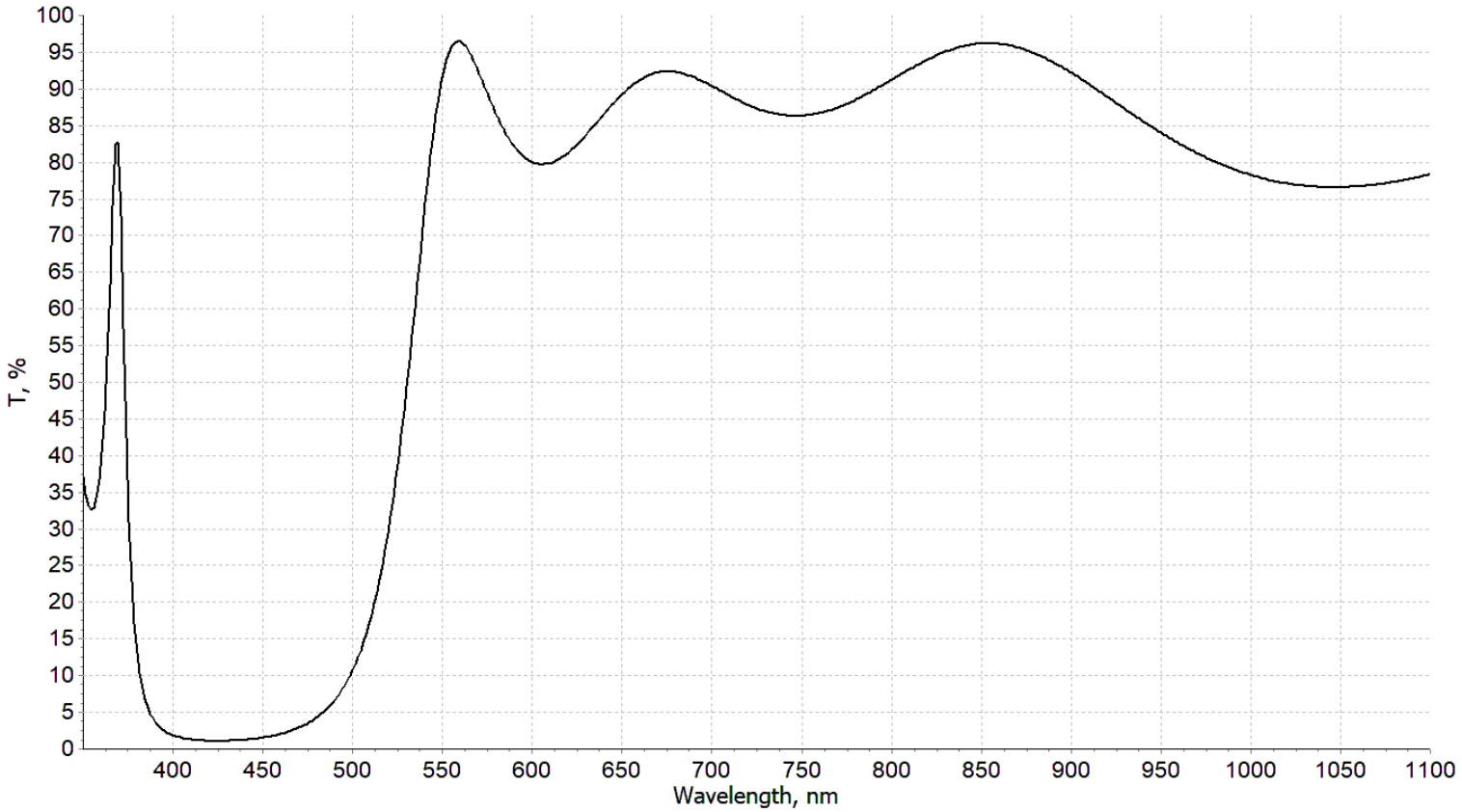
Wavelength max:
1100.000

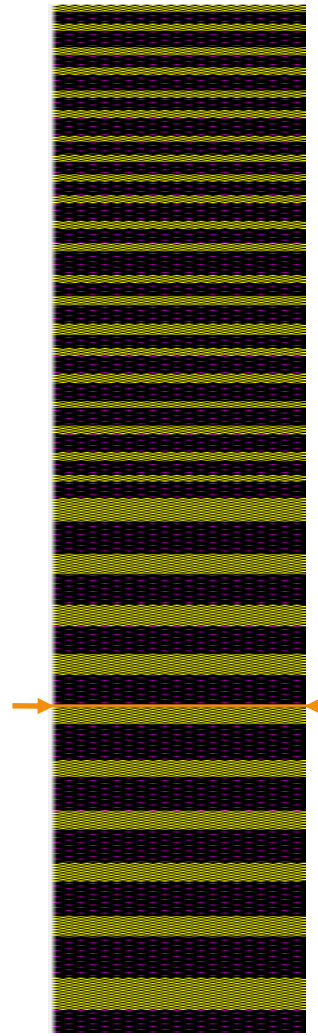
Points: 501

Preview Layer:
12

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

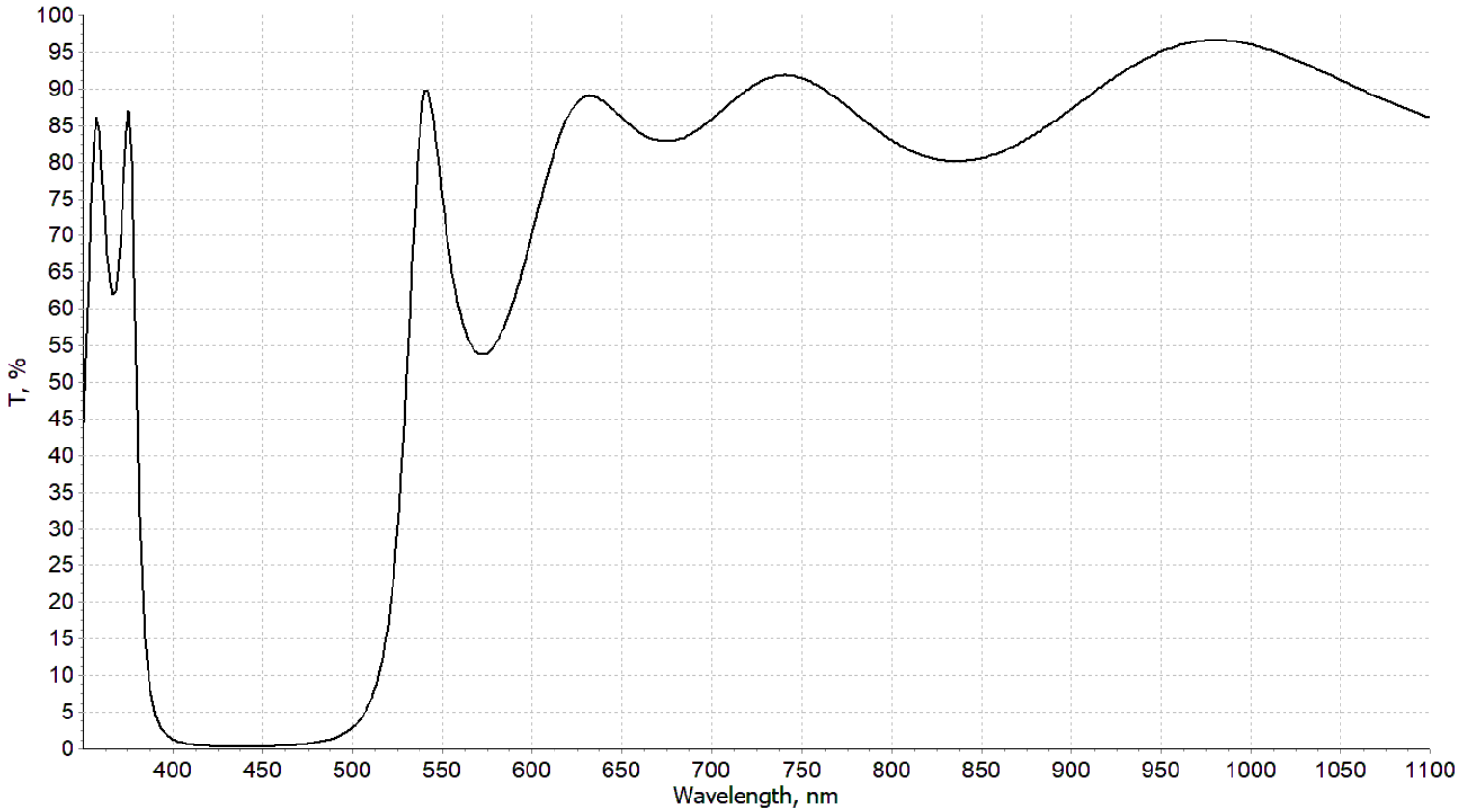
Wavelength max:
1100.000

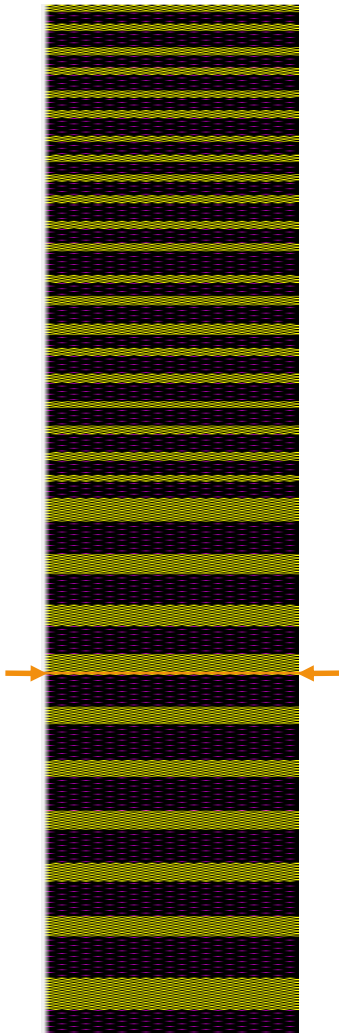
Points: 501

Preview Layer:
13

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

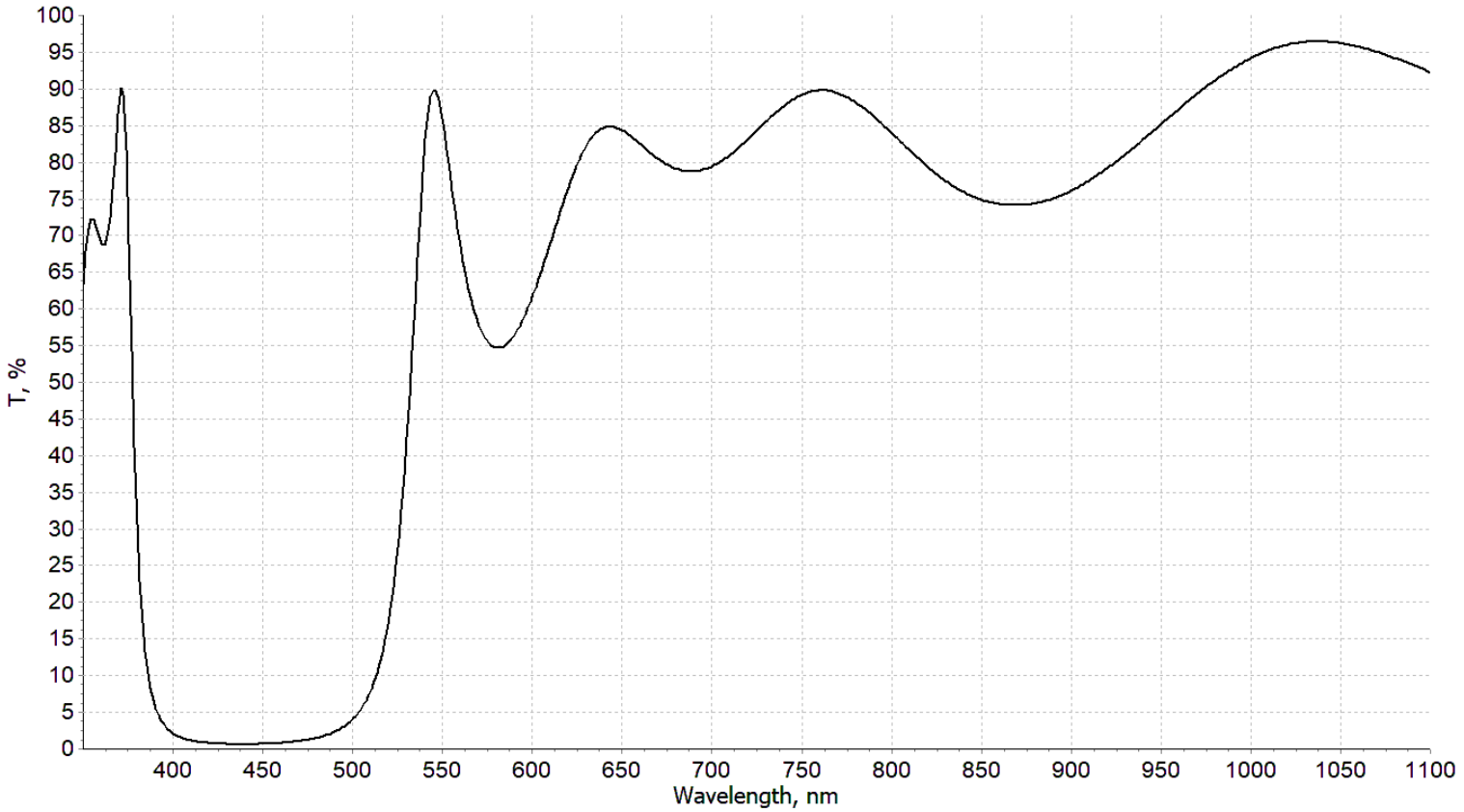
Incident angle: 0.0000

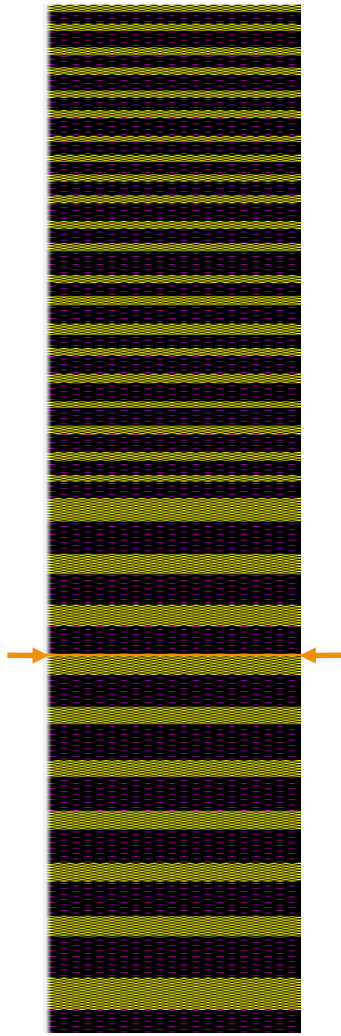
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 14
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

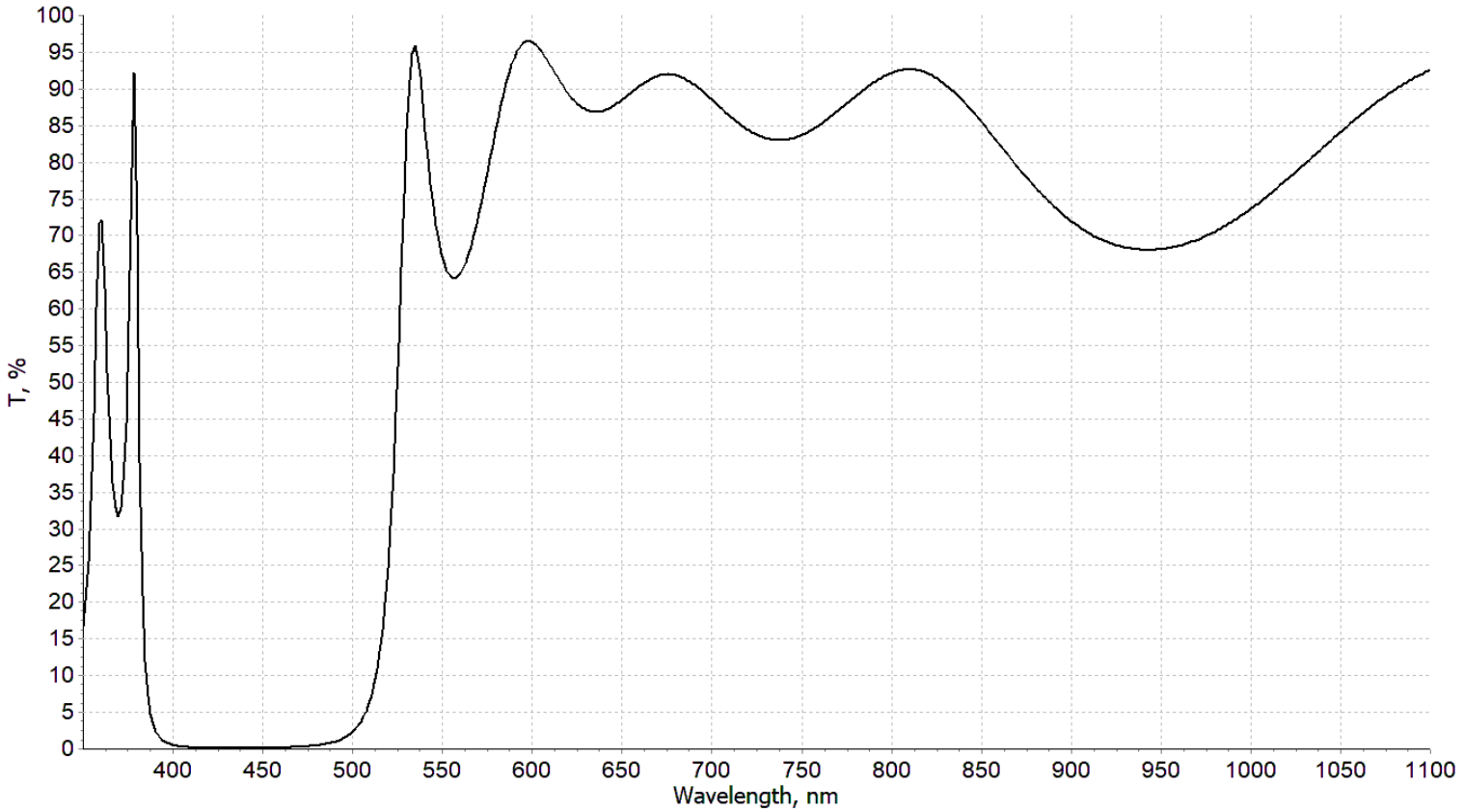
Incident angle: 0.0000

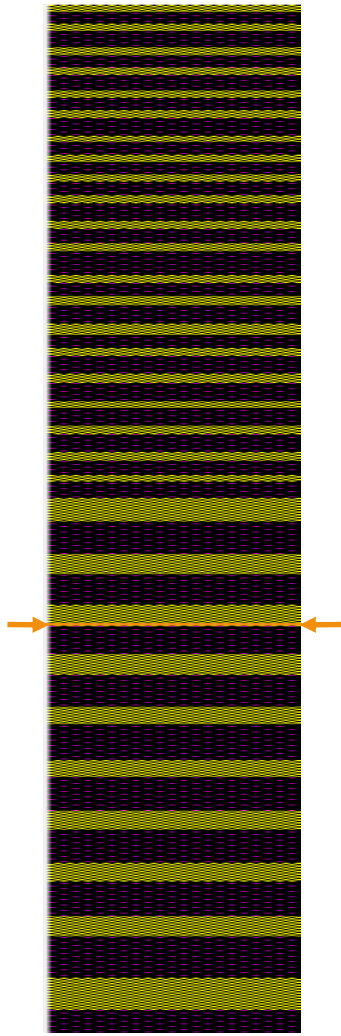
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
15
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

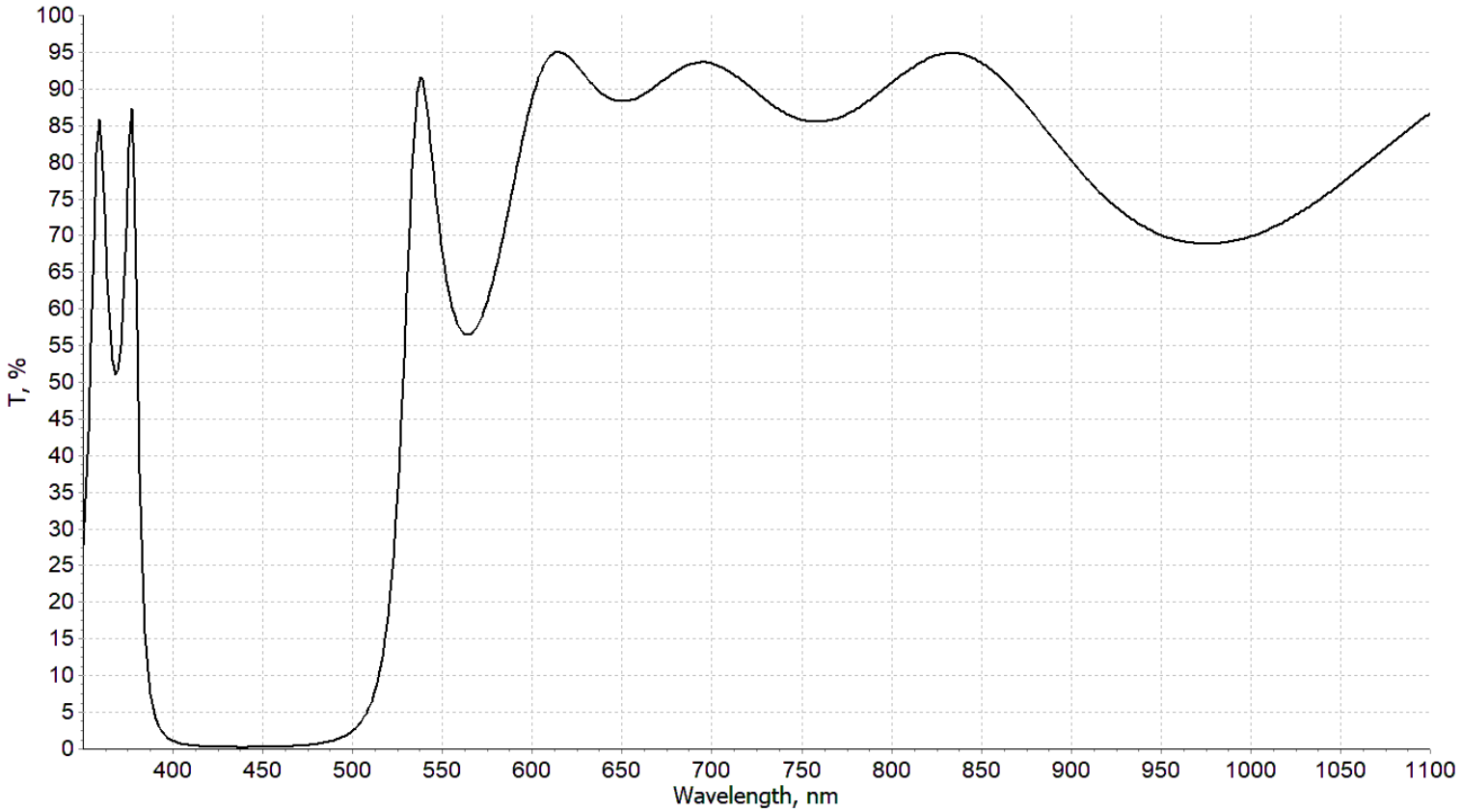
Incident angle: 0.0000

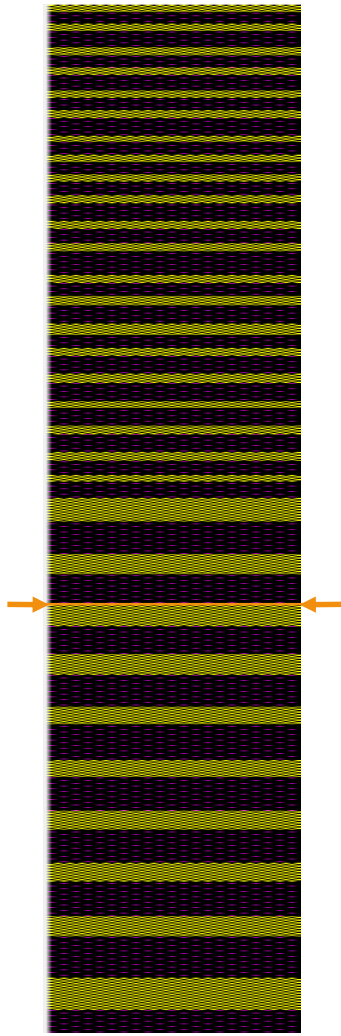
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
16
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

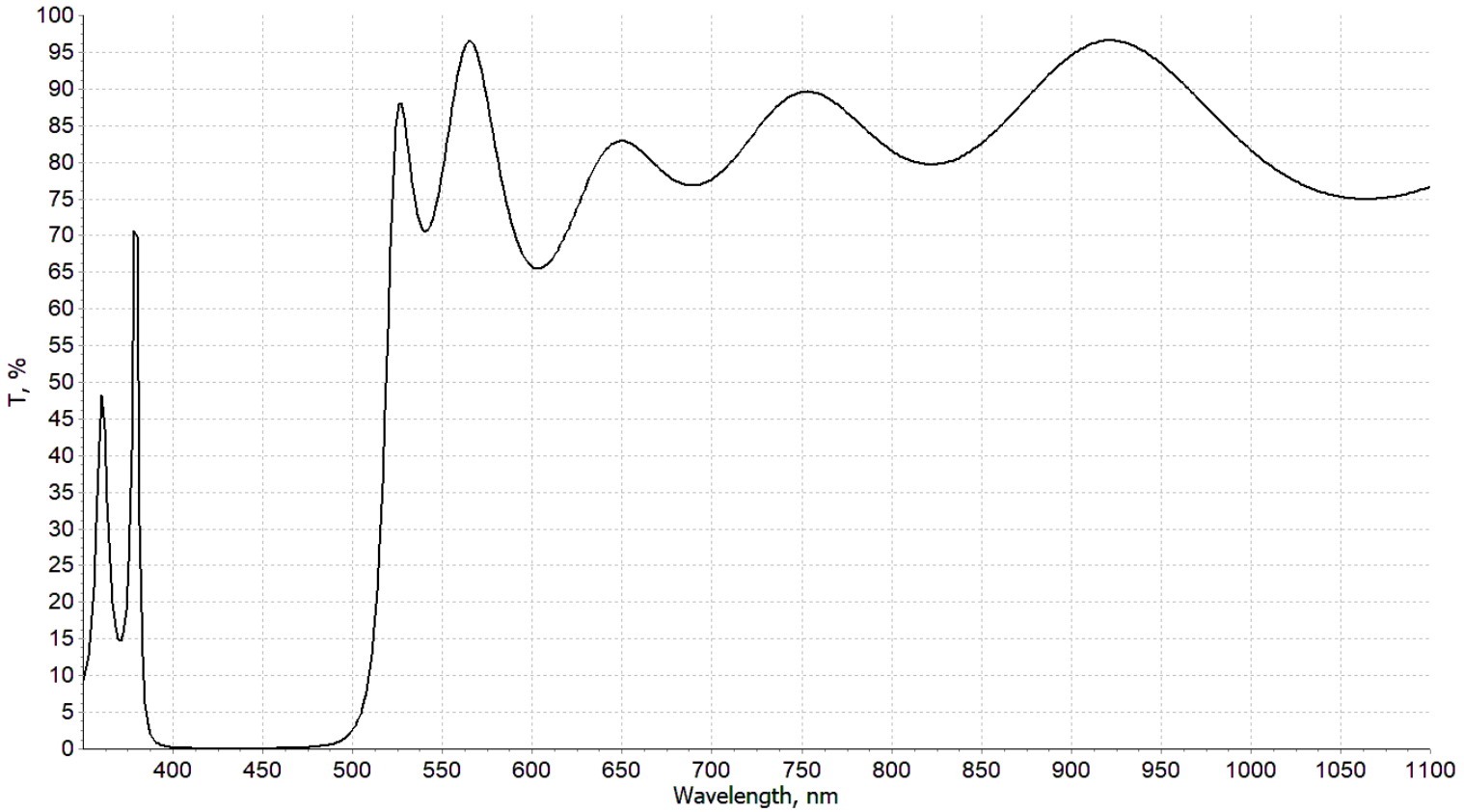
Incident angle: 0.0000

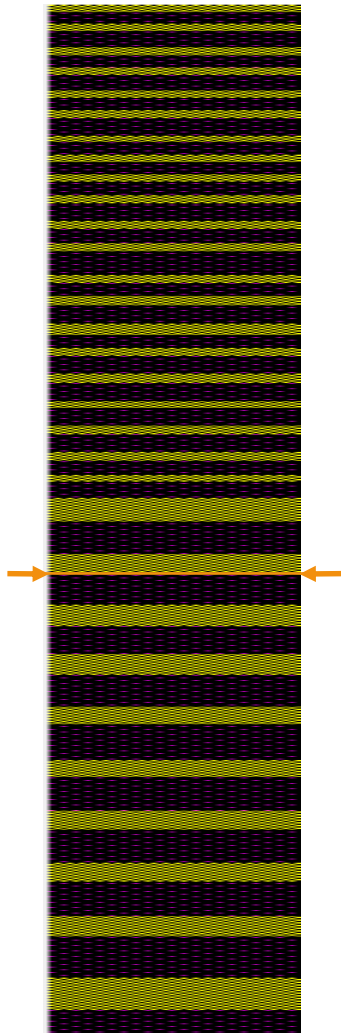
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 17
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

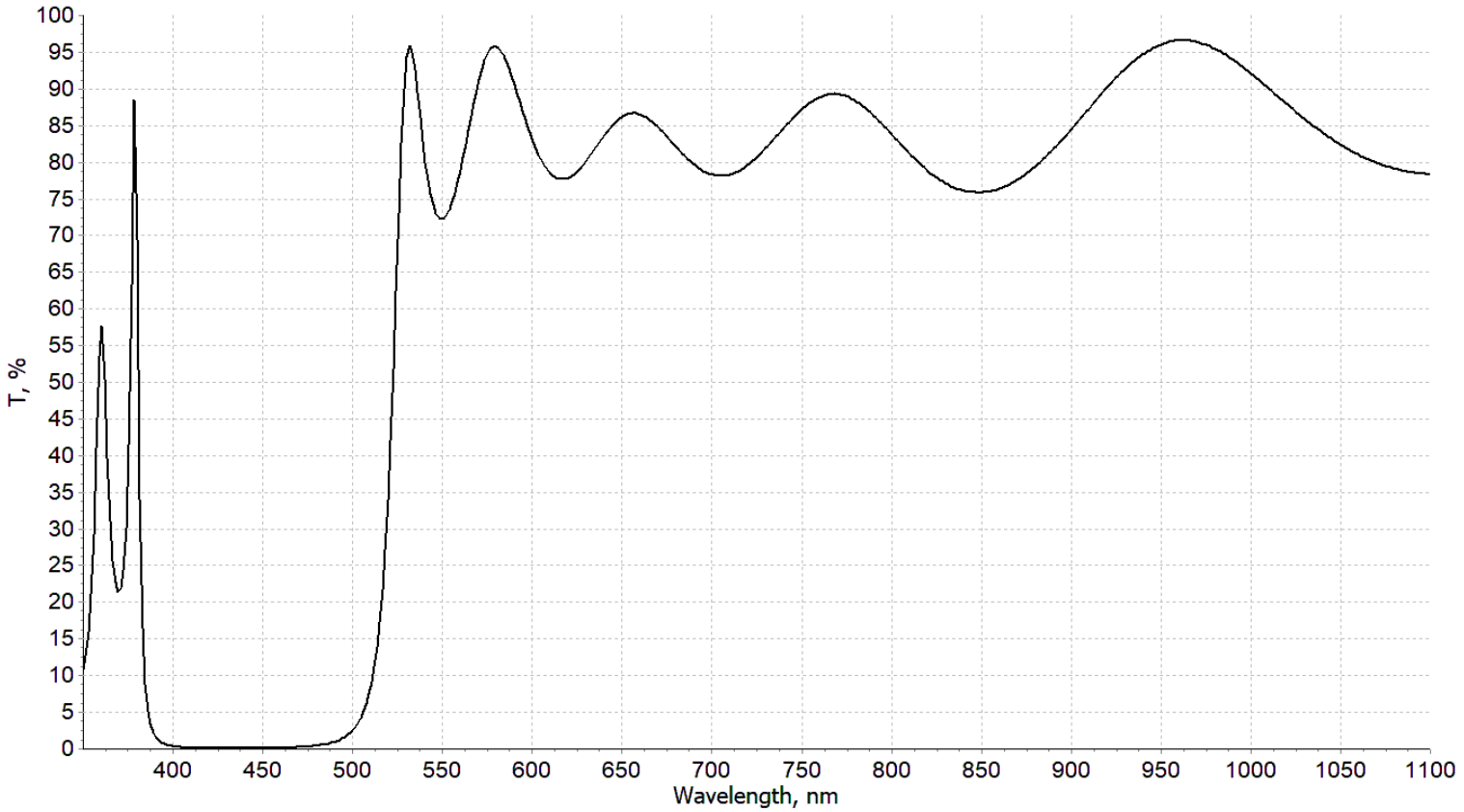
Incident angle: 0.0000

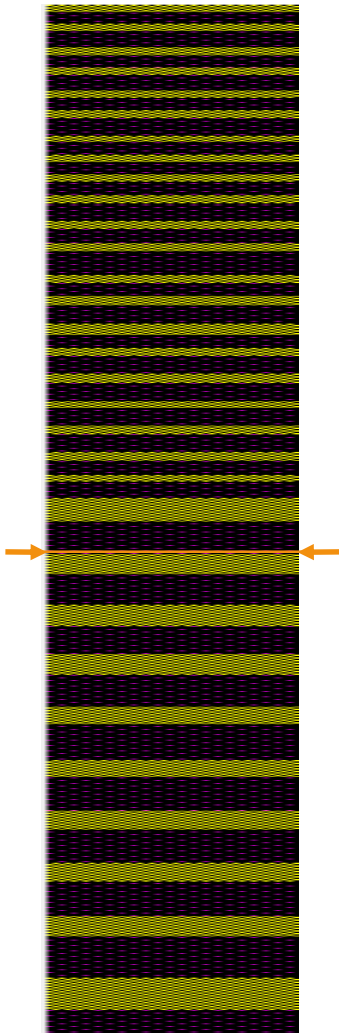
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 18
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

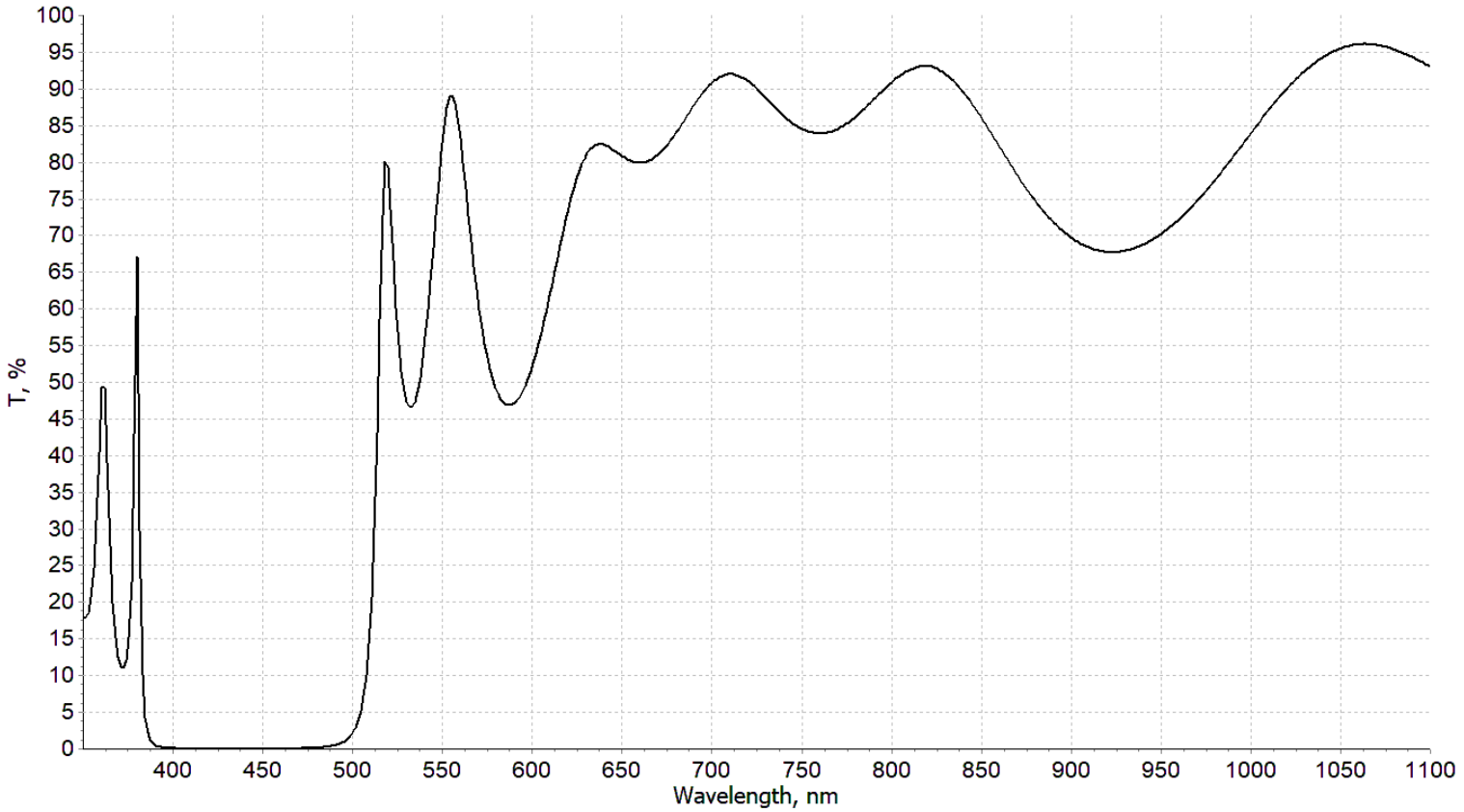
Incident angle: 0.0000

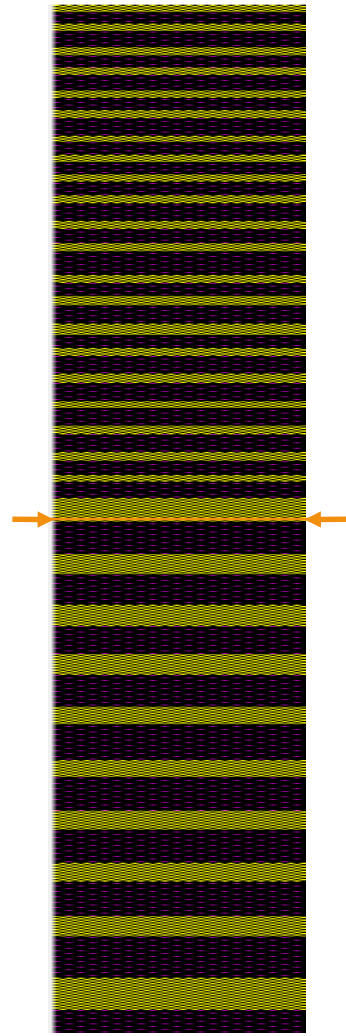
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 19
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

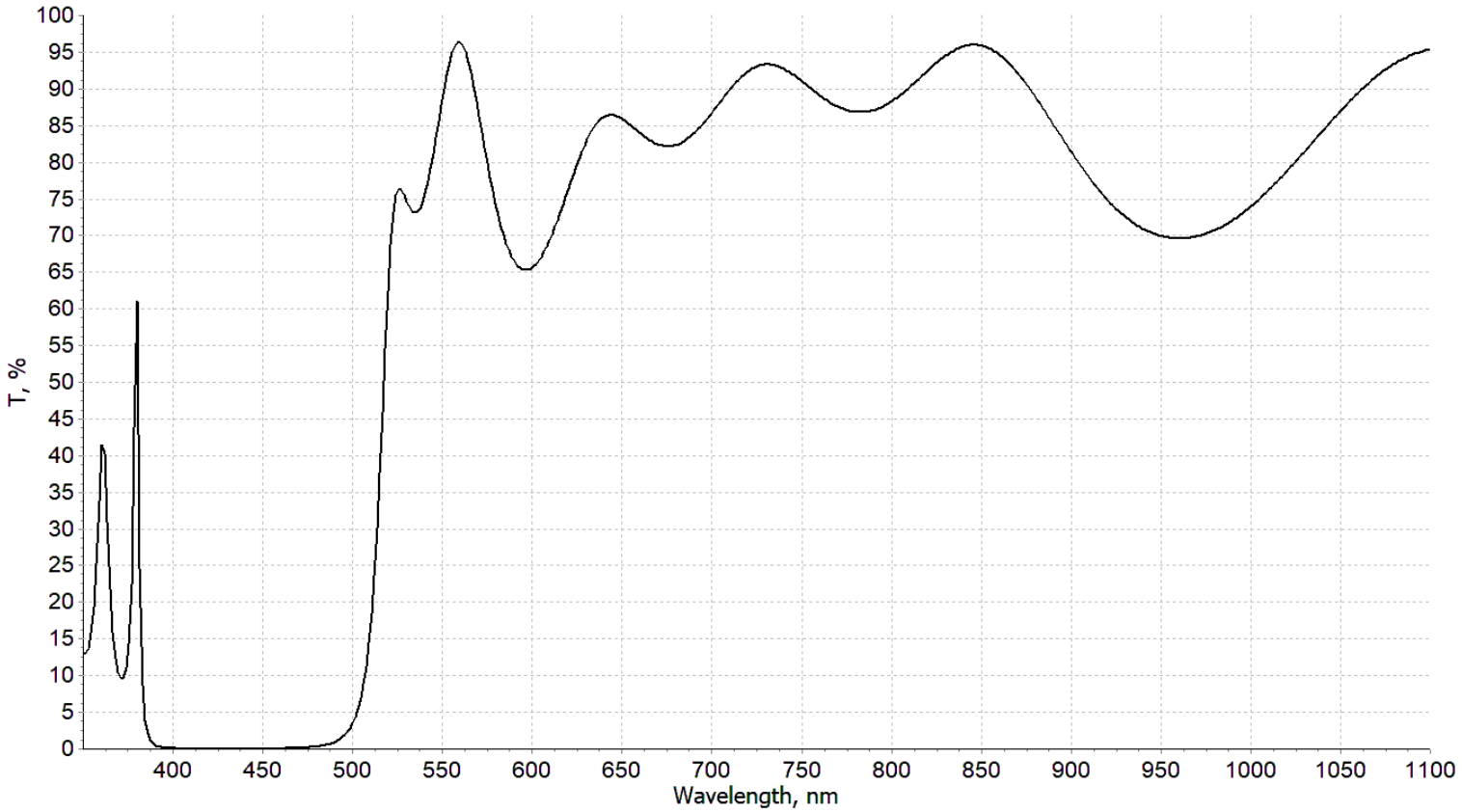
Wavelength max:
1100.000

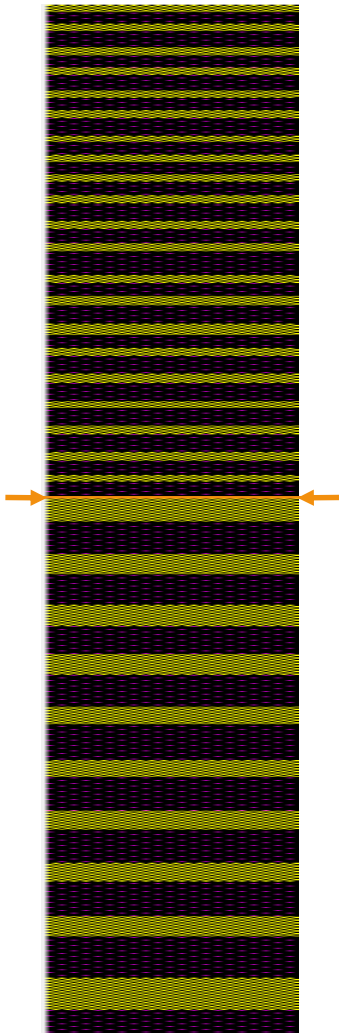
Points: 501

Preview Layer:
20

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

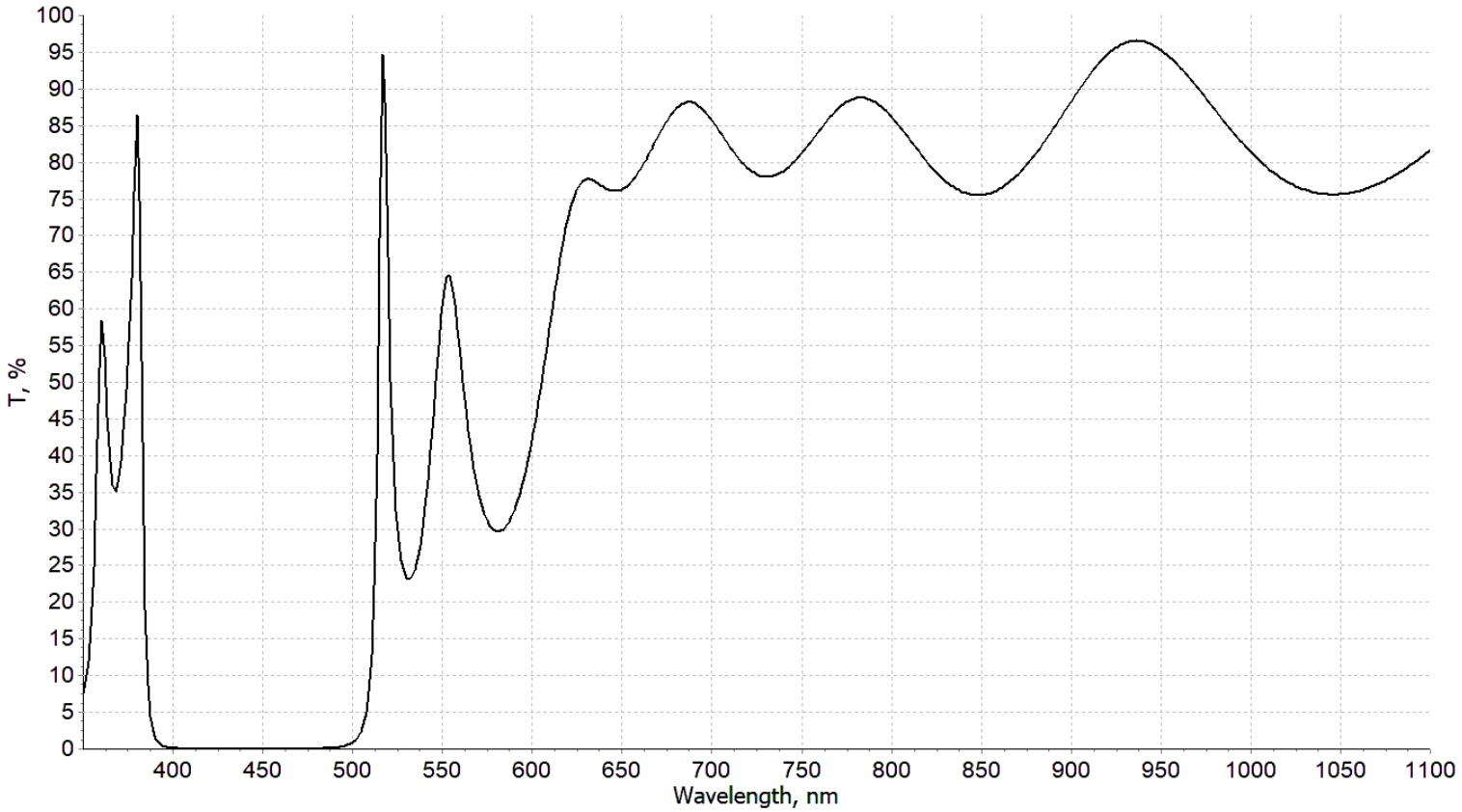
Incident angle: 0.0000

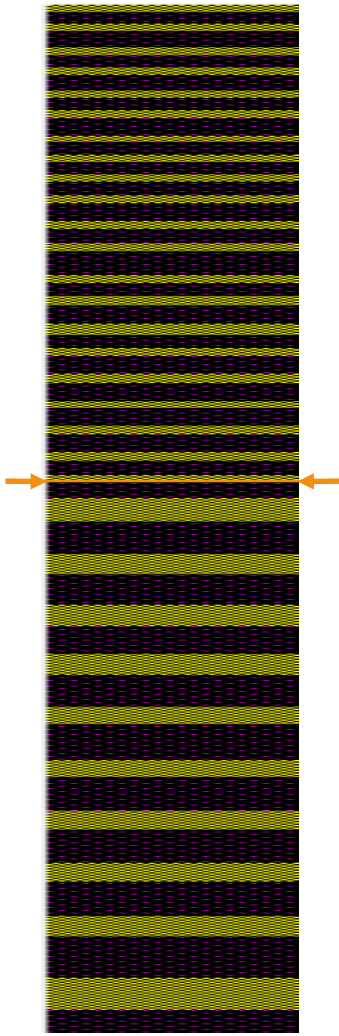
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 21
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

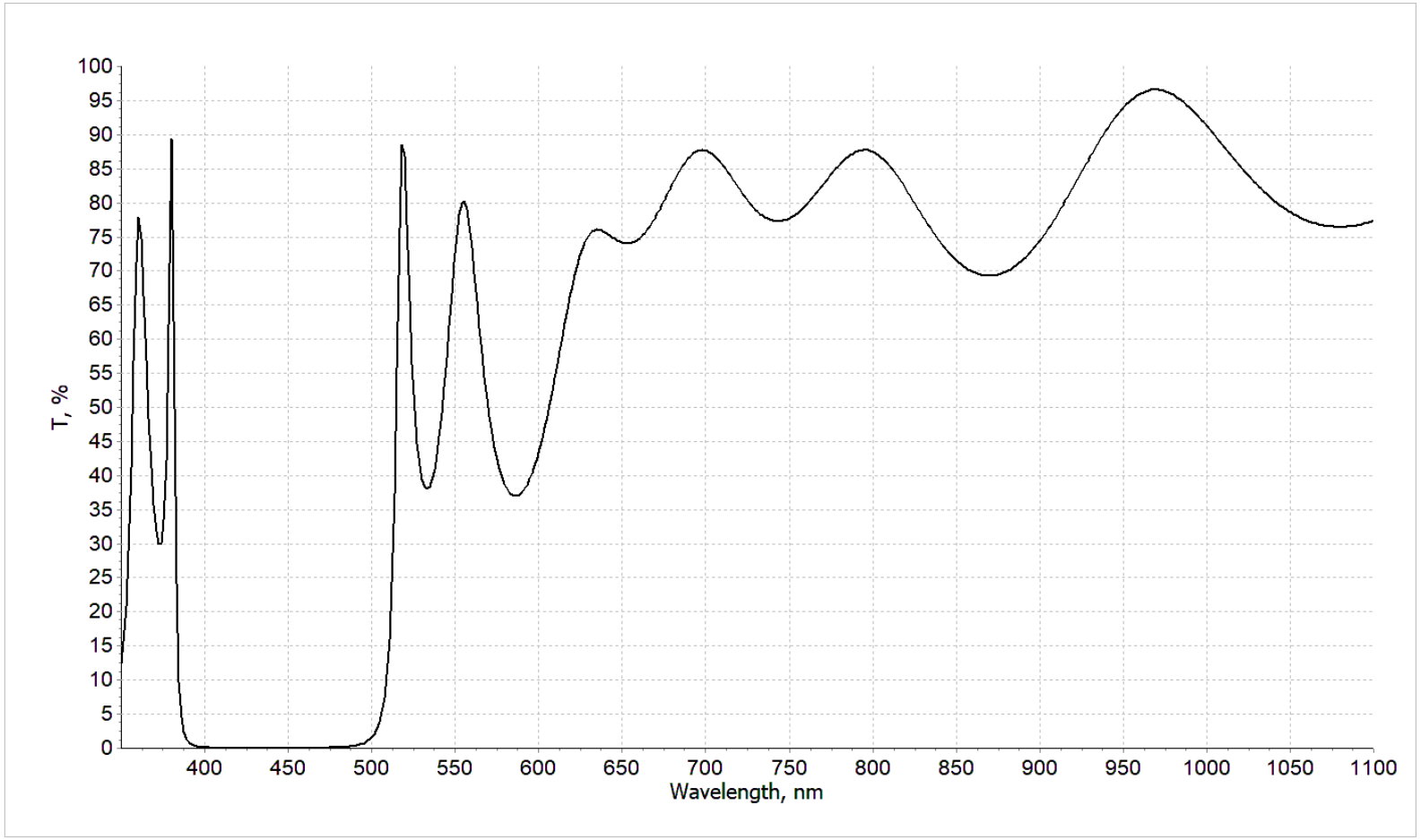
Wavelength max:
1100.000

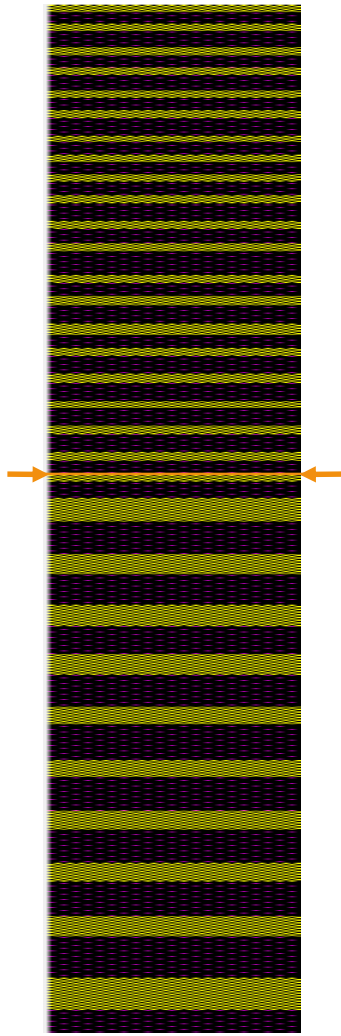
Points: 501

Preview Layer:
22

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

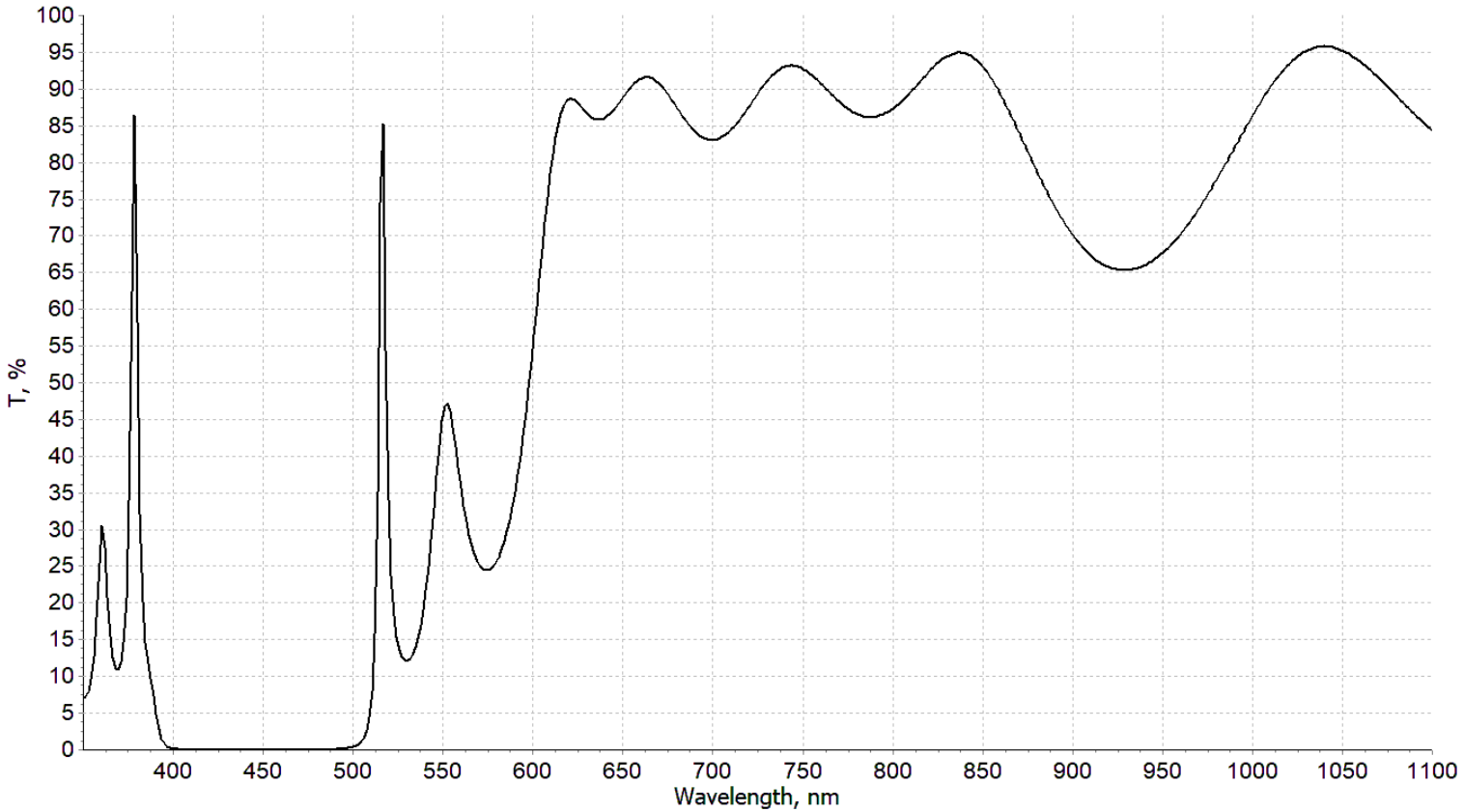
Incident angle: 0.0000

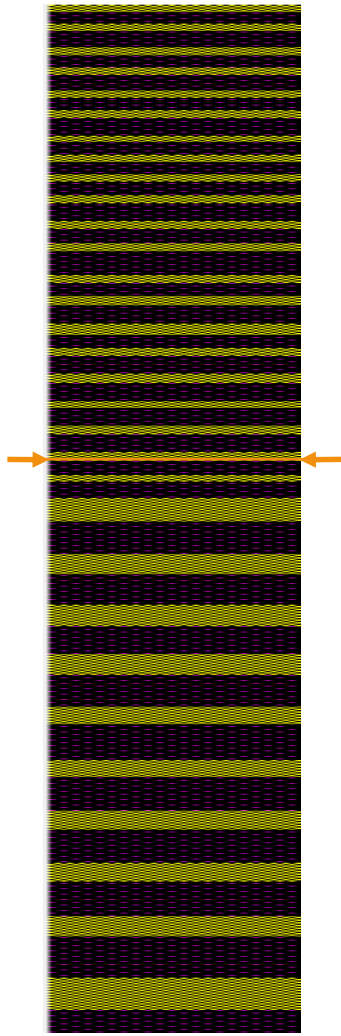
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
23
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

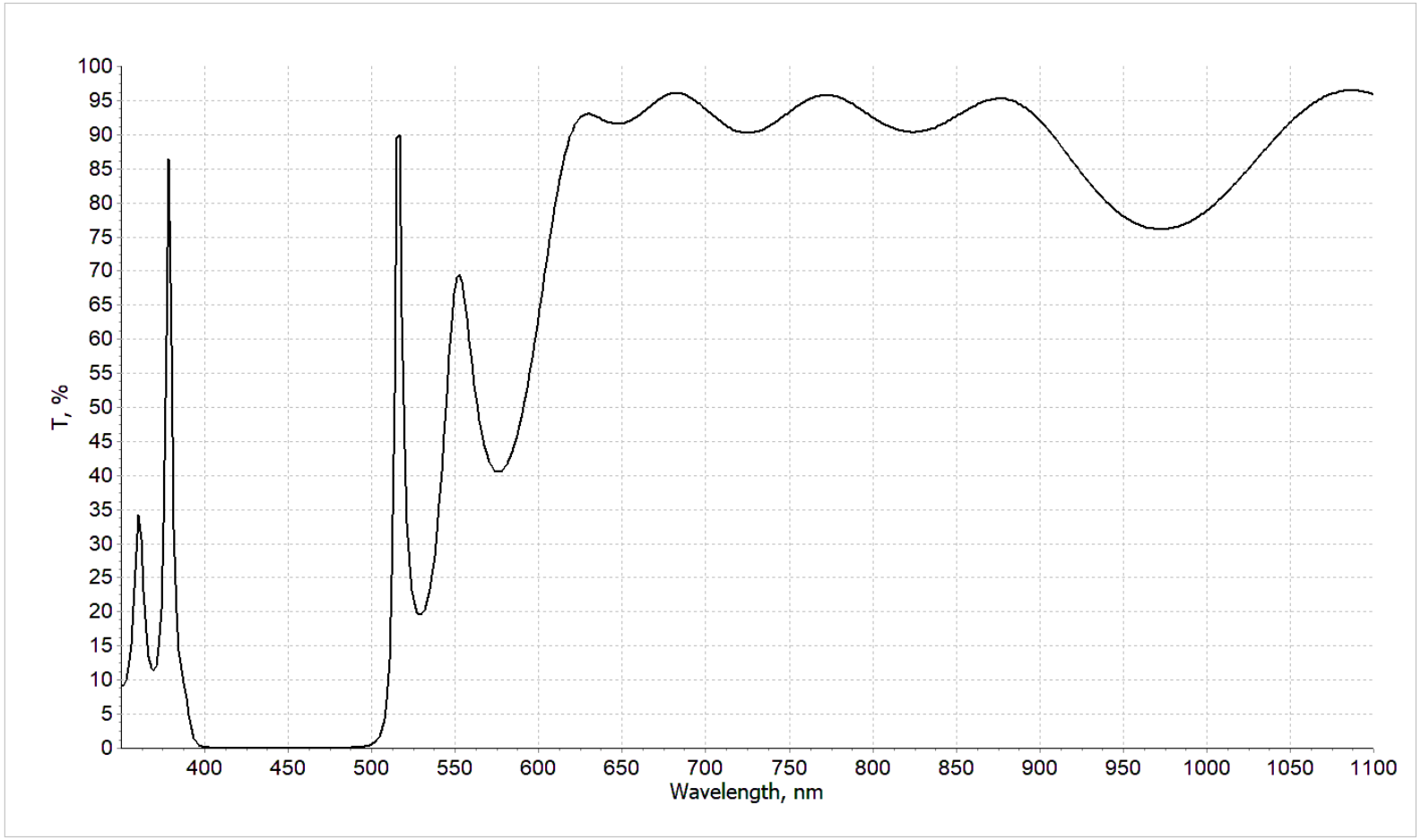
Incident angle: 0.0000

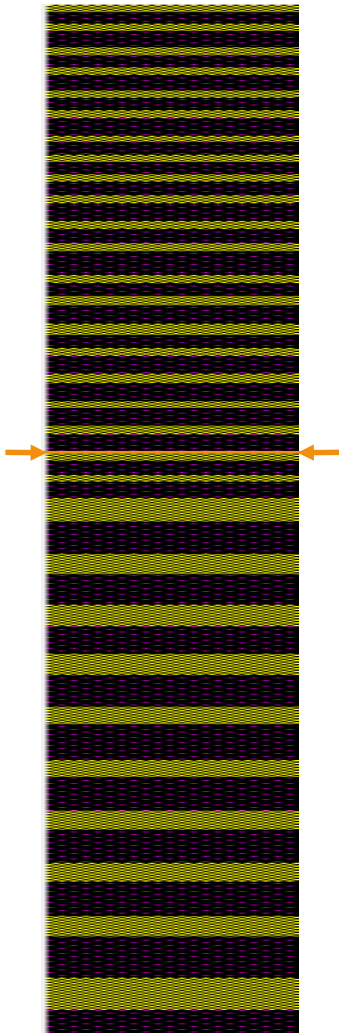
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 24
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

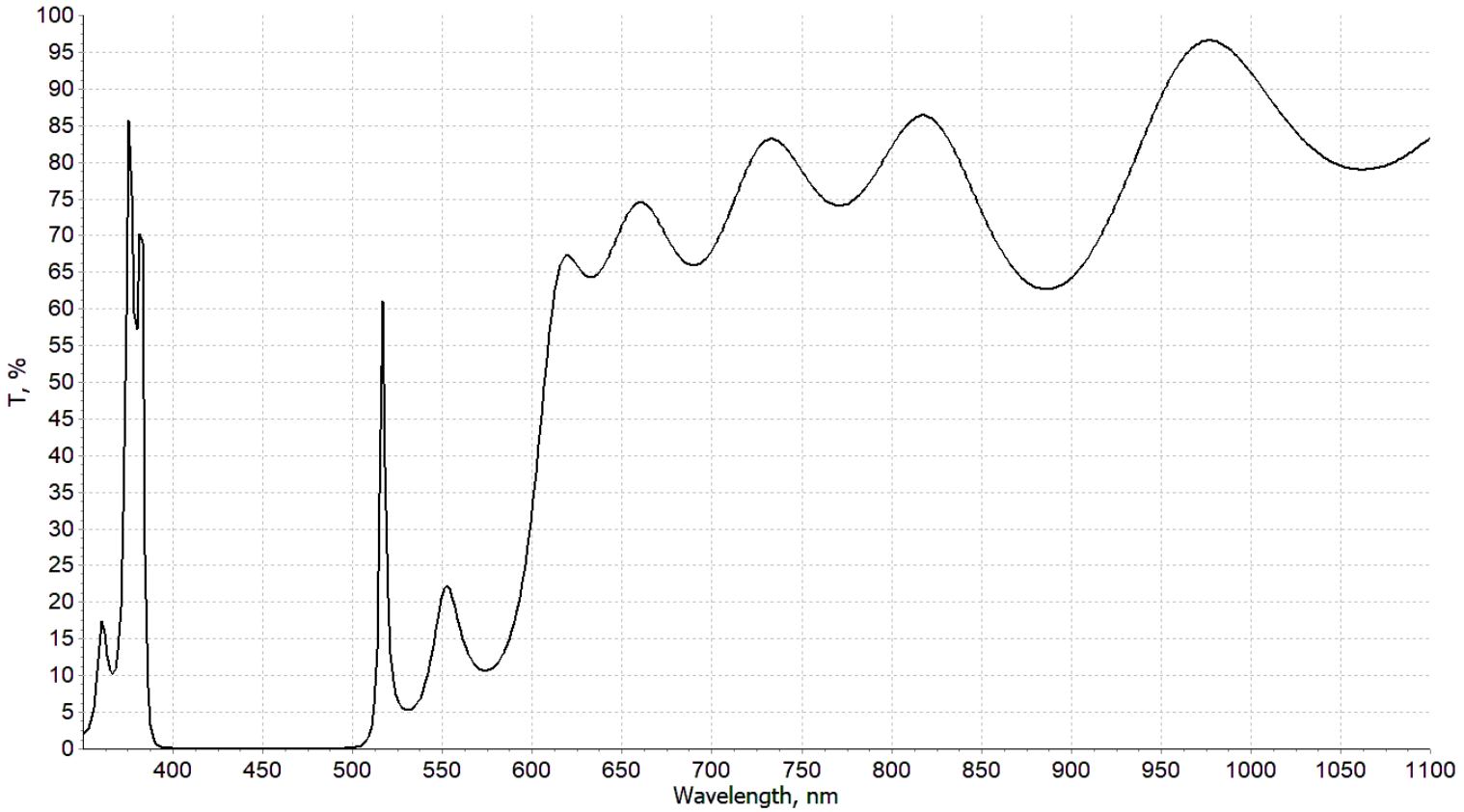
Wavelength max:
1100.000

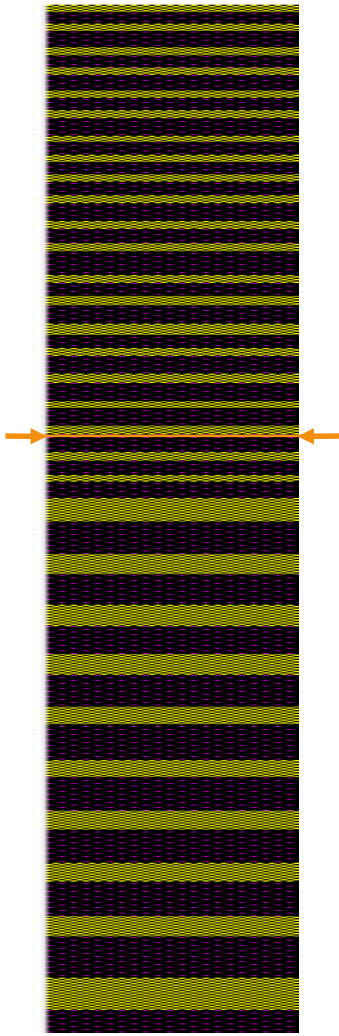
Points: 501

Preview Layer:
25

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

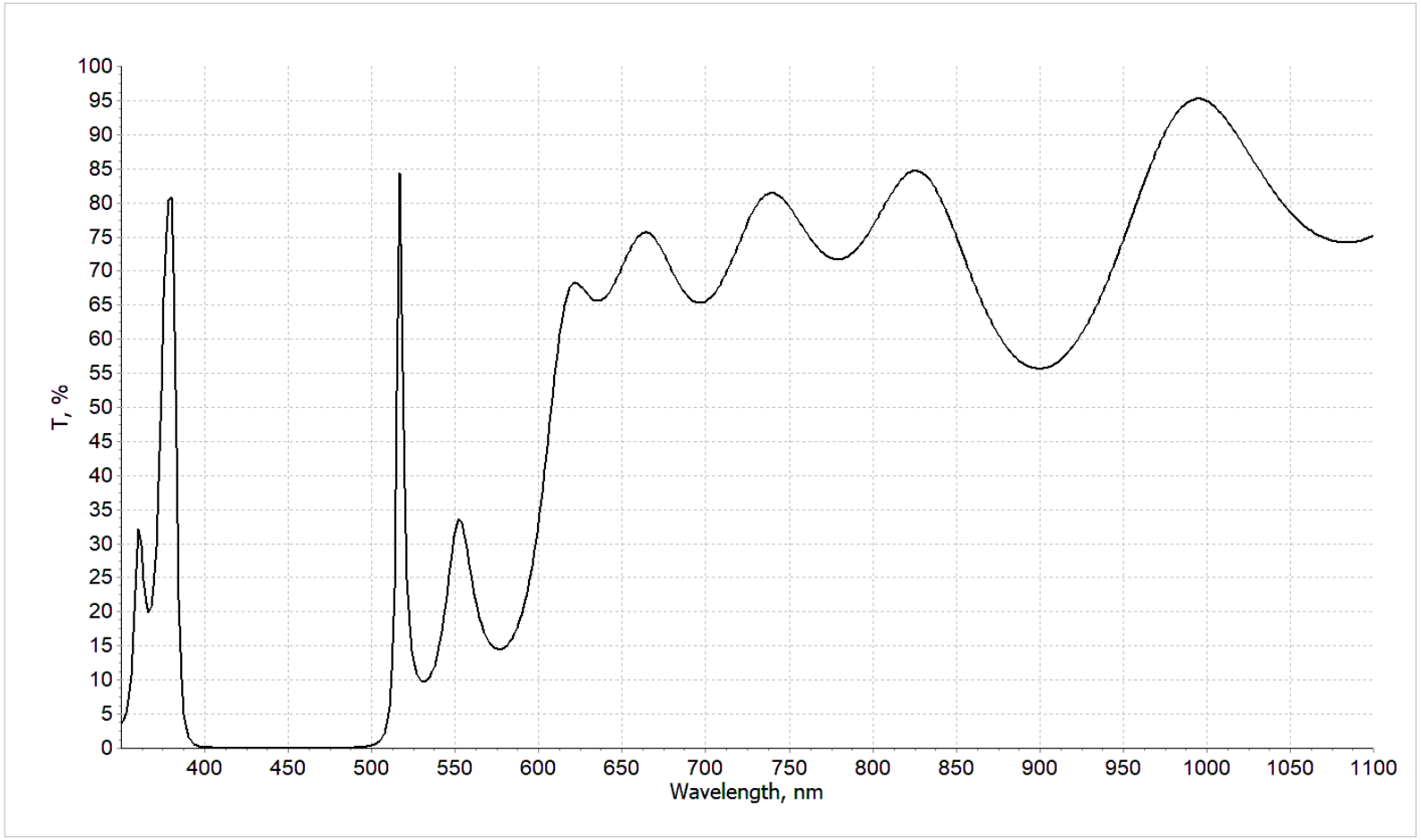
Wavelength max:
1100.000

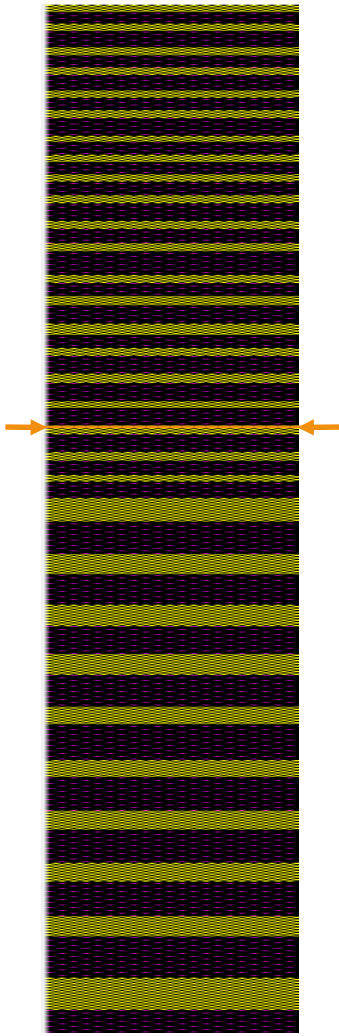
Points: 501

Preview Layer:
26

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

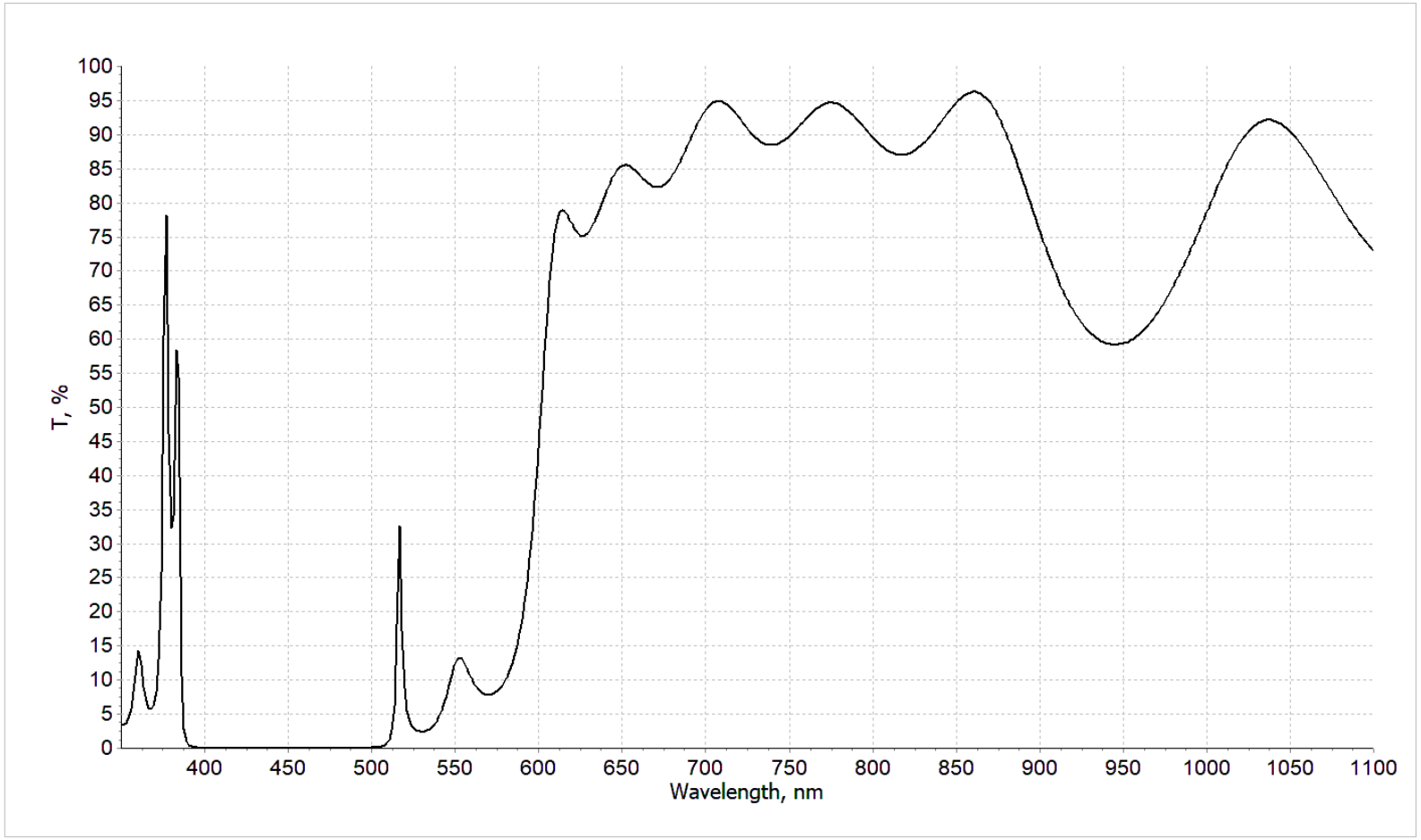
Wavelength max:
1100.000

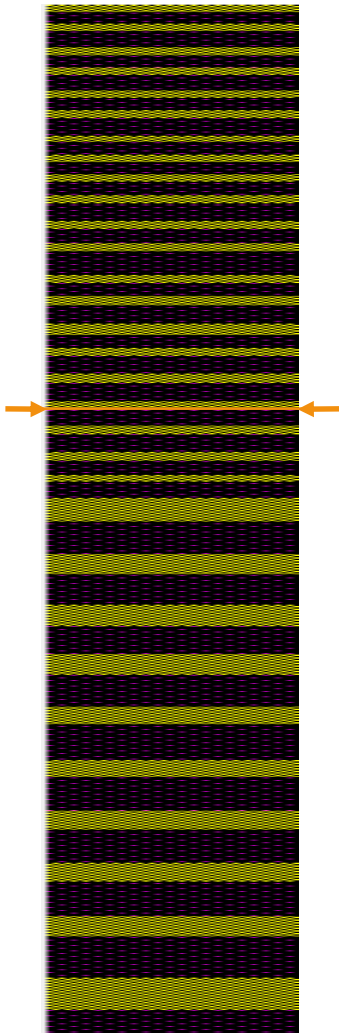
Points: 501

Preview Layer:
27

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

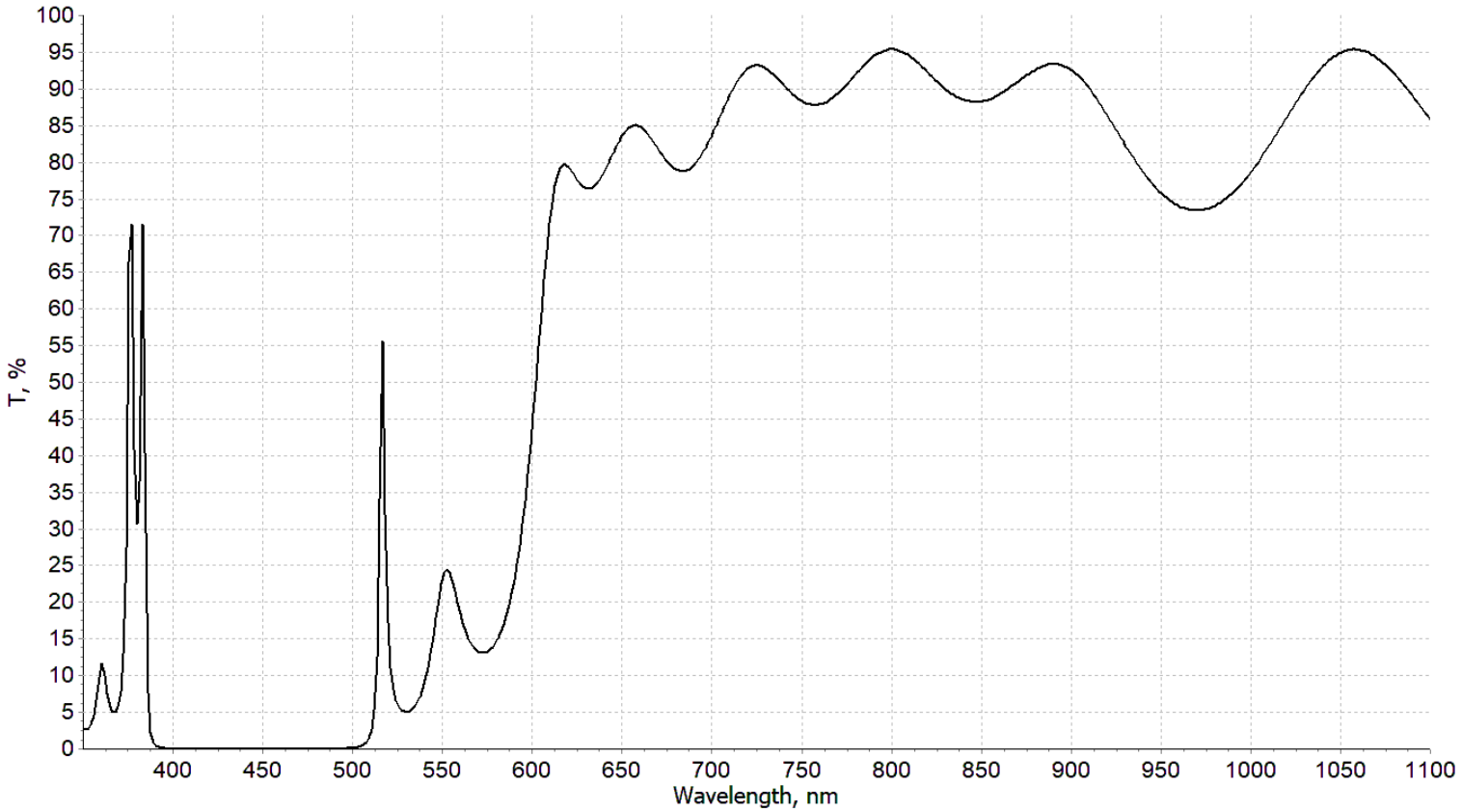
Wavelength max:
1100.000

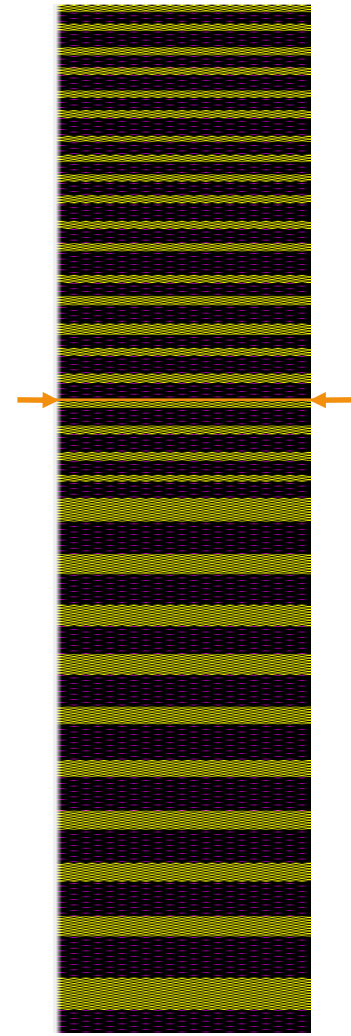
Points: 501

Preview Layer:
28

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

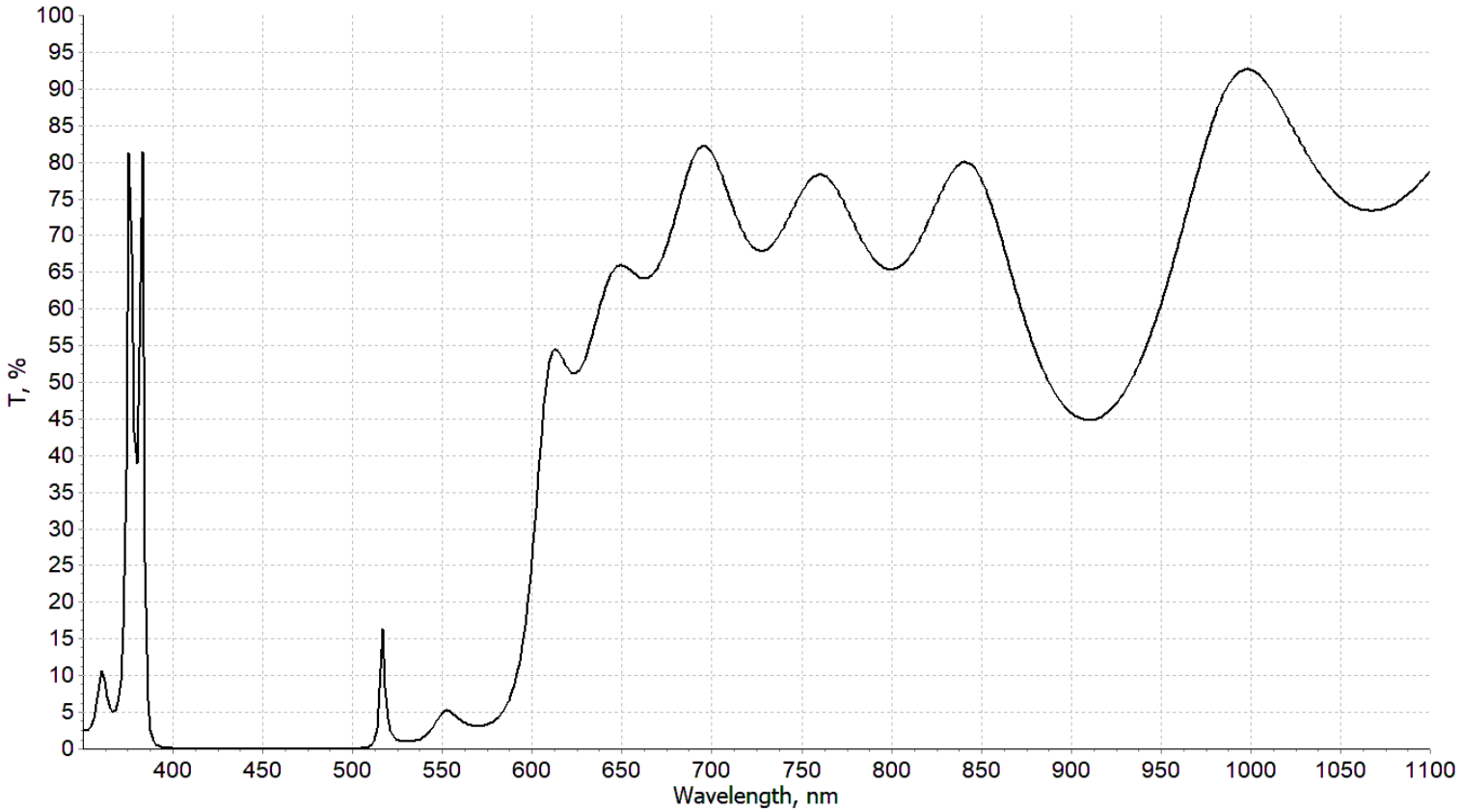
Wavelength max:
1100.000

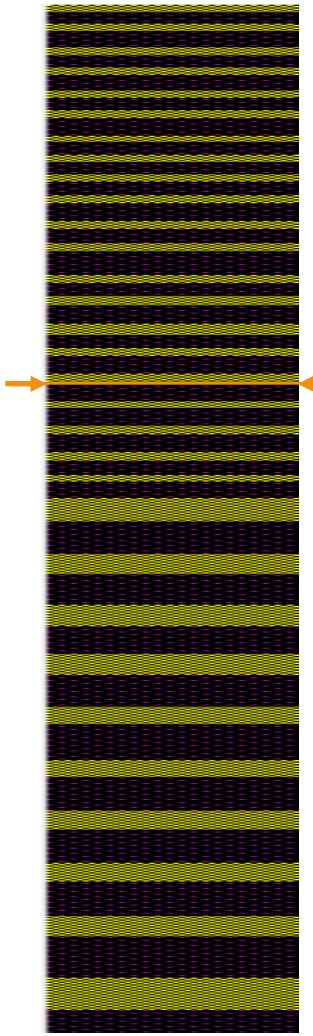
Points: 501

Preview Layer:
29

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

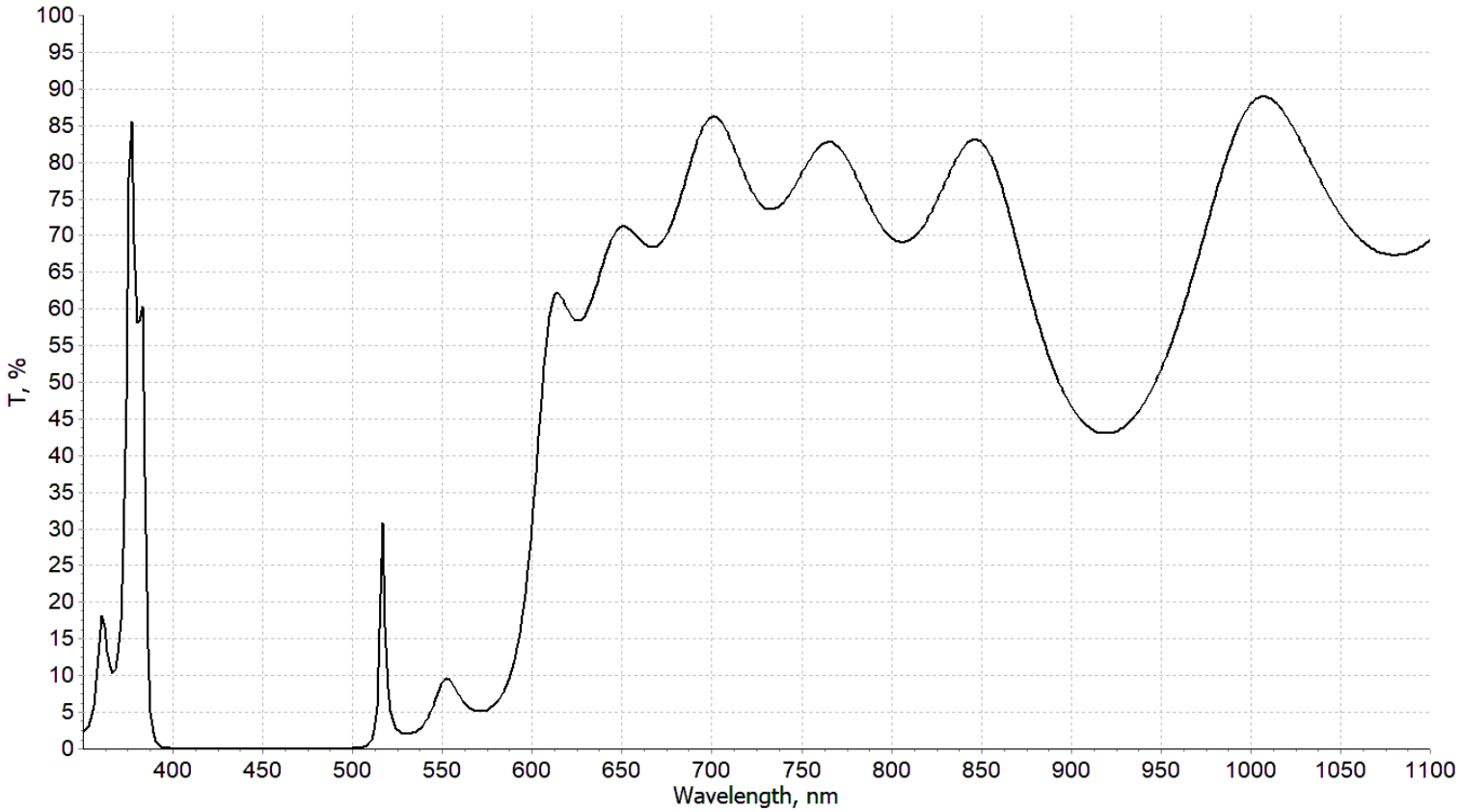
Wavelength max:
1100.000

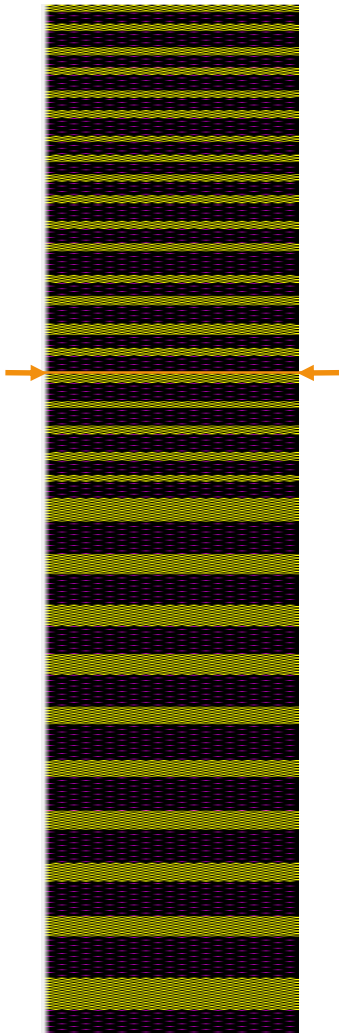
Points: 501

Preview Layer:
30

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

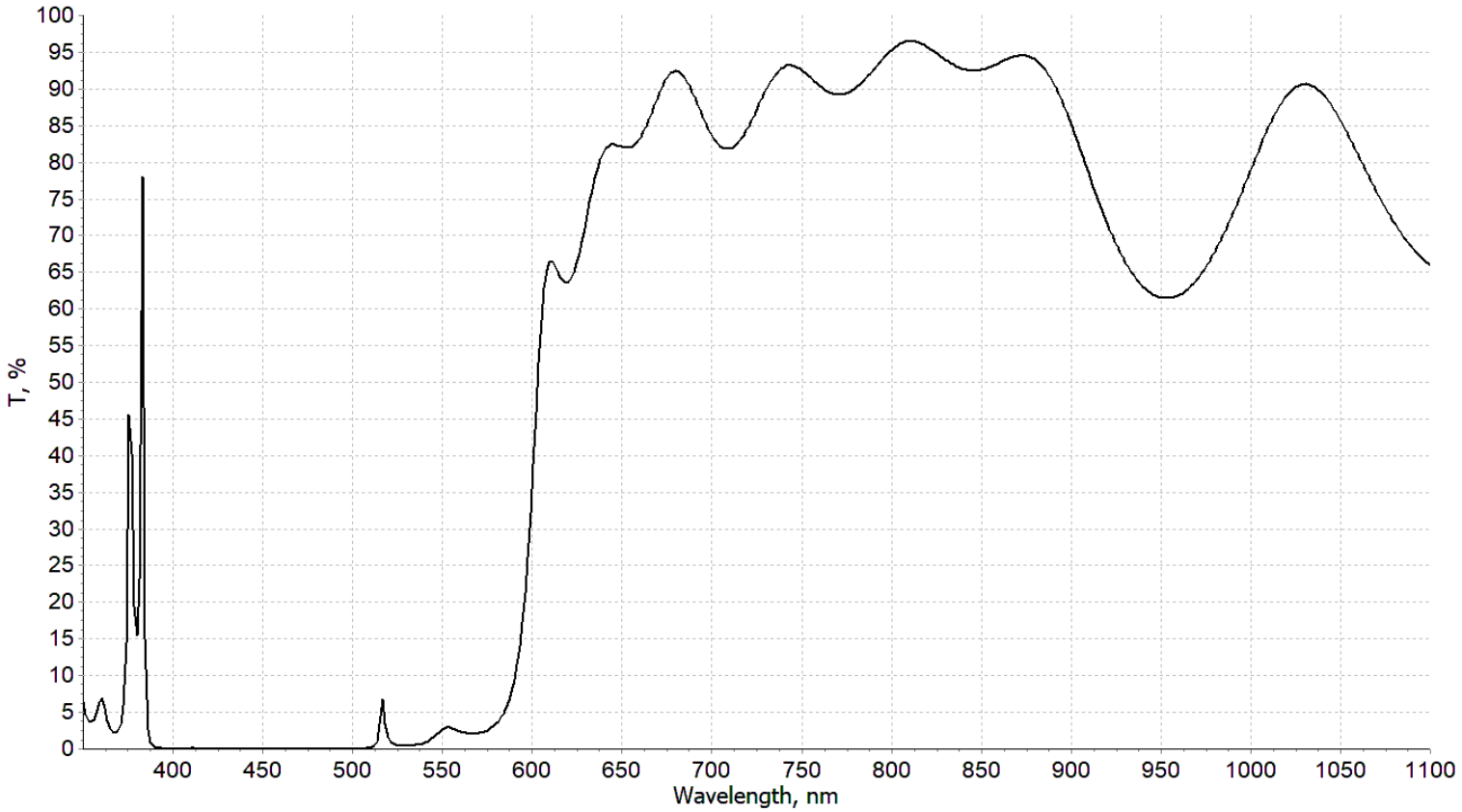
Incident angle: 0.0000

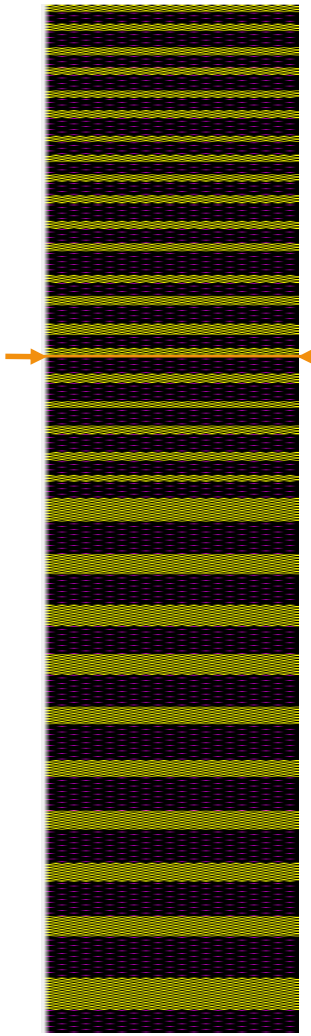
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 31
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

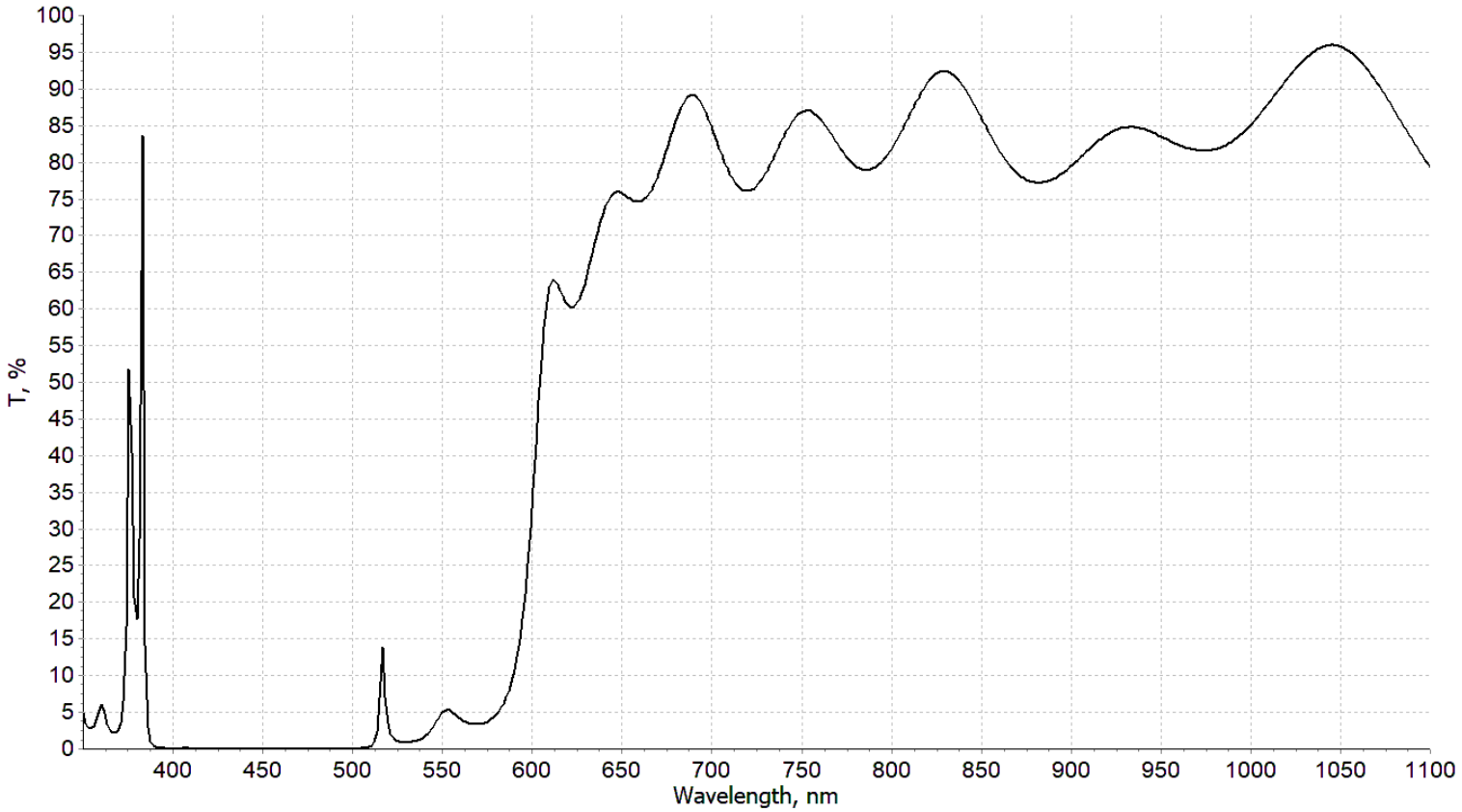
Incident angle: 0.0000

Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 32
Update

Y Axis Scale:
Auto 100%



Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

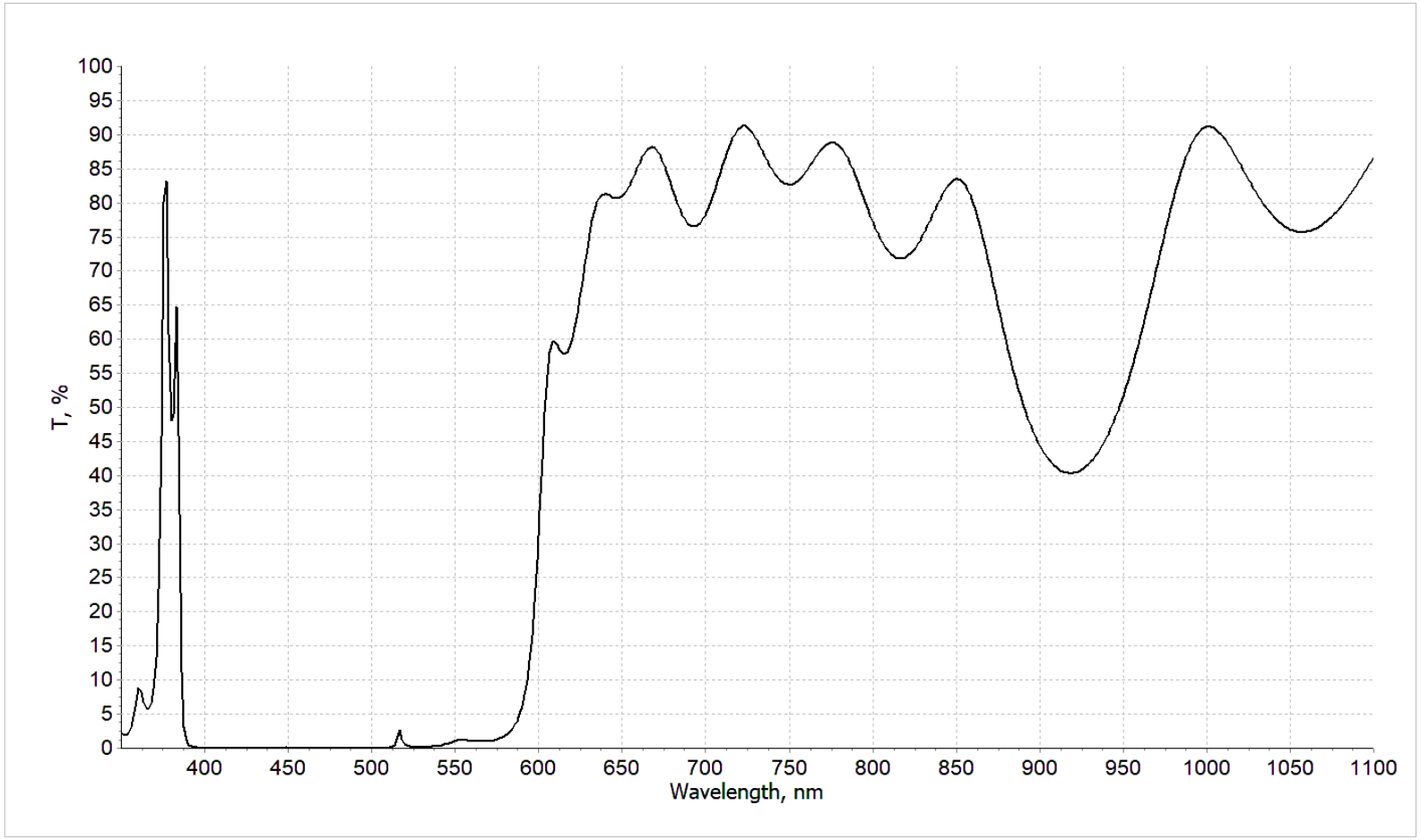
Wavelength max:
1100.000

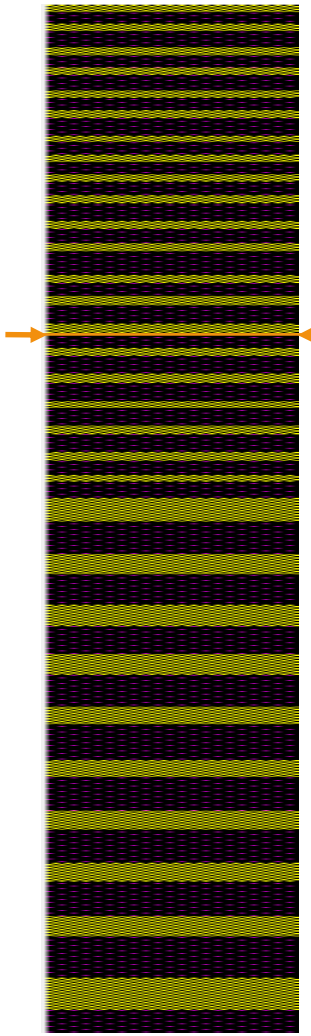
Points: 501

Preview Layer:
33

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

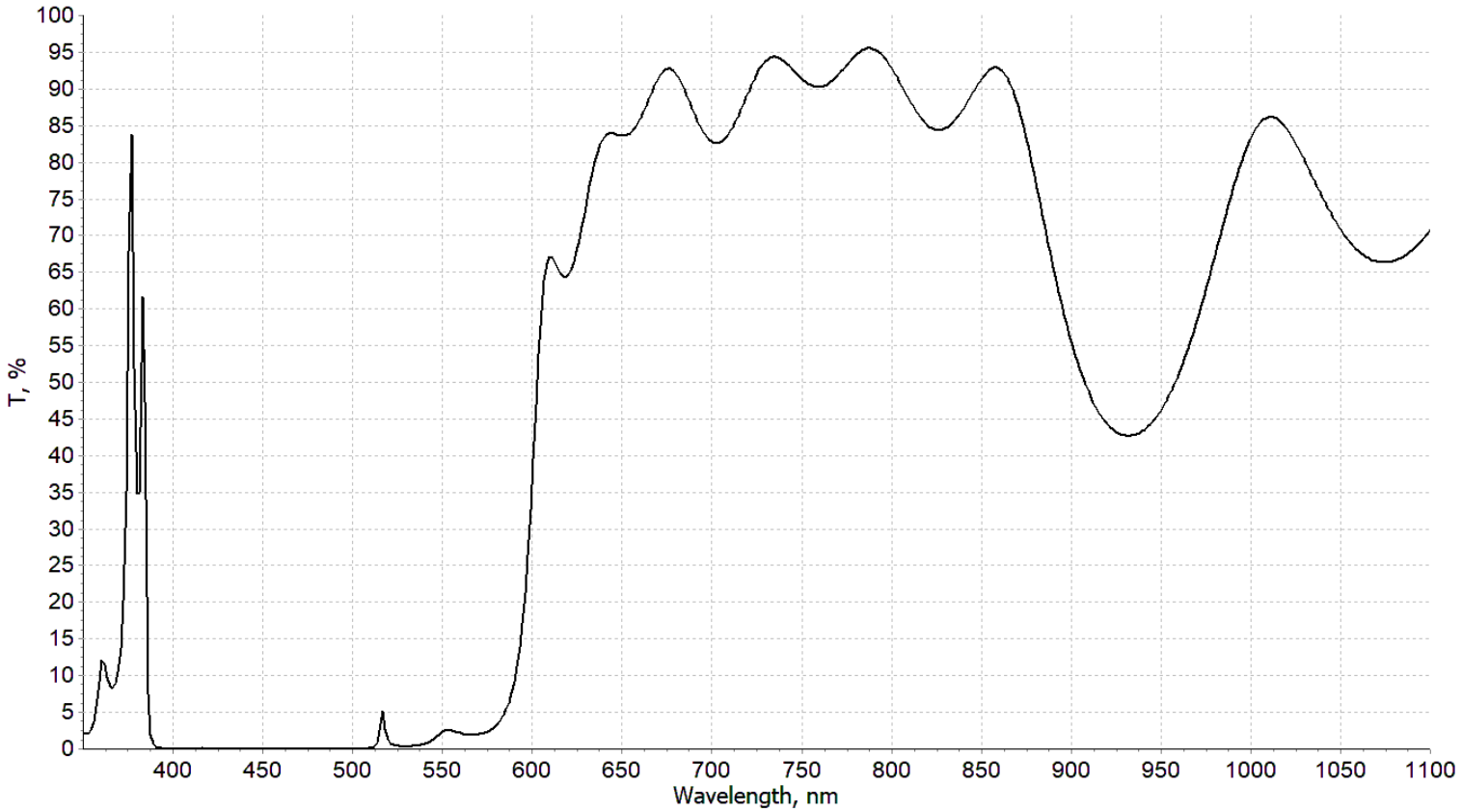
Wavelength max:
1100.000

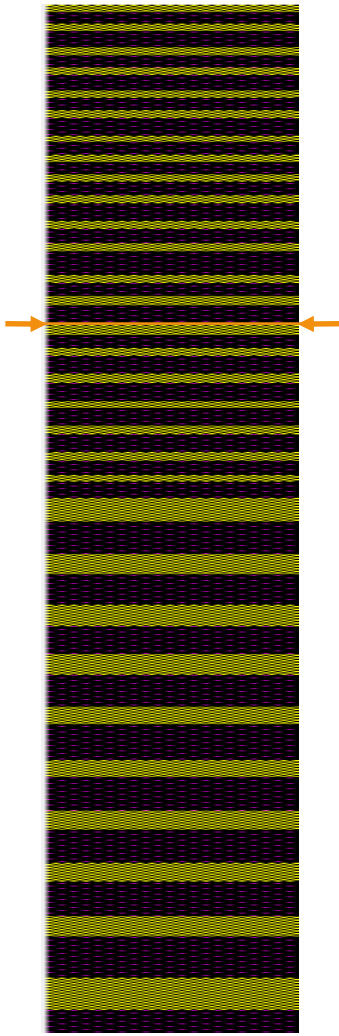
Points: 501

Preview Layer:
34

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

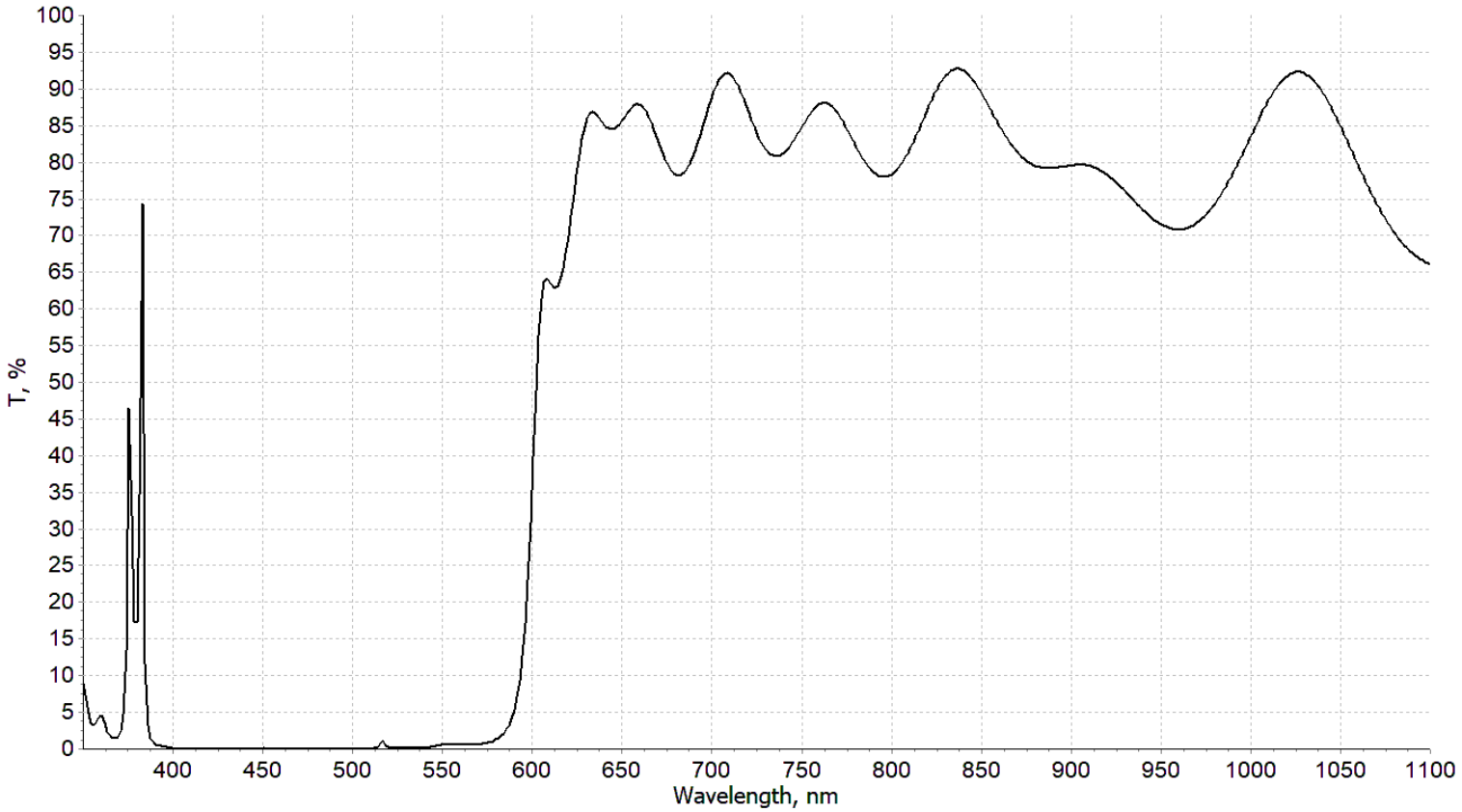
Incident angle: 0.0000

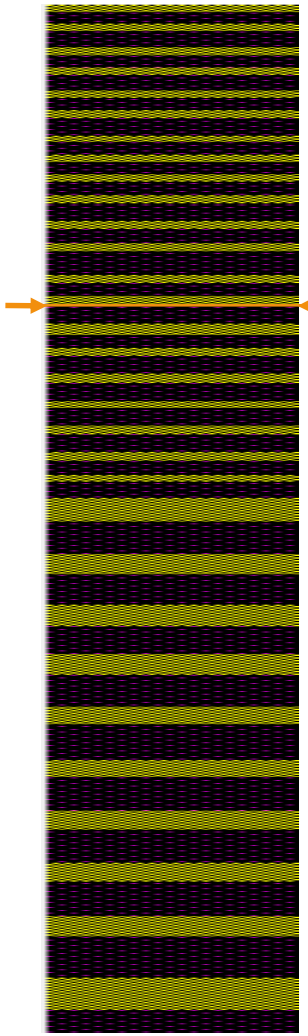
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 35
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

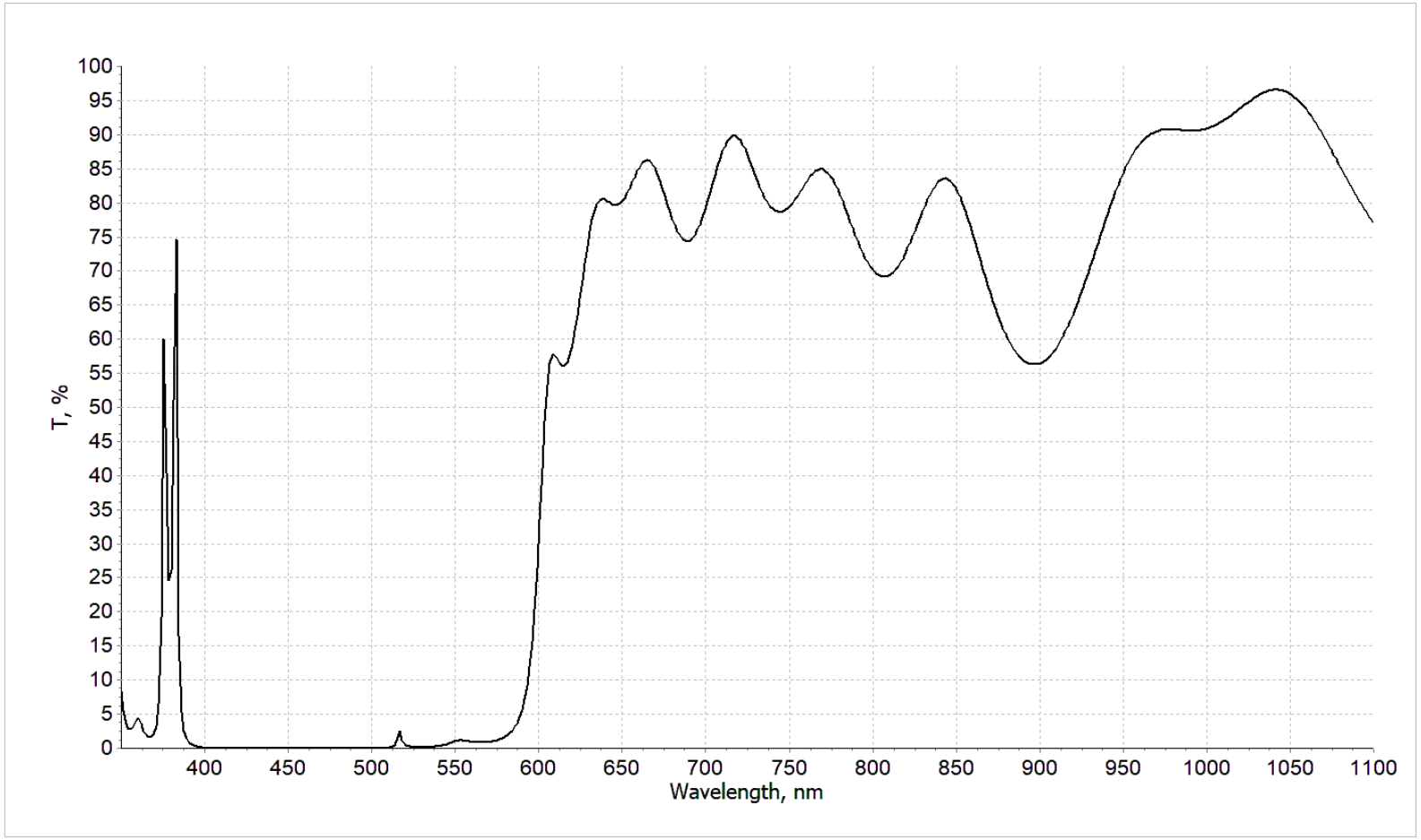
Incident angle: 0.0000

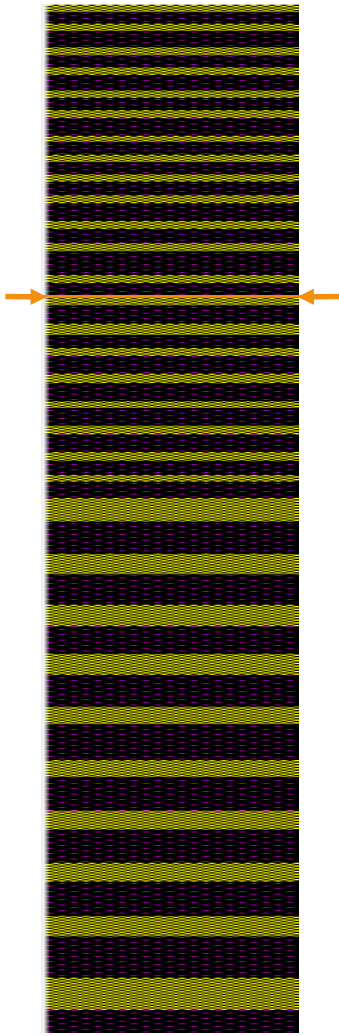
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 36
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

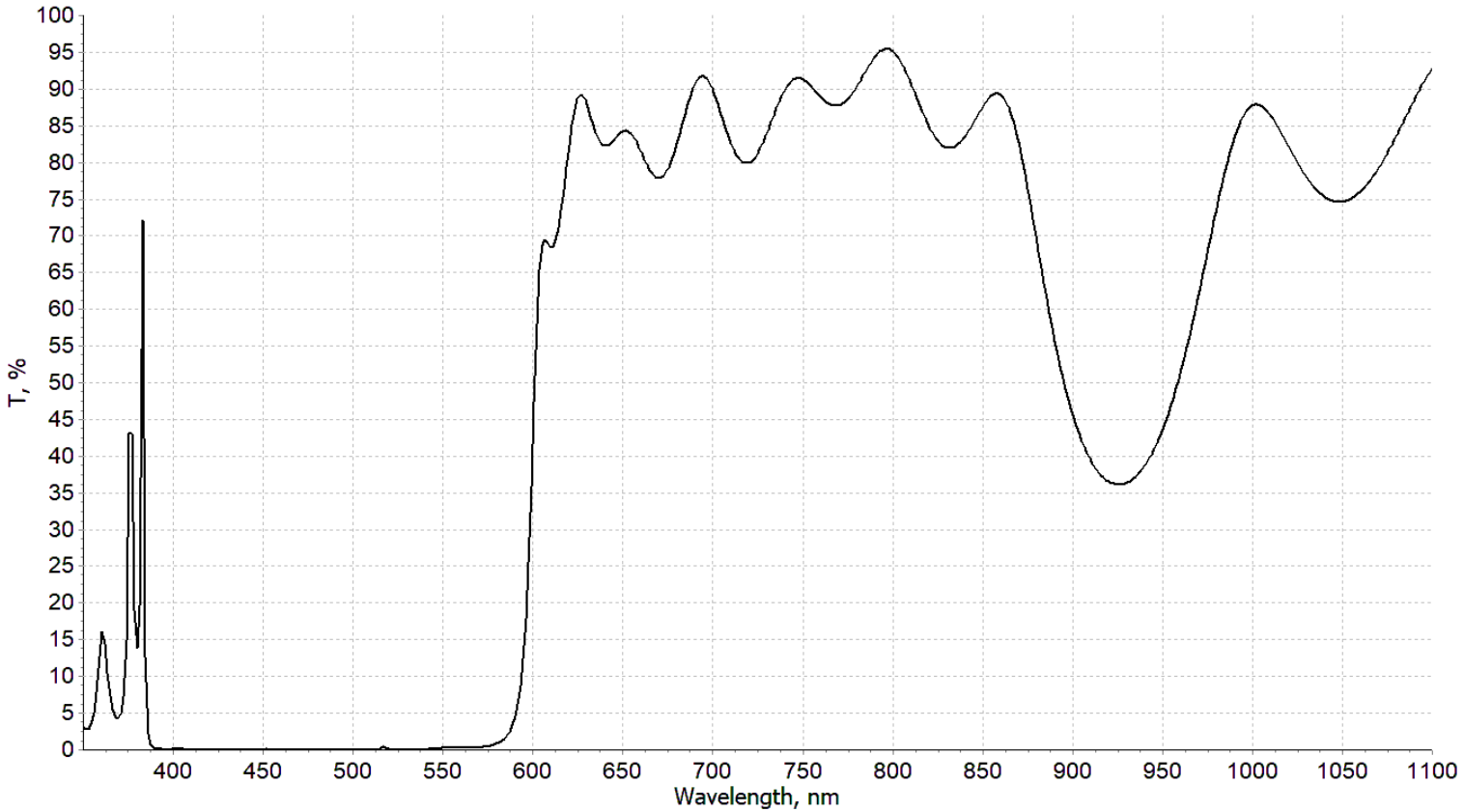
Incident angle: 0.0000

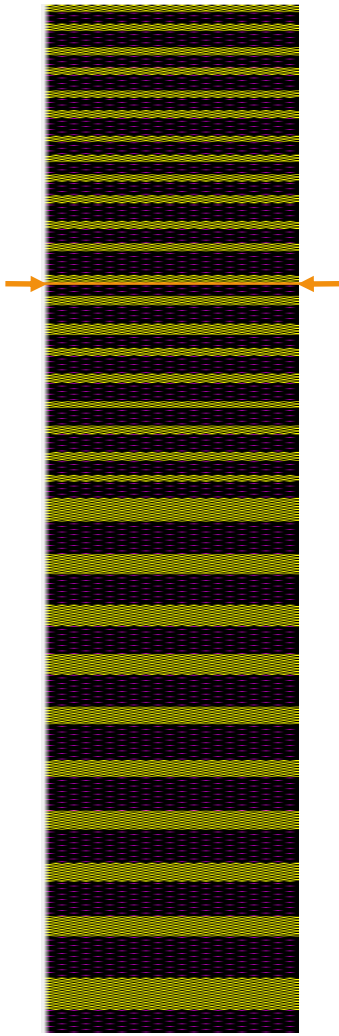
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 37
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

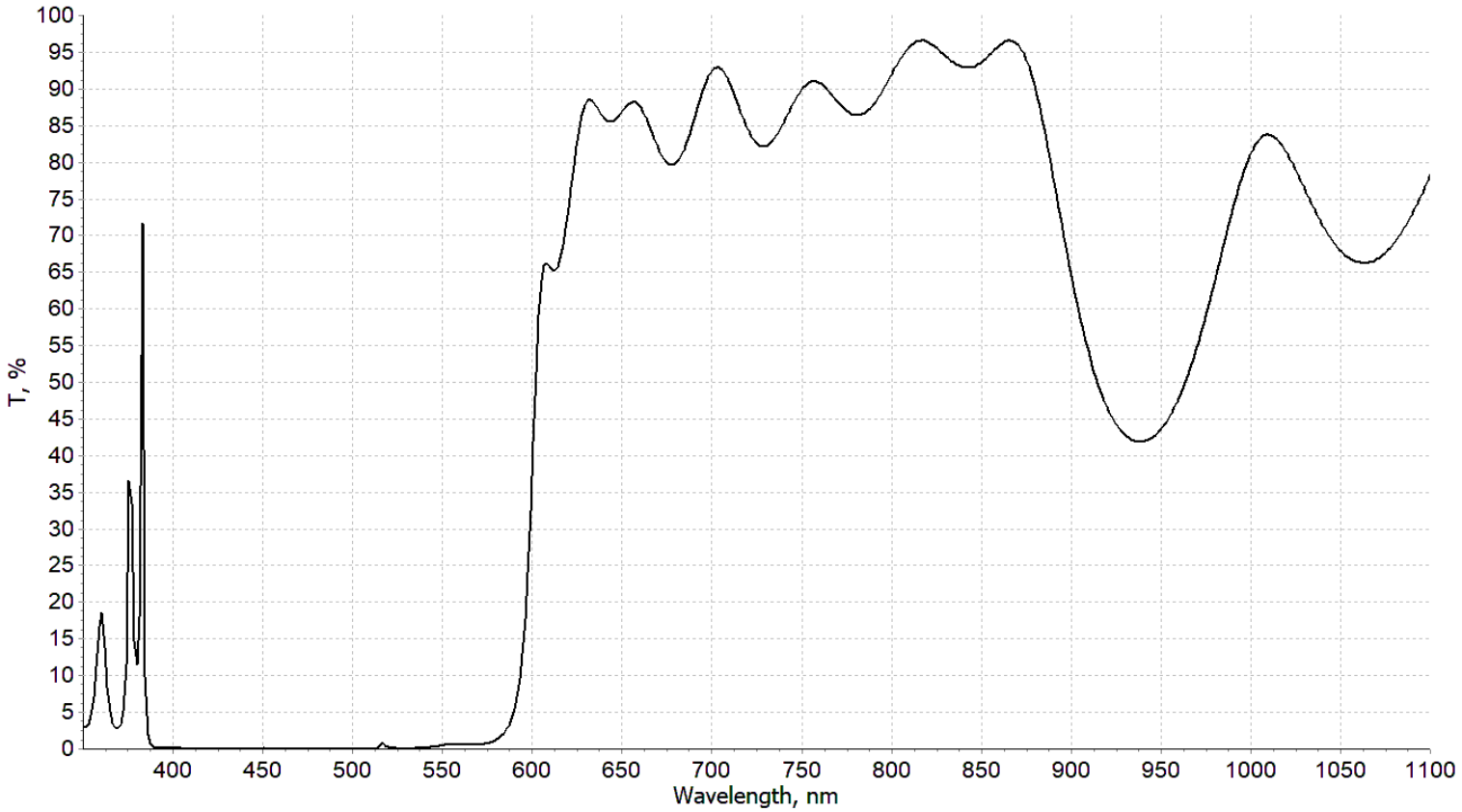
Incident angle: 0.0000

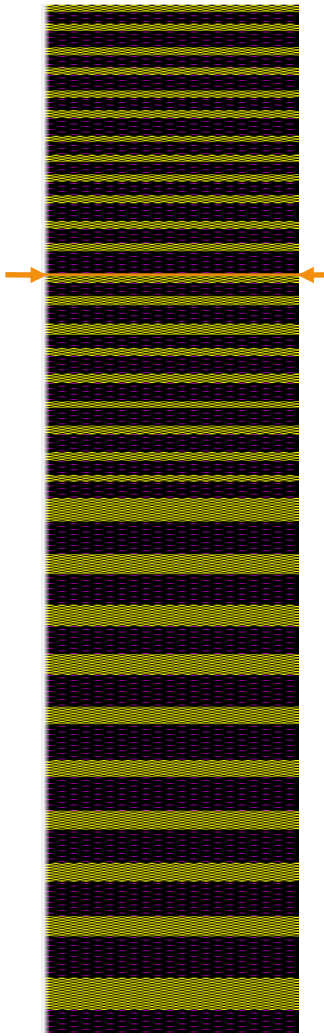
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 38
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

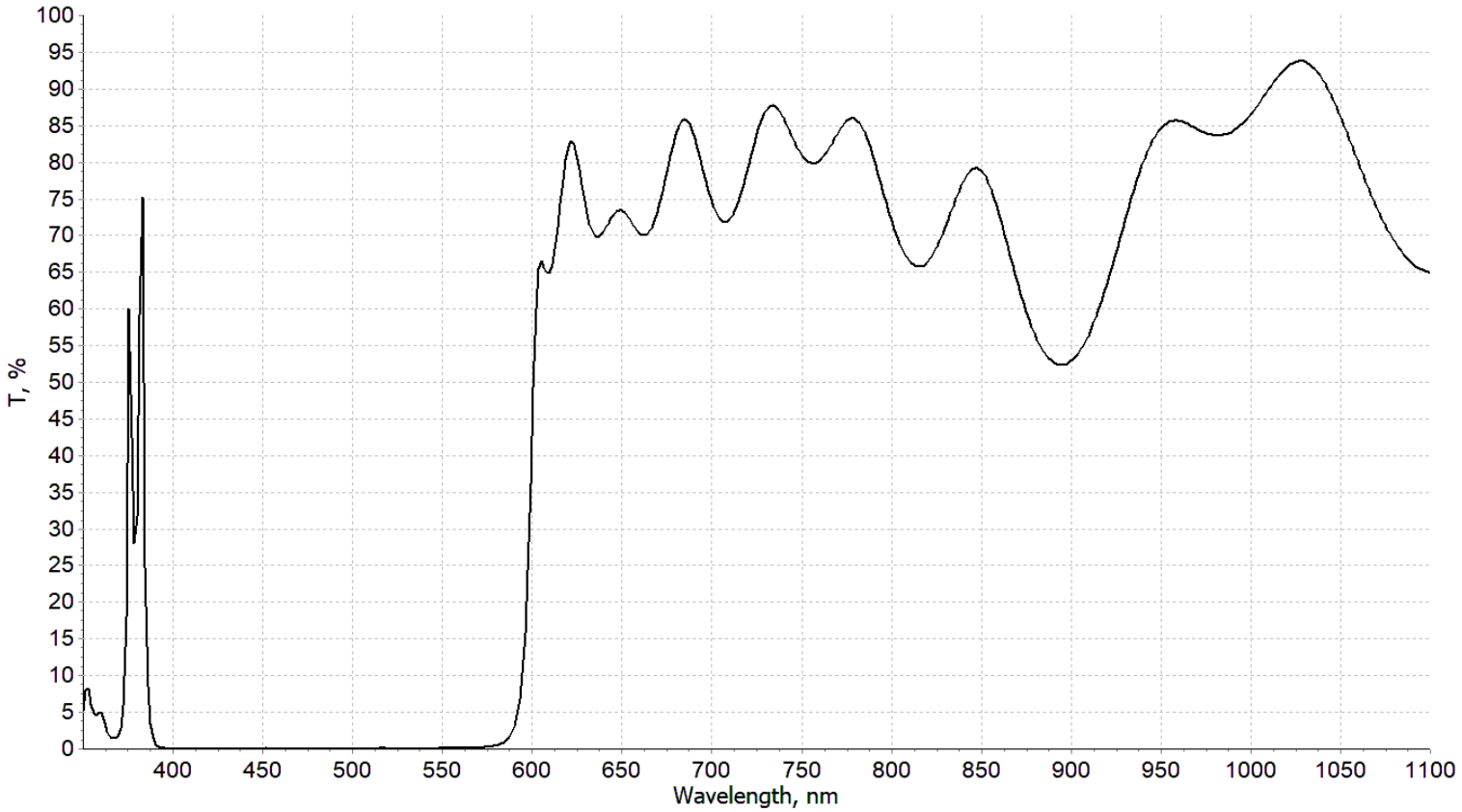
Wavelength max:
1100.000

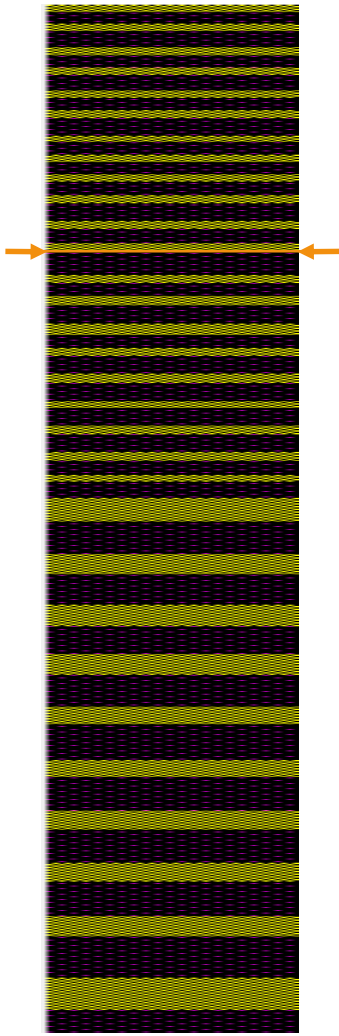
Points: 501

Preview Layer:
39

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

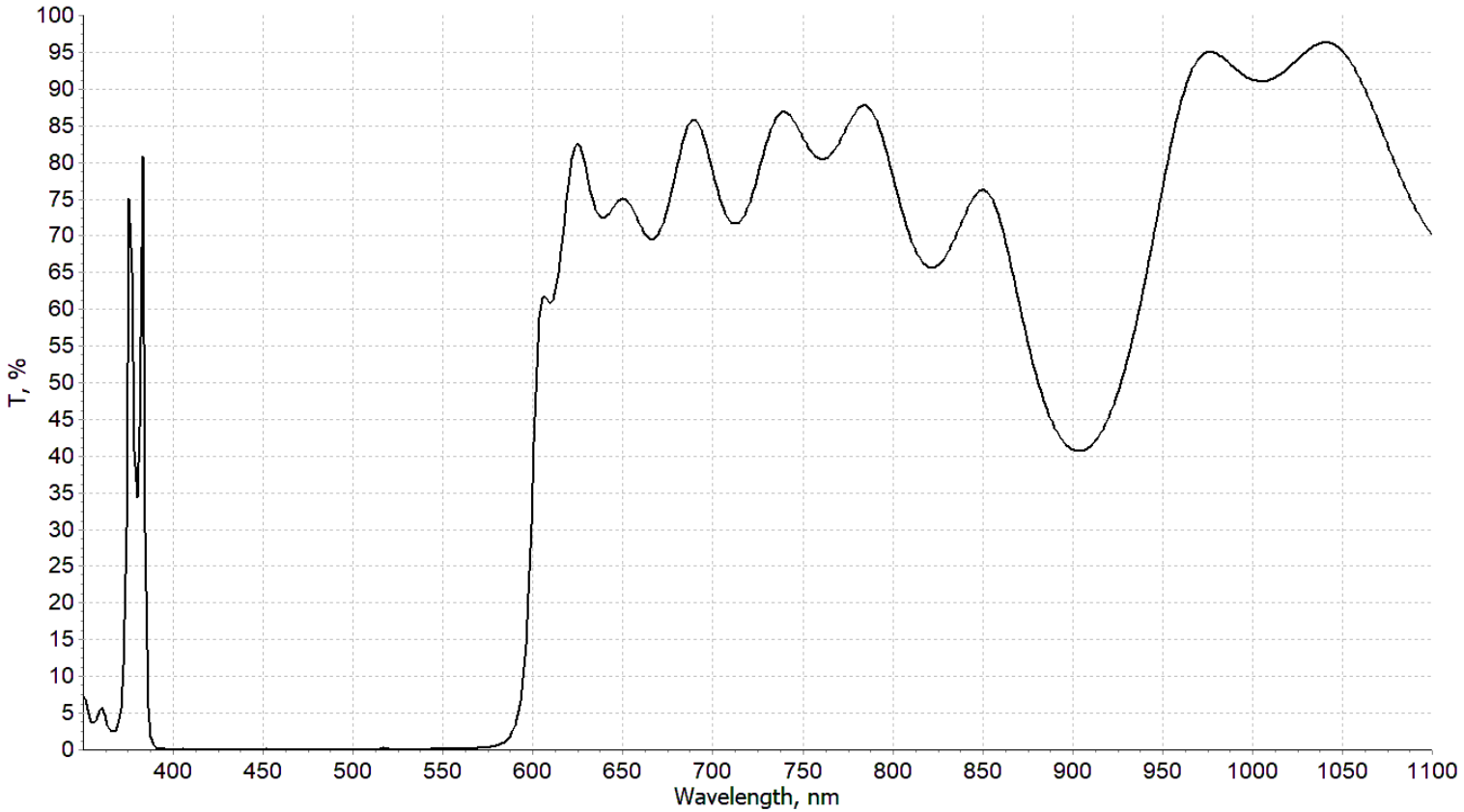
Incident angle: 0.0000

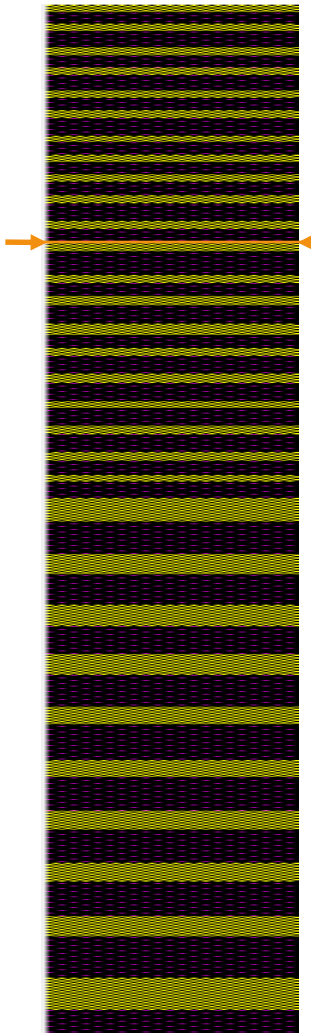
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 40
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

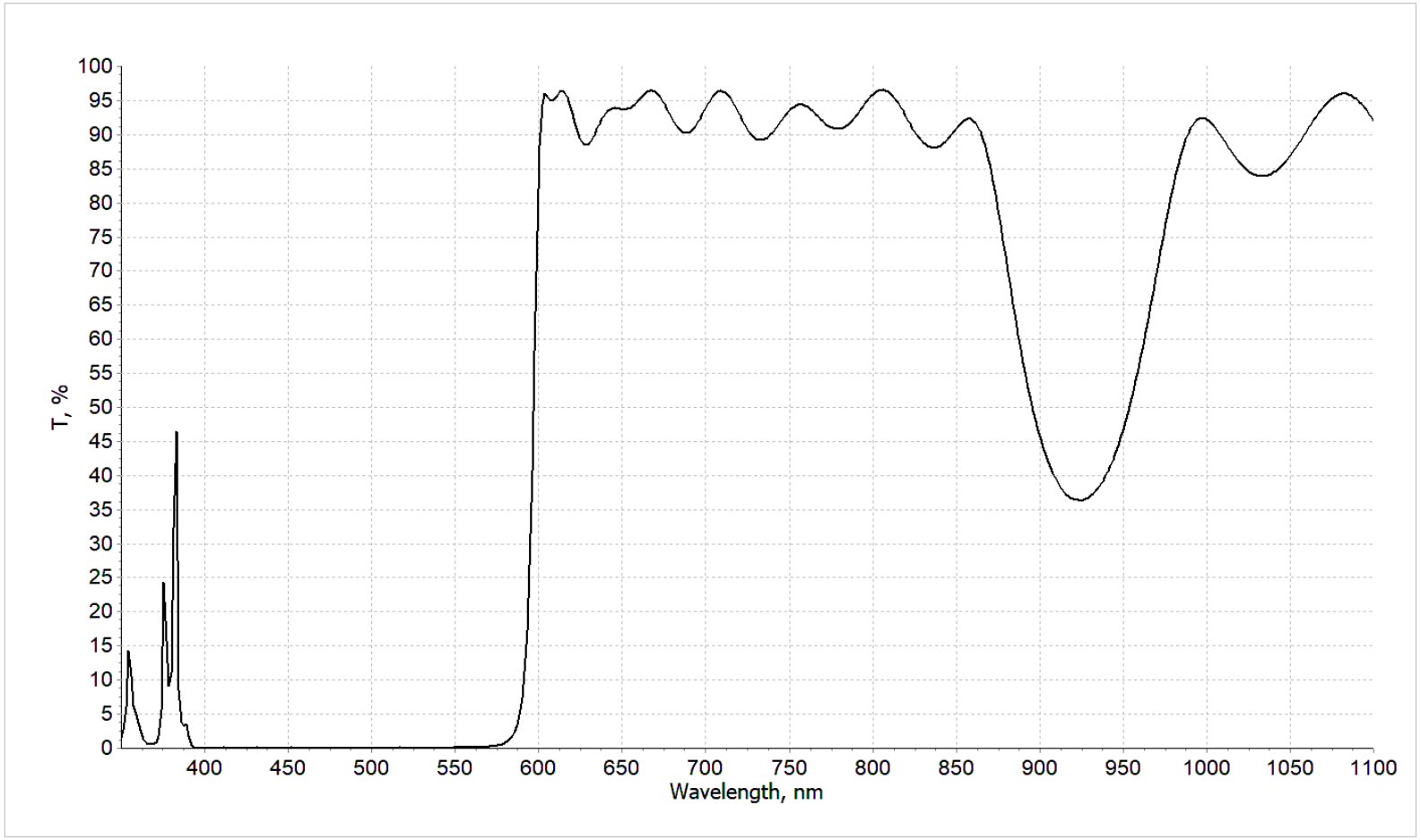
Incident angle: 0.0000

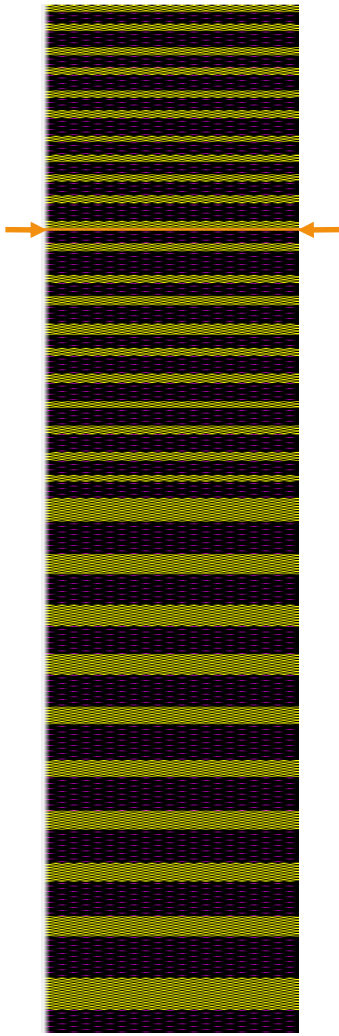
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 41
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

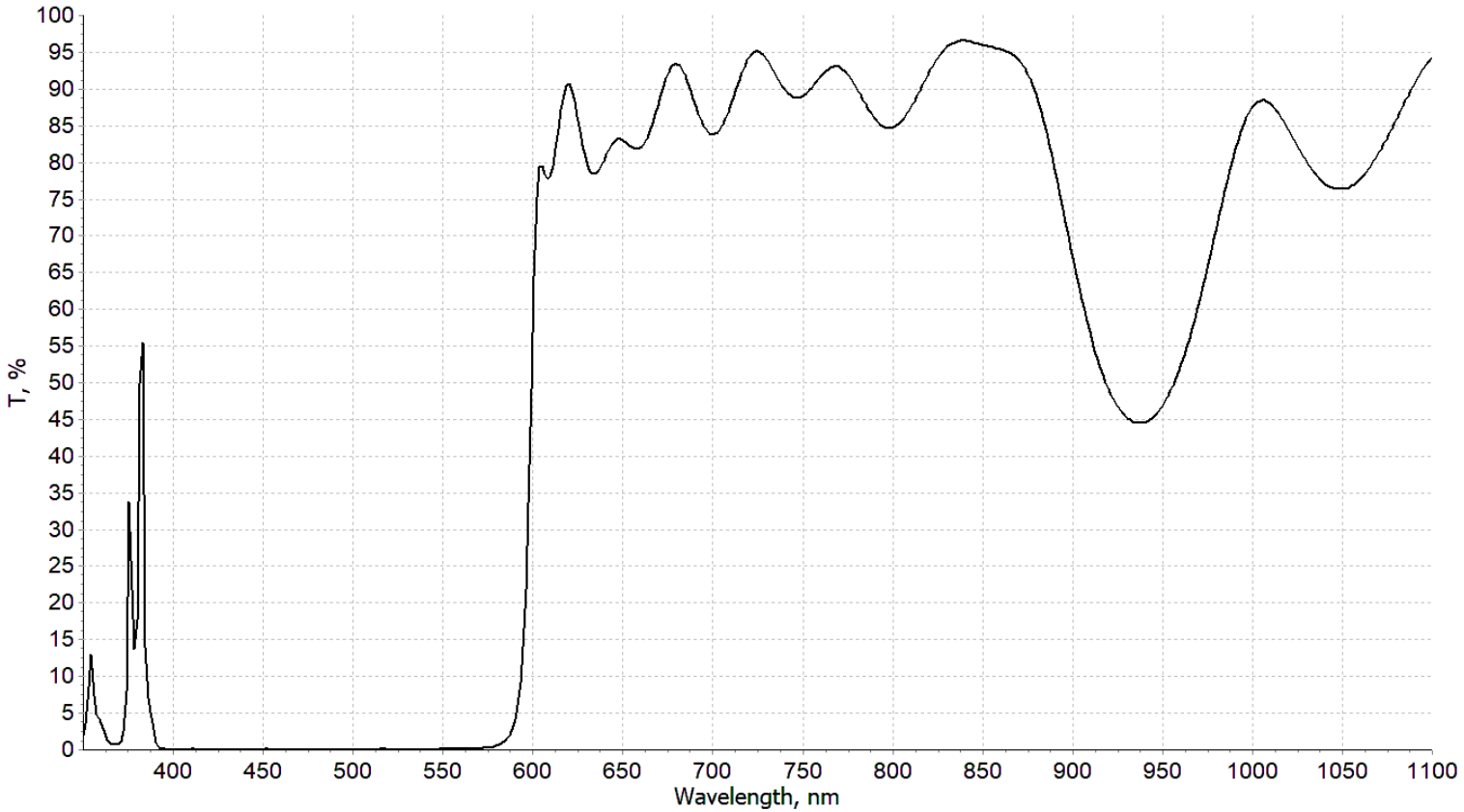
Incident angle: 0.0000

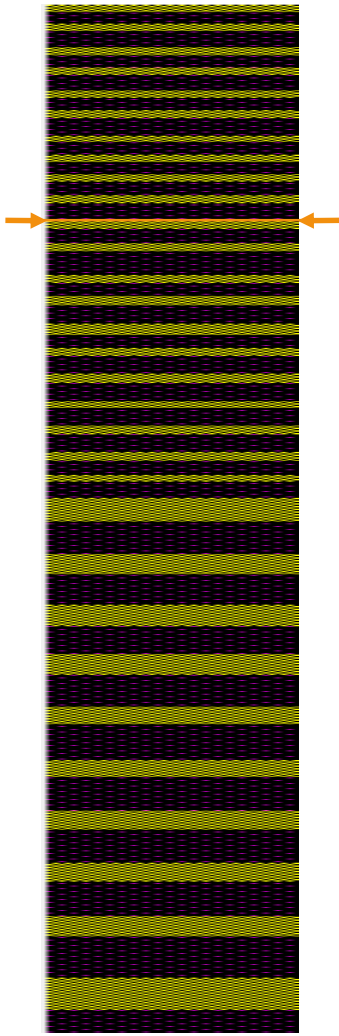
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 42
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

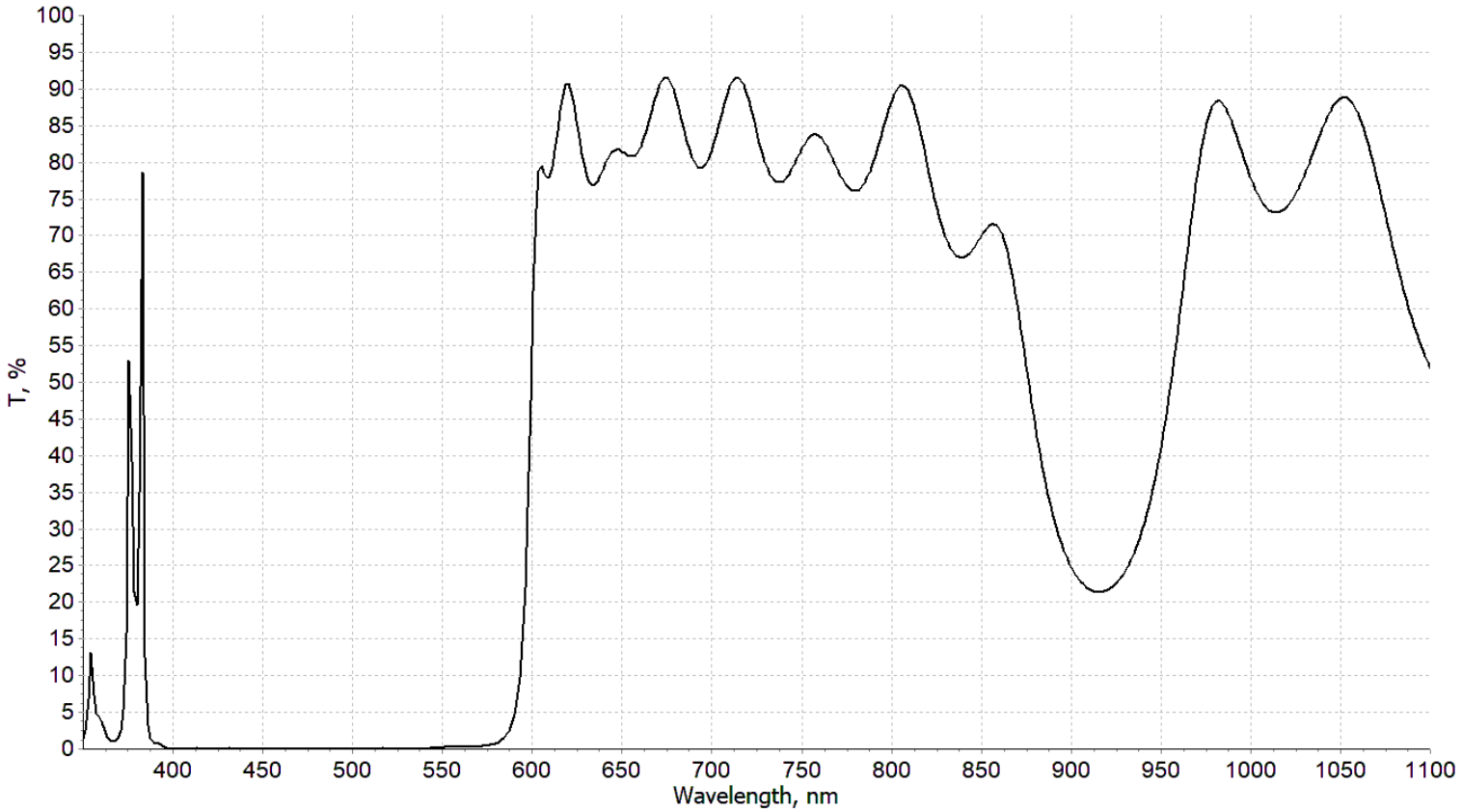
Incident angle: 0.0000

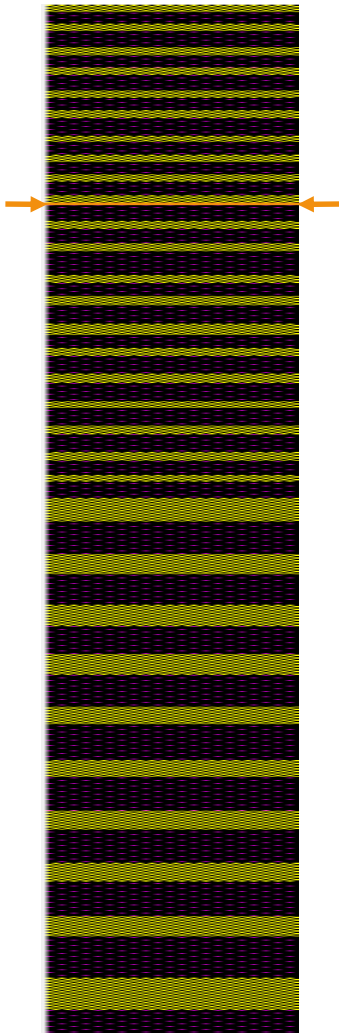
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 43
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

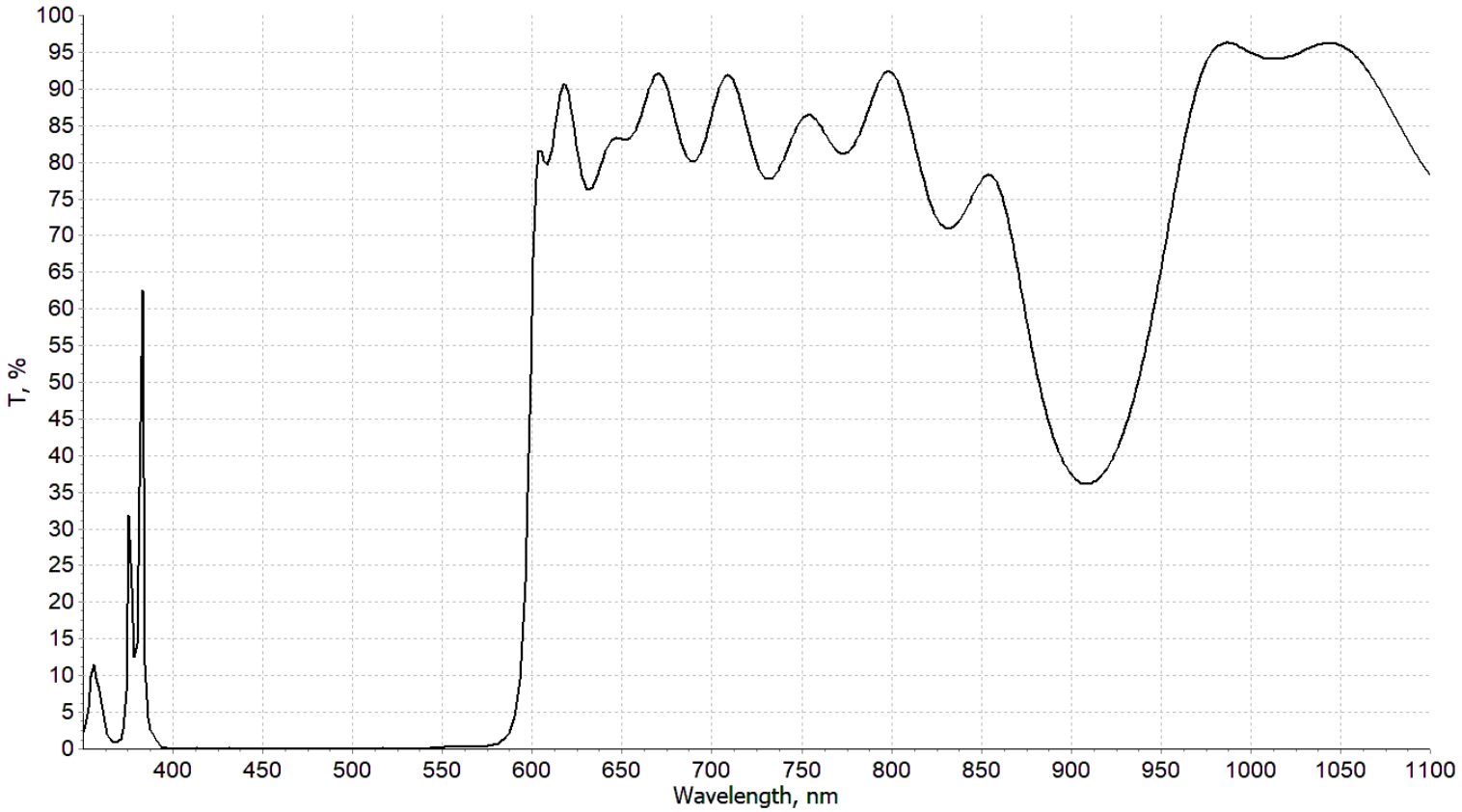
Wavelength max:
1100.000

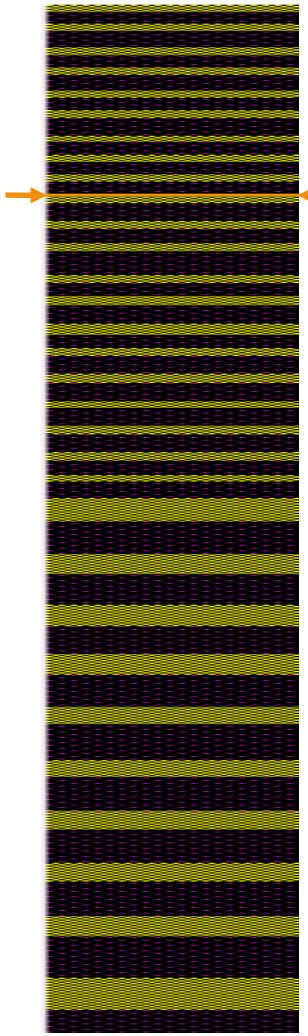
Points: 501

Preview Layer:
44

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

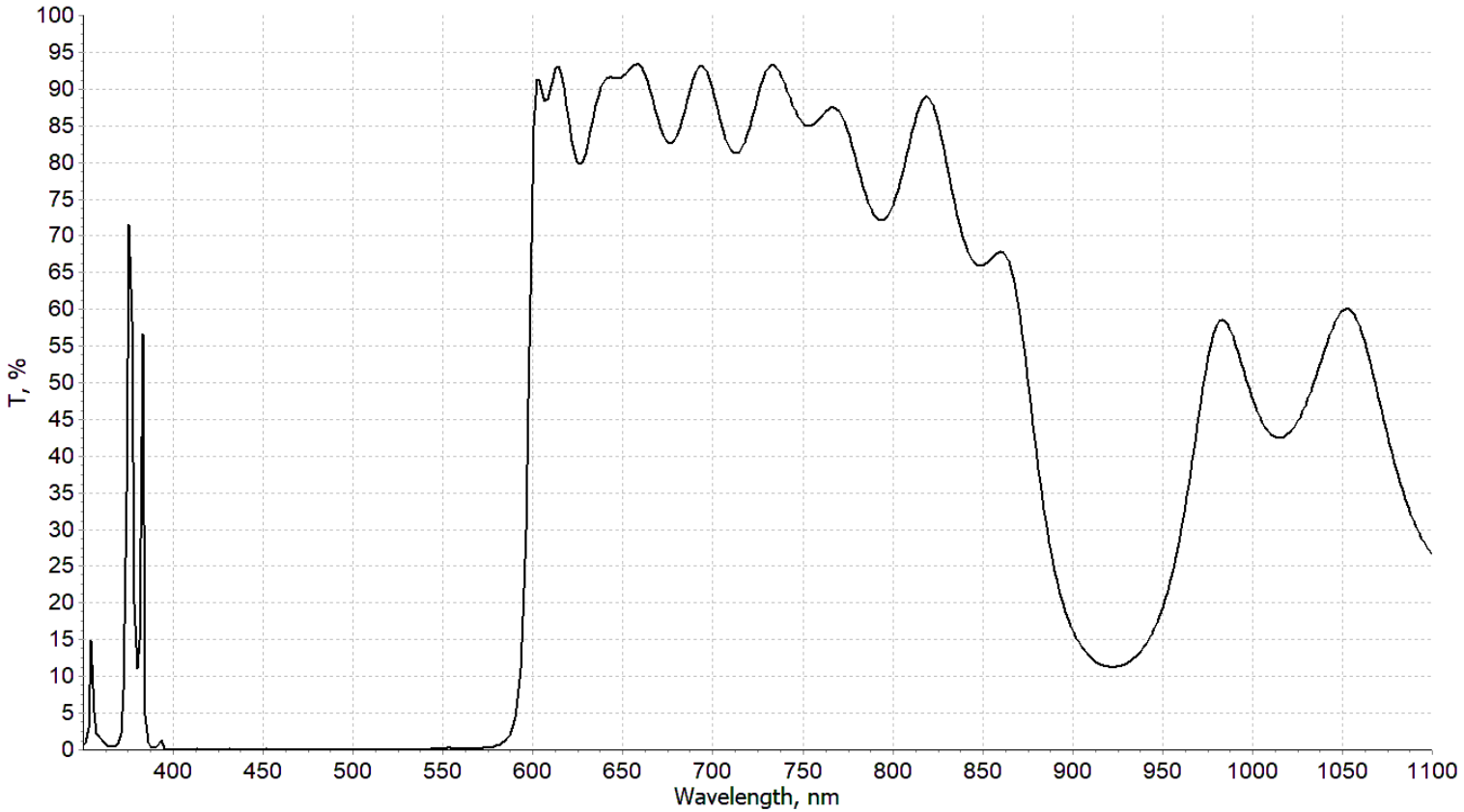
Incident angle: 0.0000

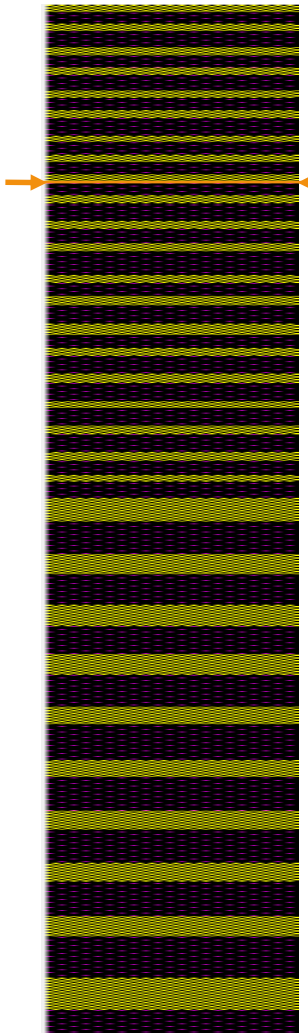
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 45
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

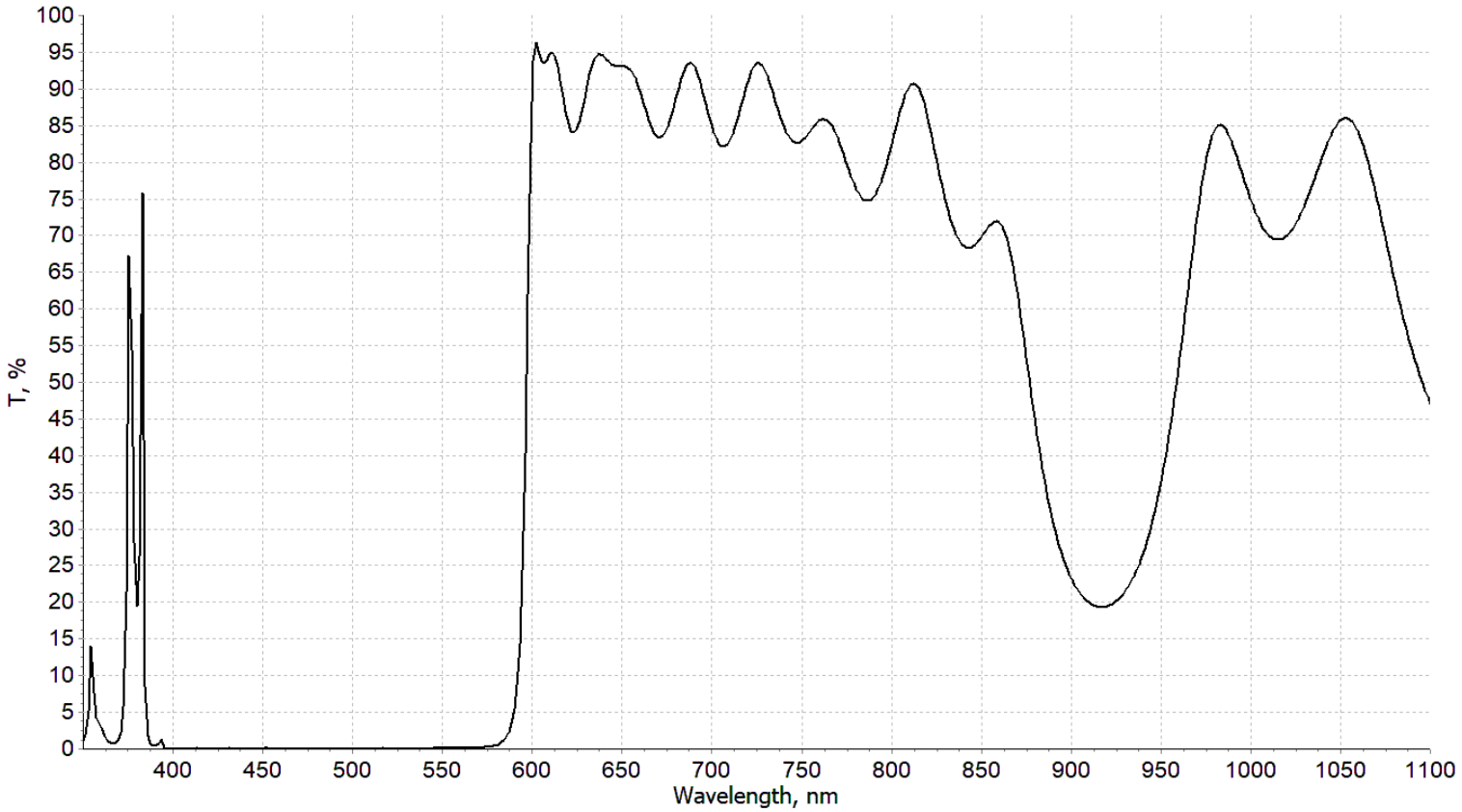
Incident angle: 0.0000

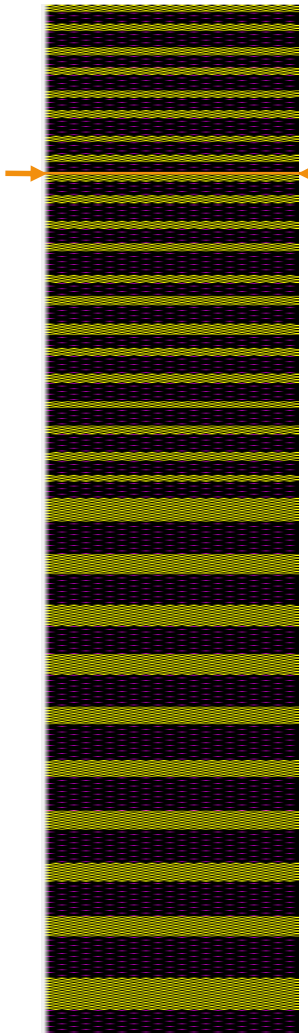
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 46
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

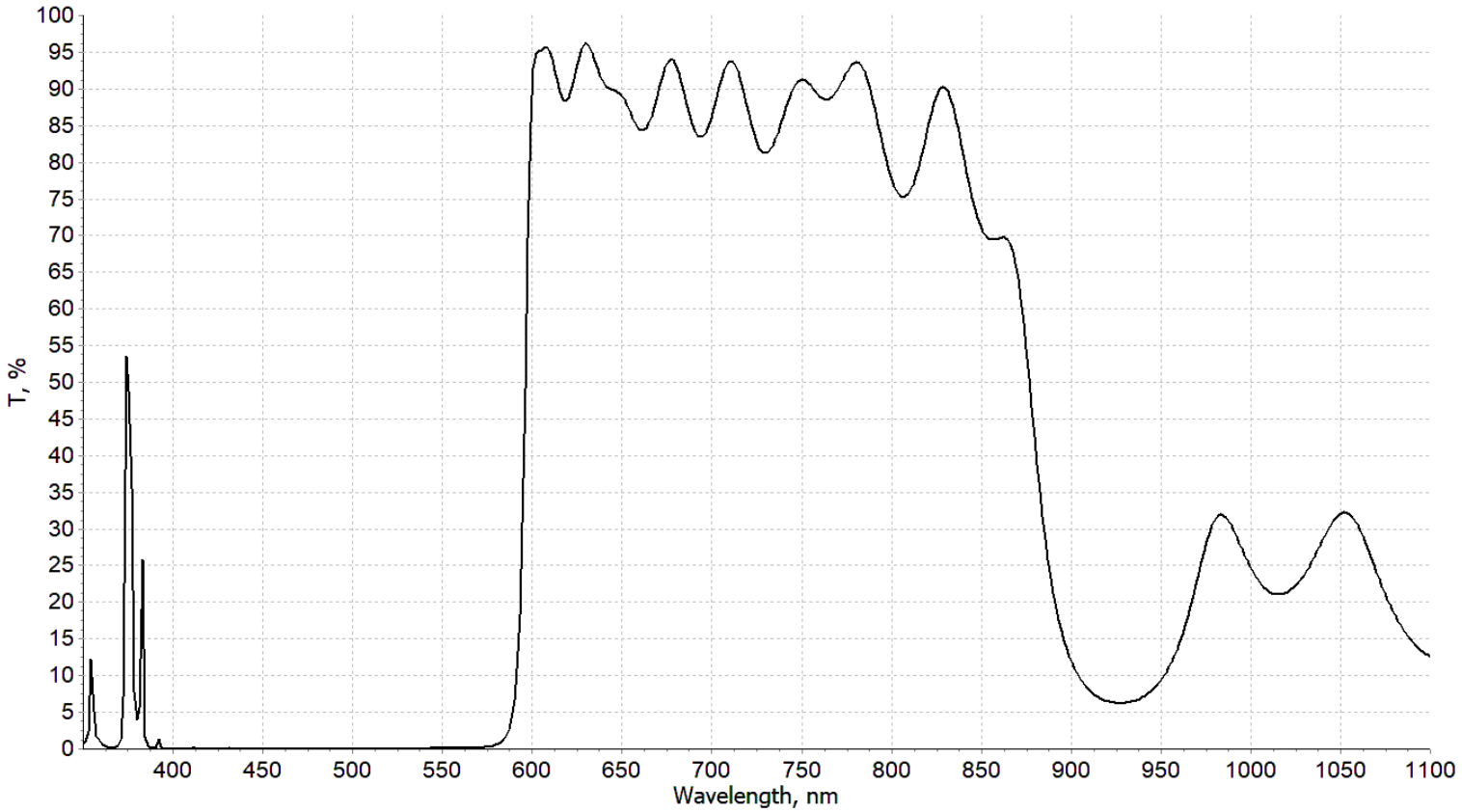
Wavelength max:
1100.000

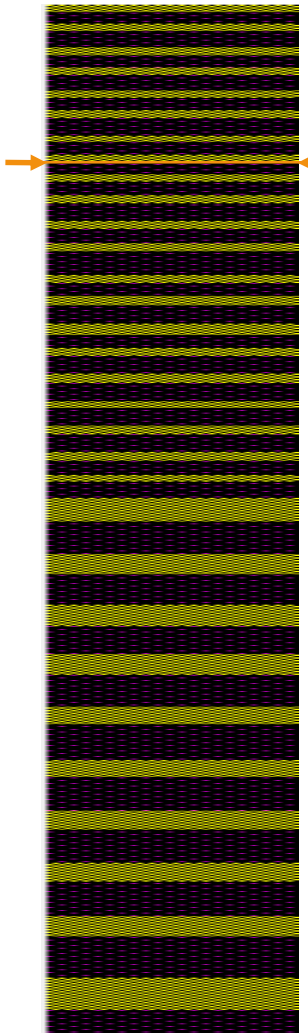
Points: 501

Preview Layer:
47

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

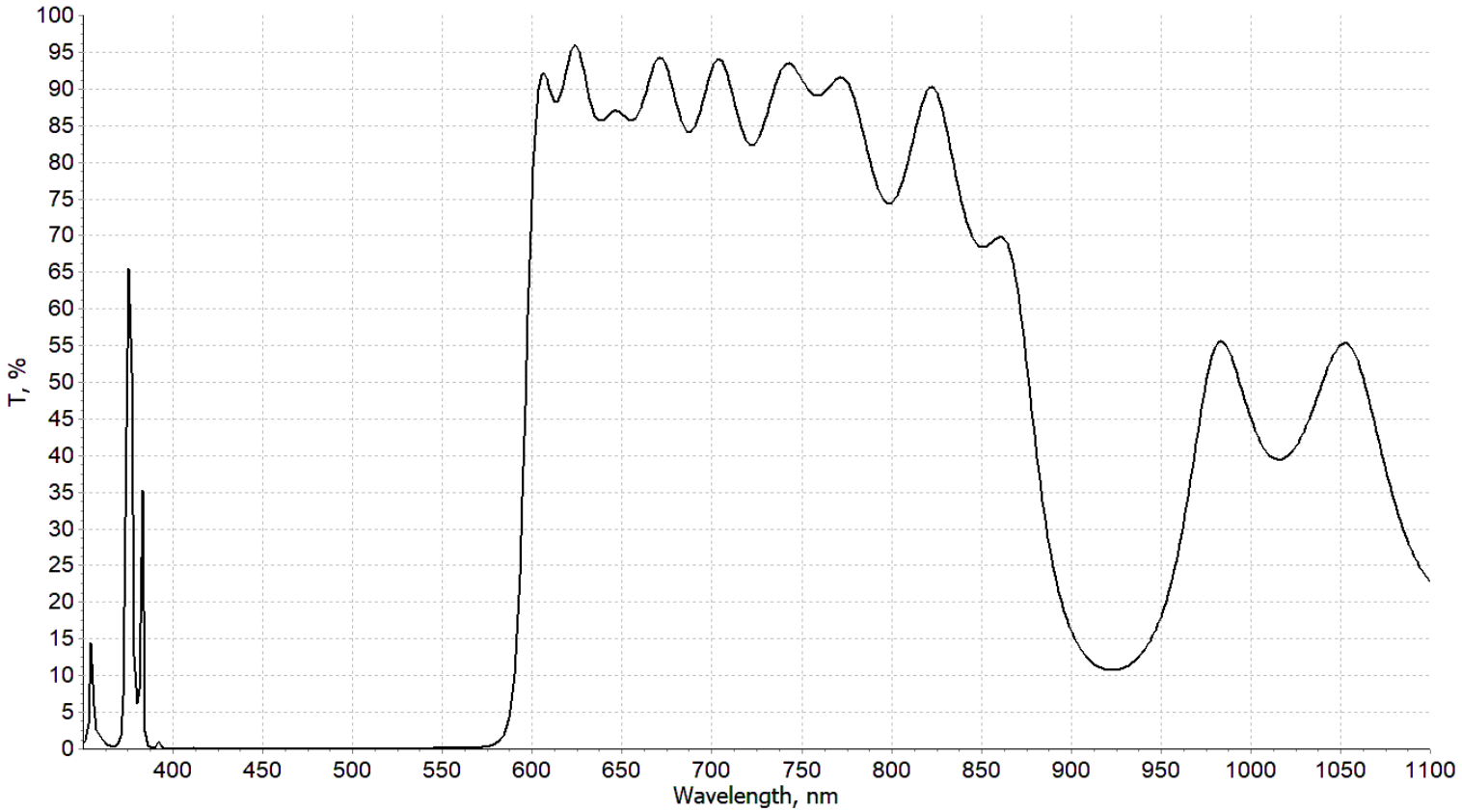
Incident angle: 0.0000

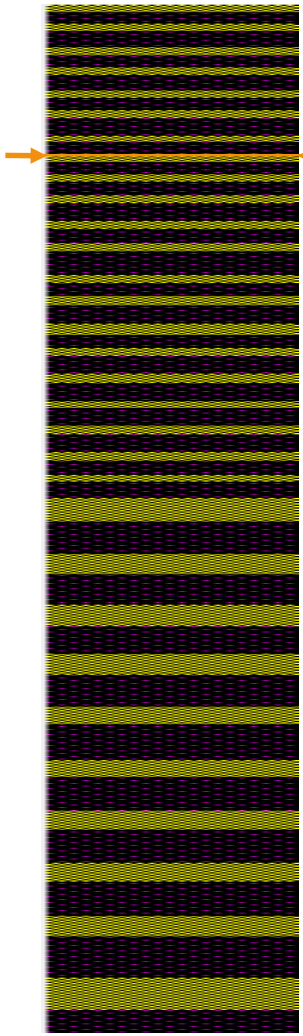
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 48
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

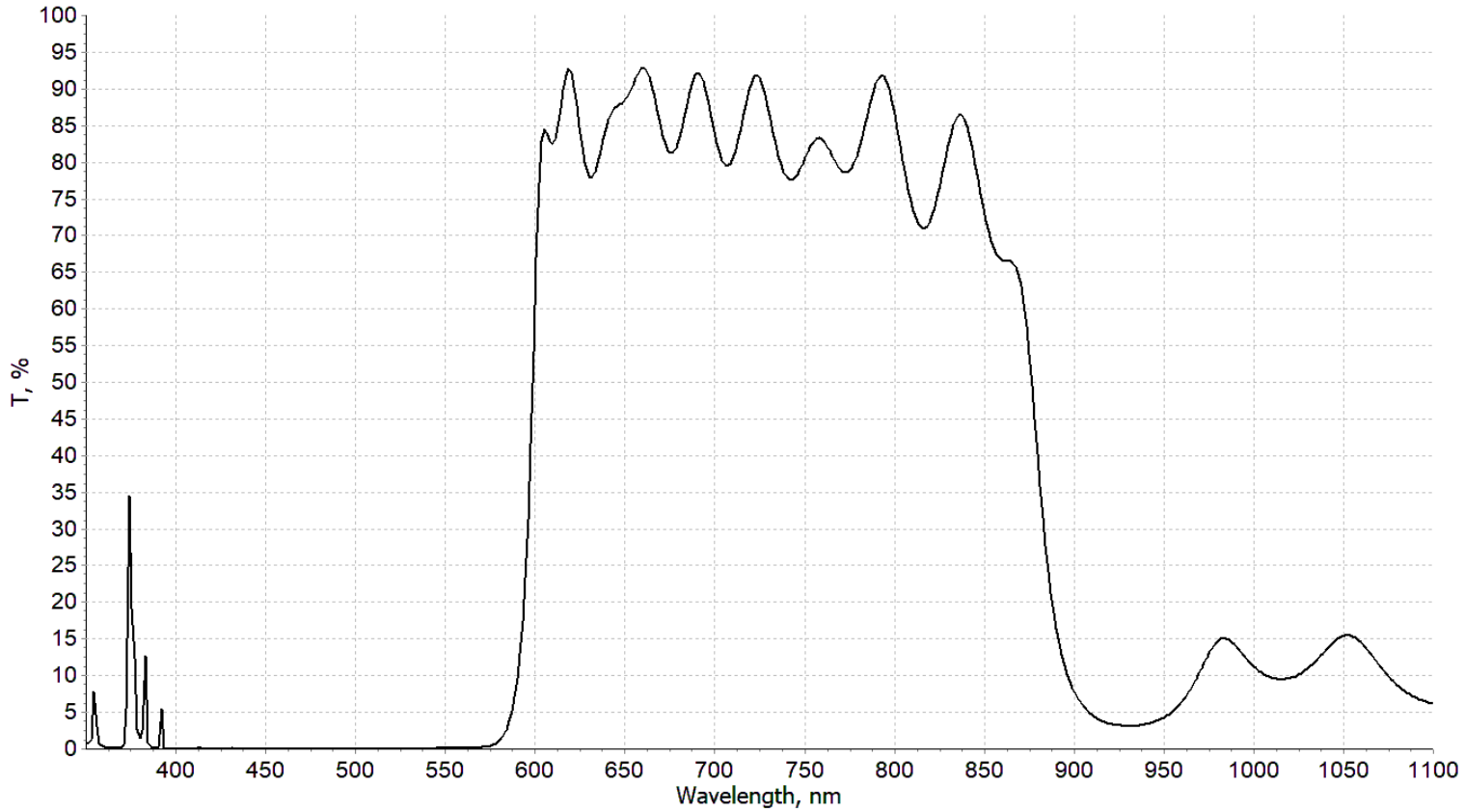
Incident angle: 0.0000

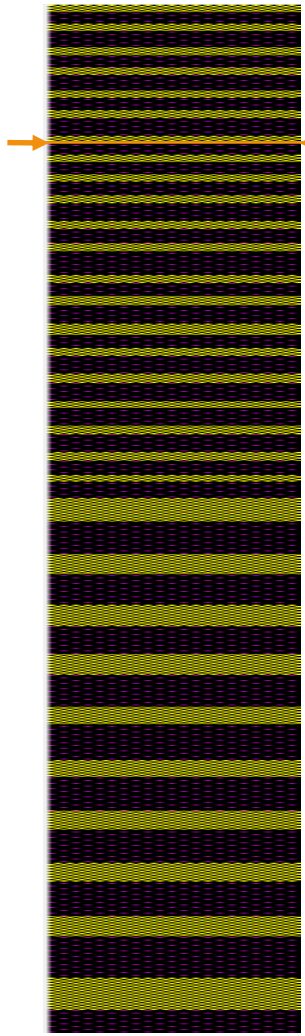
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
49
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

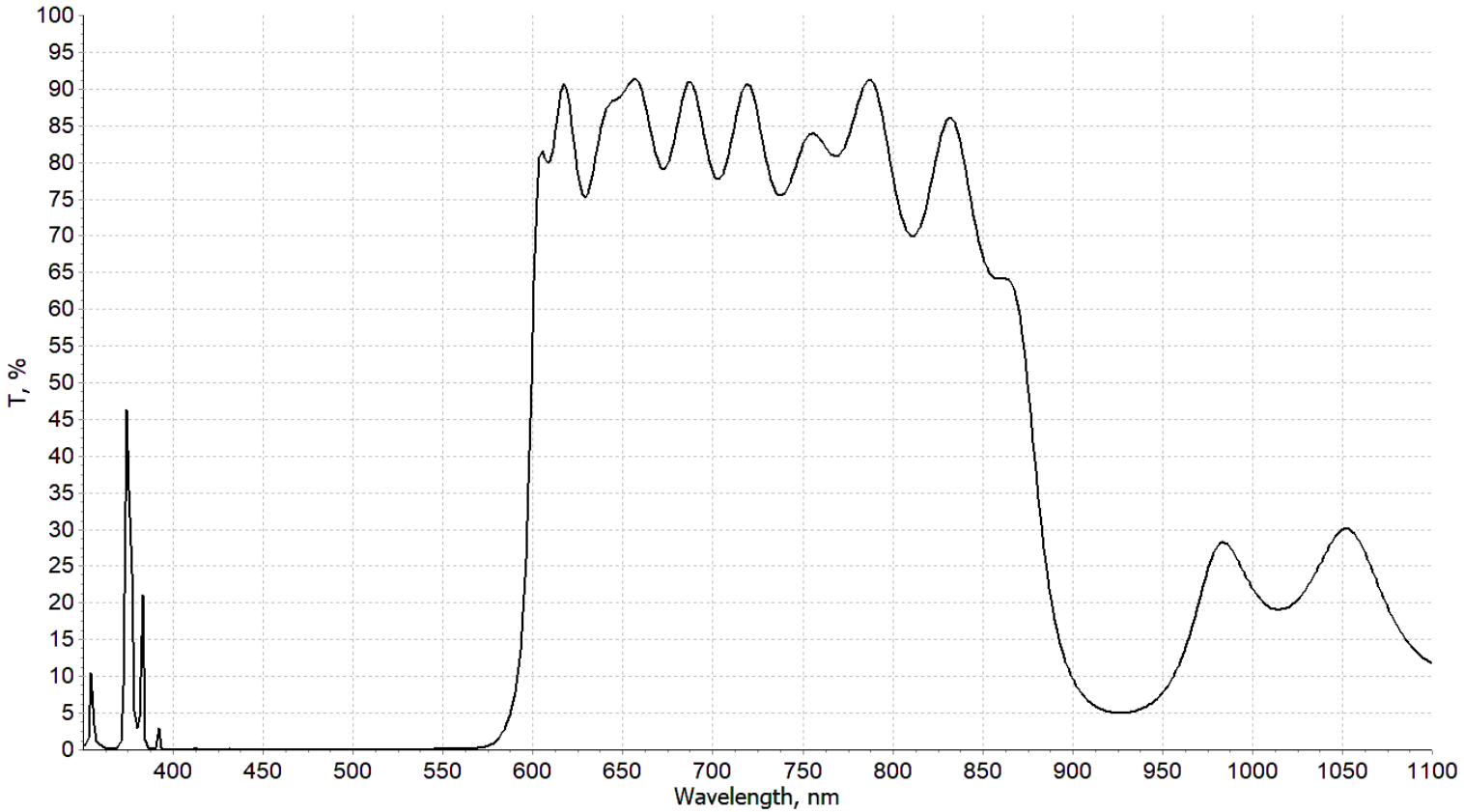
Wavelength max:
1100.000

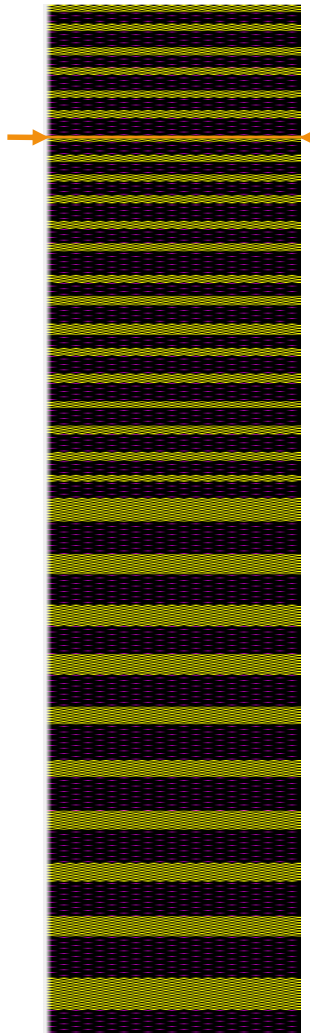
Points: 501

Preview Layer:
50

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

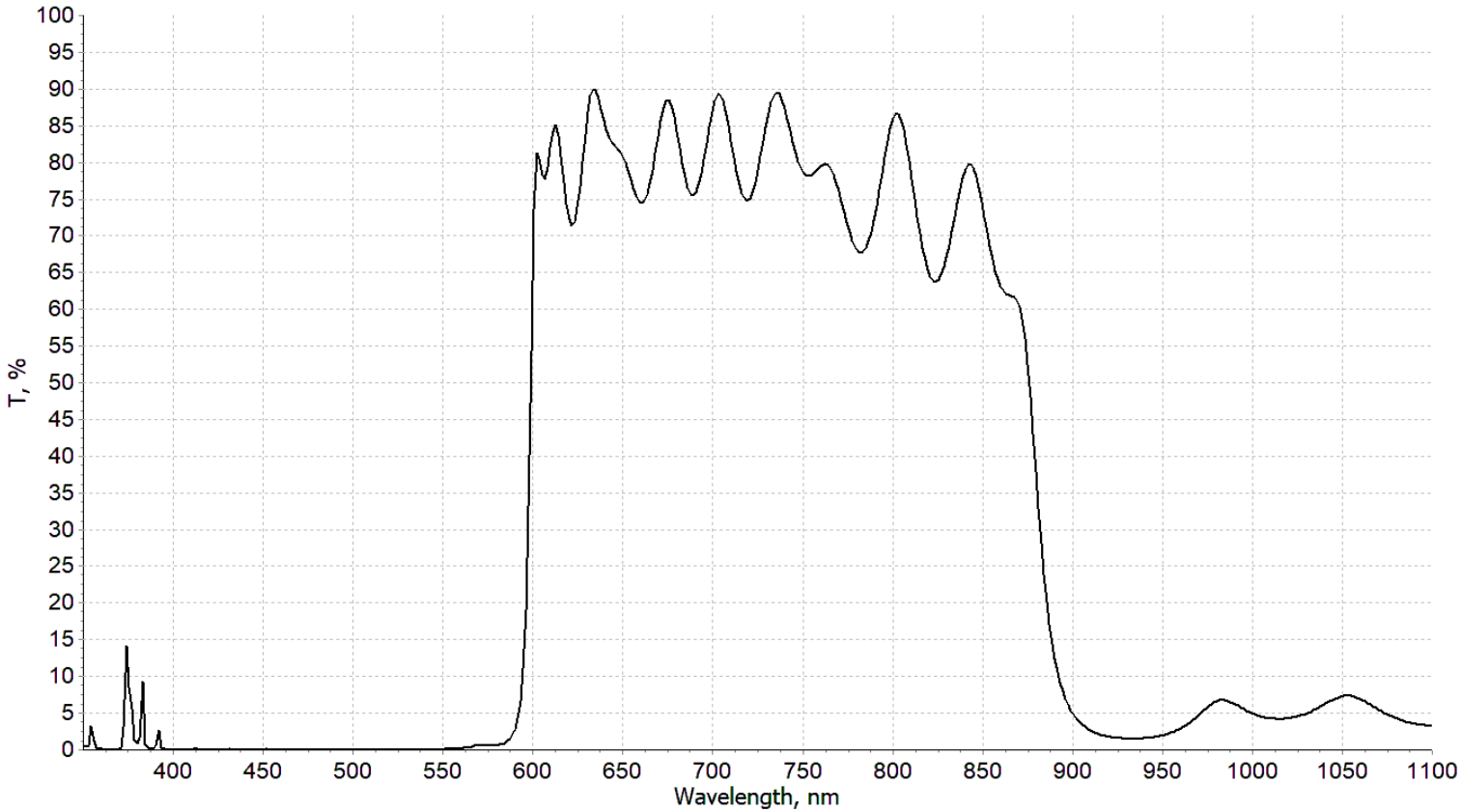
Wavelength max:
1100.000

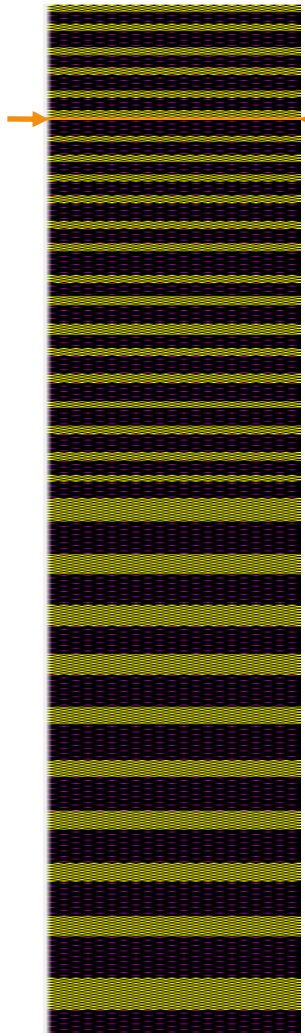
Points: 501

Preview Layer:
51

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

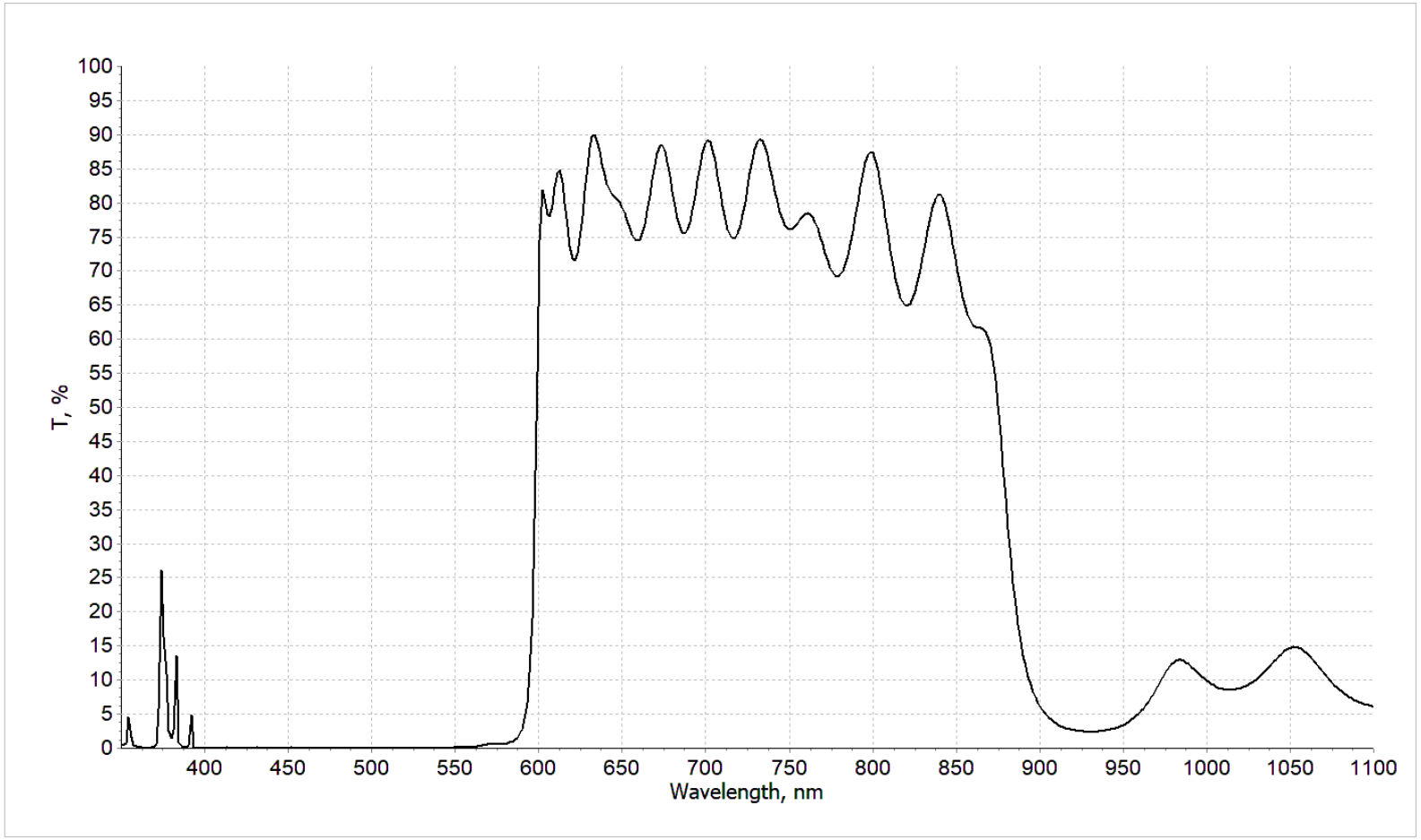
Wavelength max:
1100.000

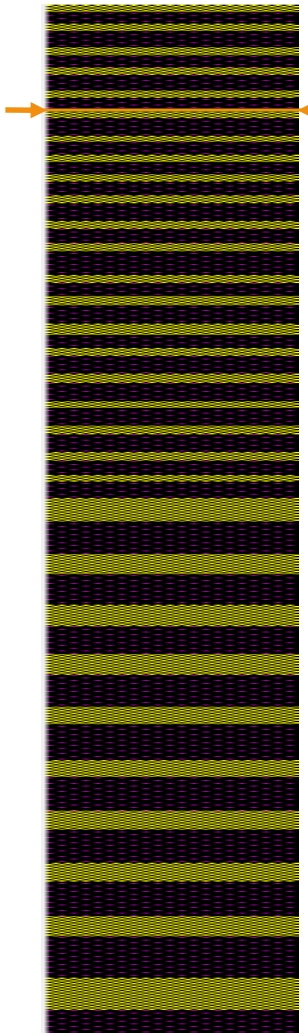
Points: 501

Preview Layer:
52

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

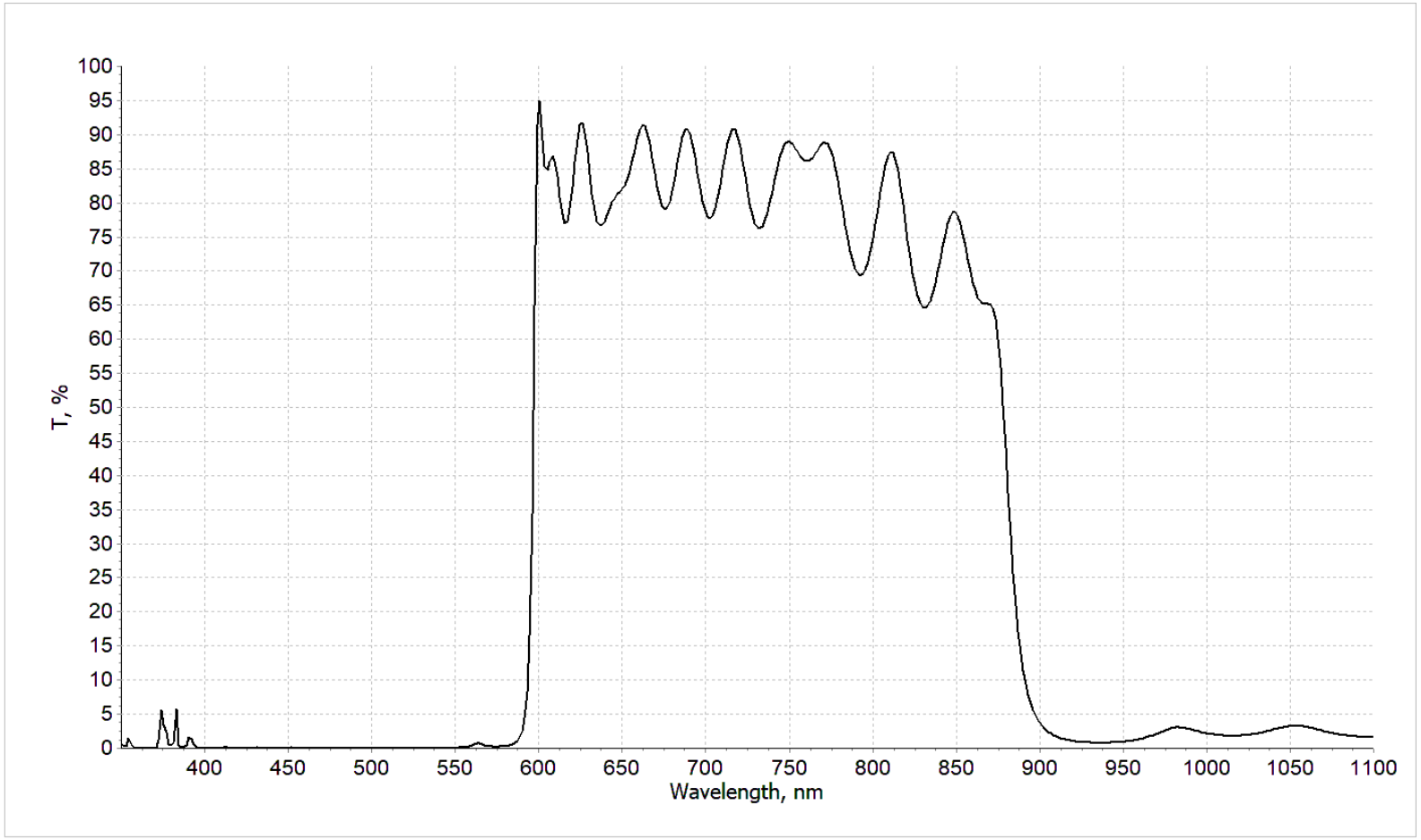
Wavelength max:
1100.000

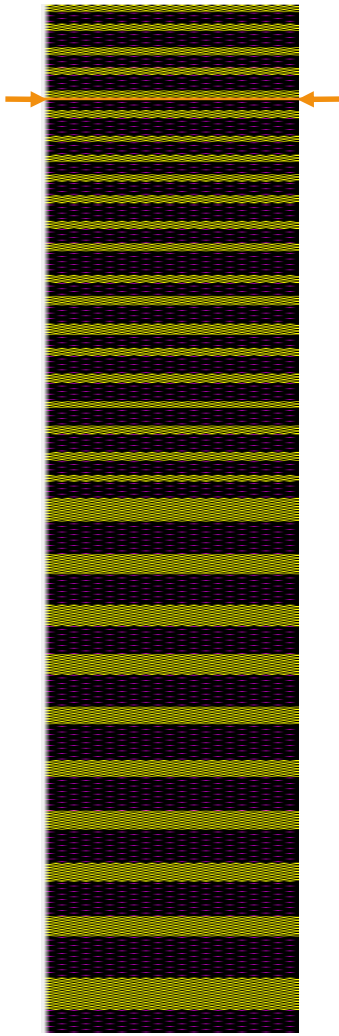
Points: 501

Preview Layer:
53

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

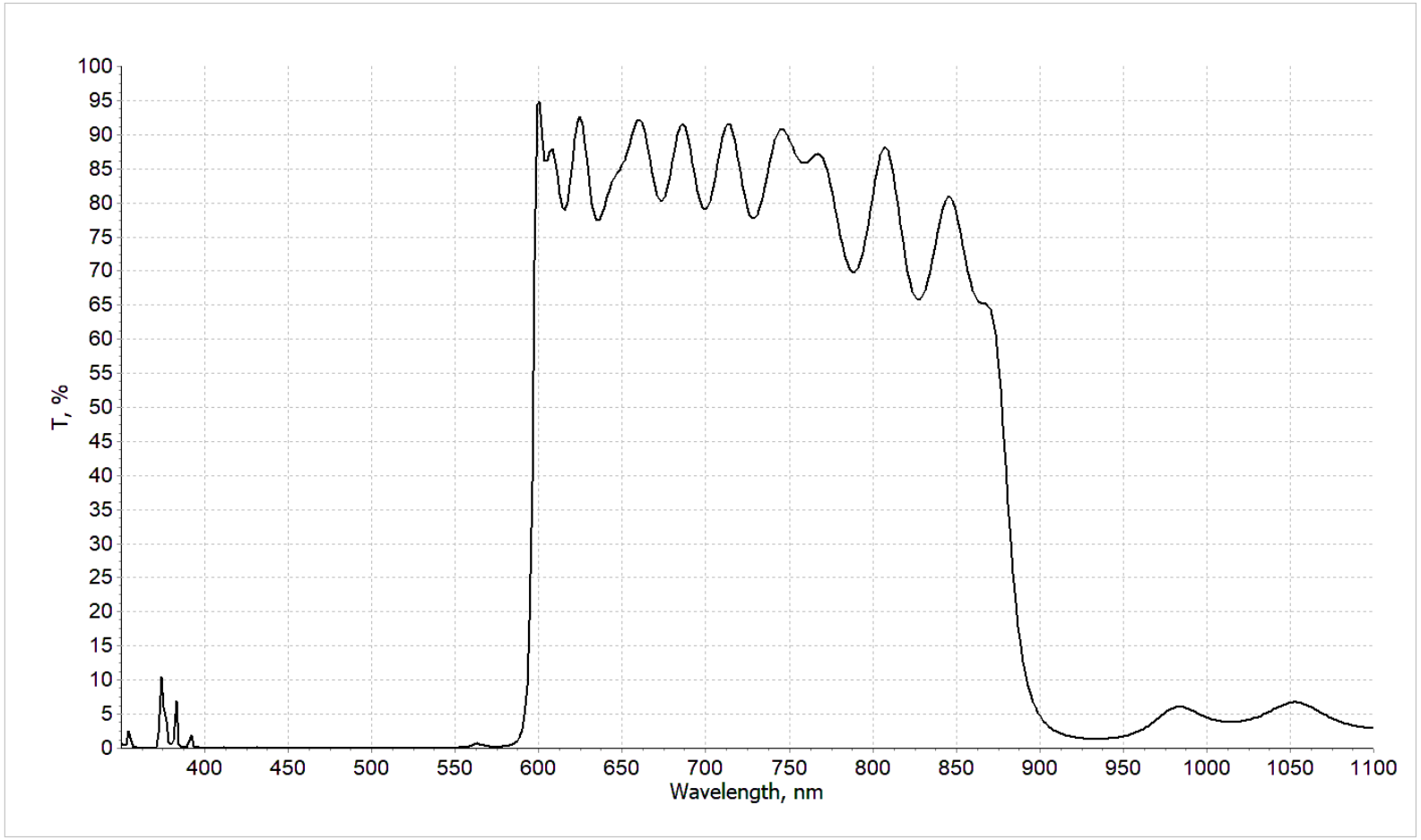
Wavelength max:
1100.000

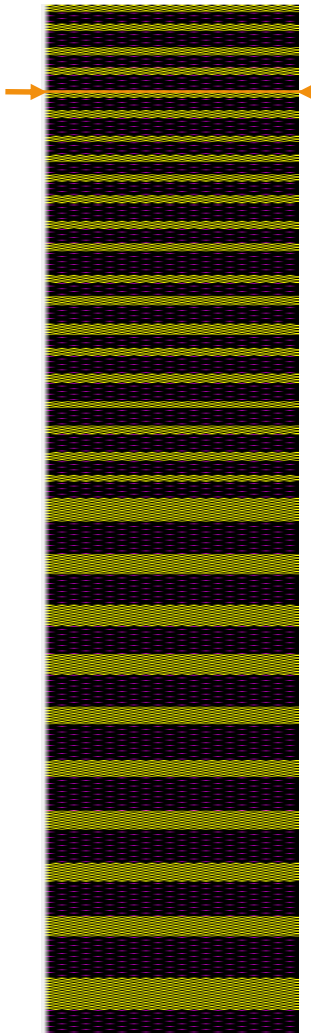
Points: 501

Preview Layer:
54

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

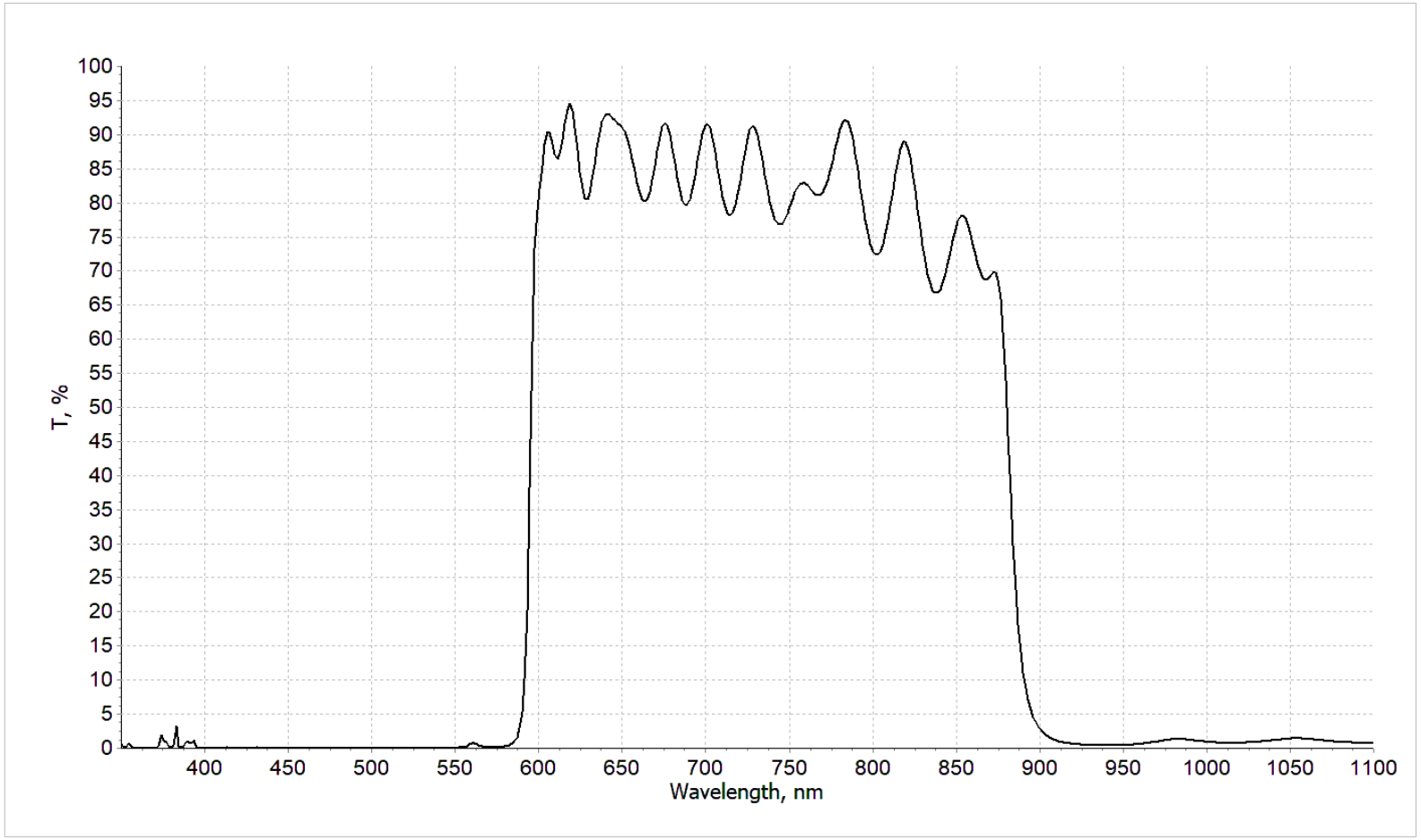
Wavelength max:
1100.000

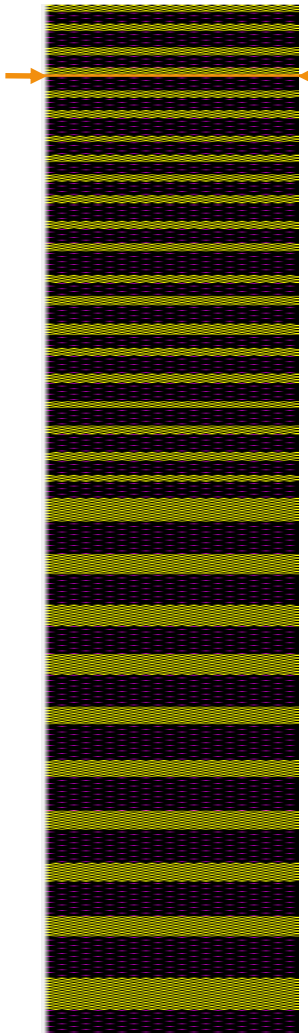
Points: 501

Preview Layer:
55

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

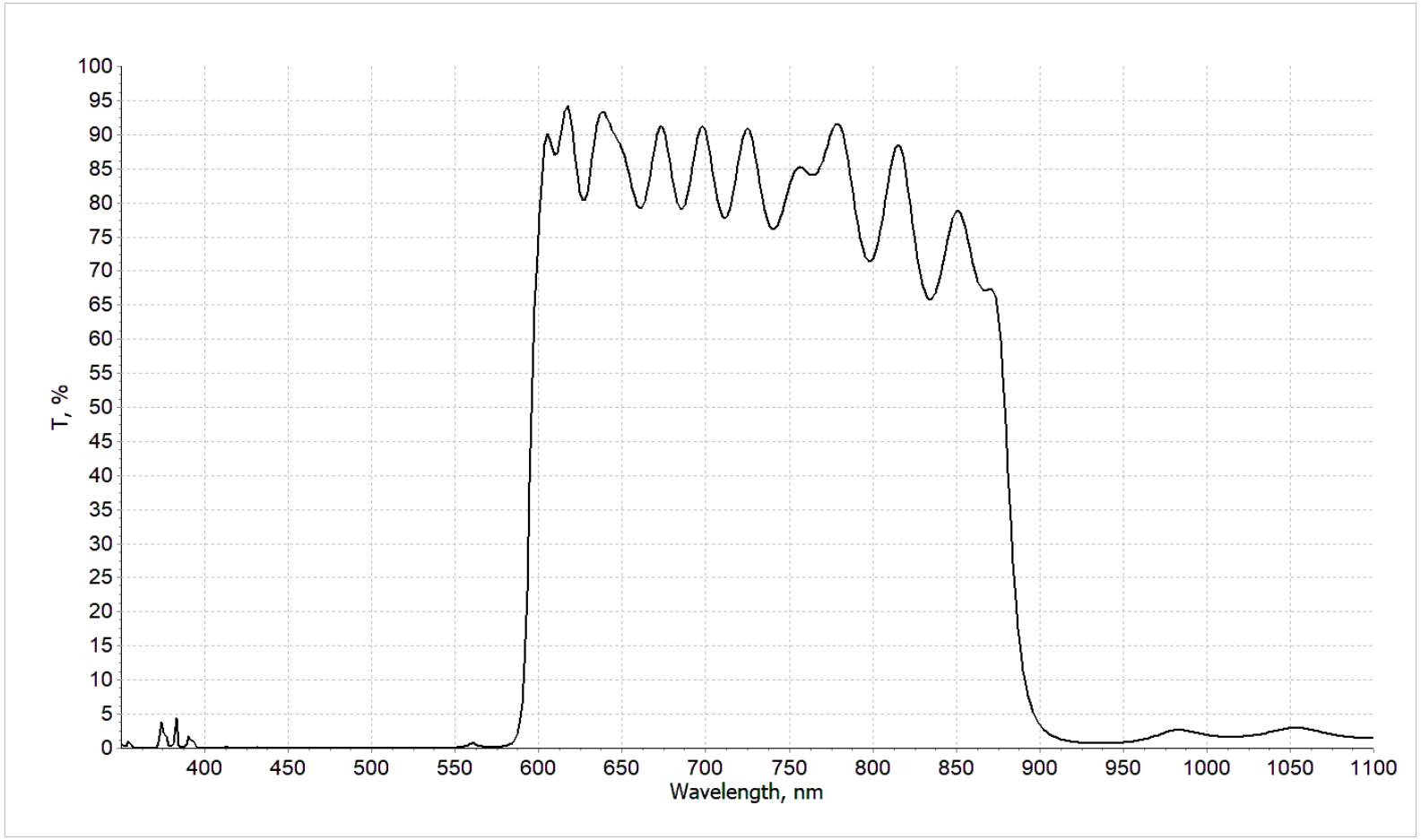
Incident angle: 0.0000

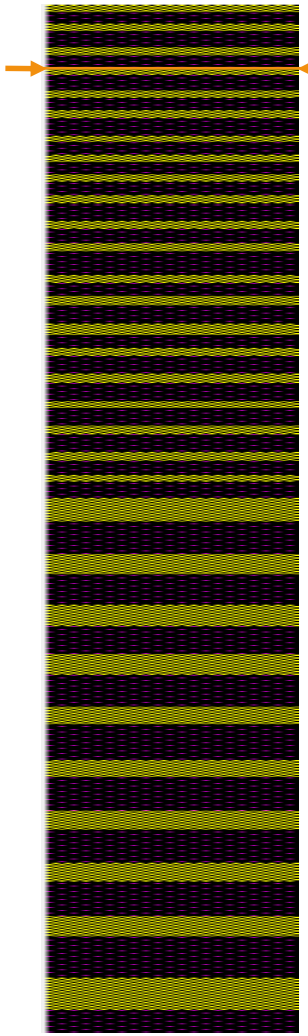
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 56
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

Sensing is life.

TS

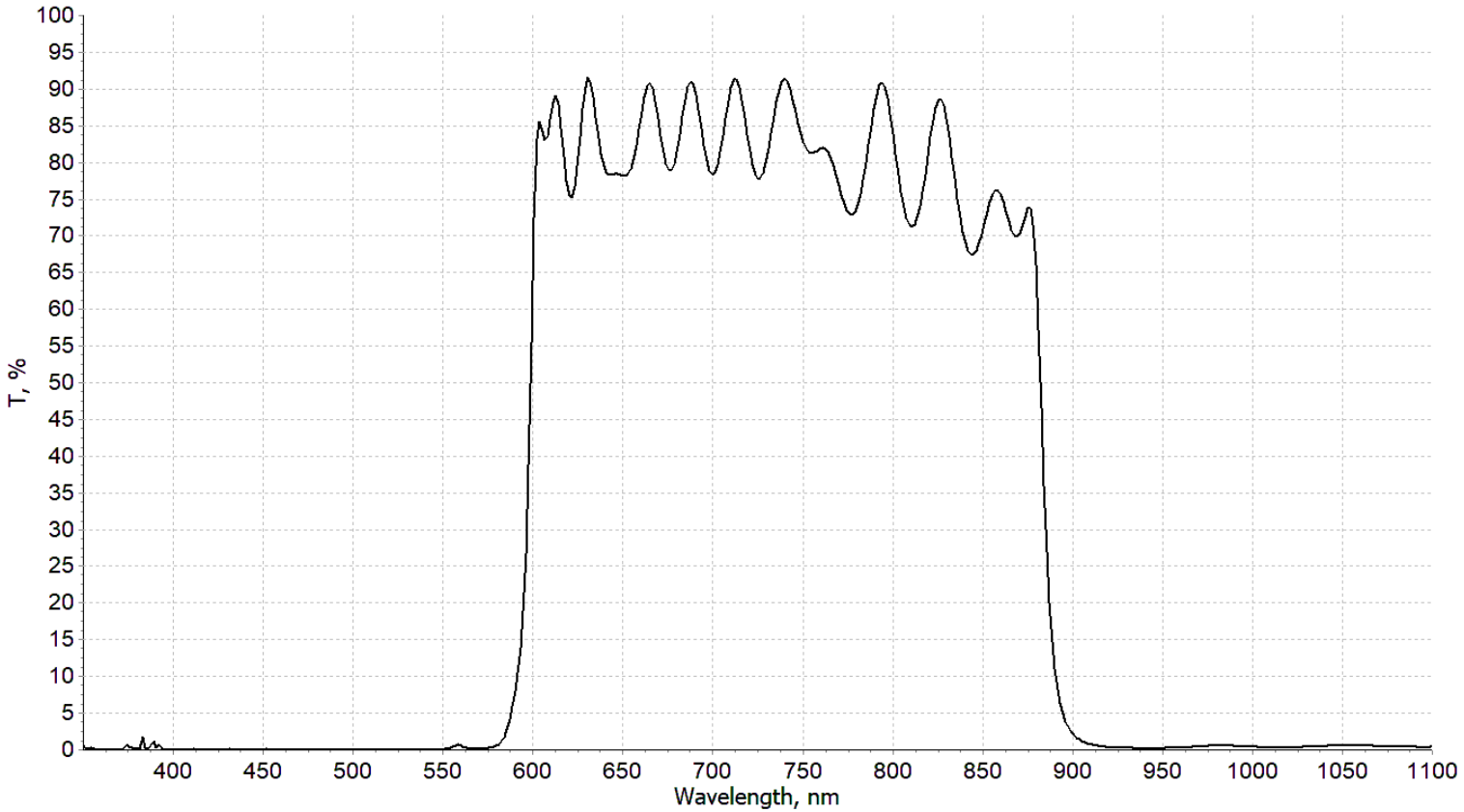
Incident angle: 0.0000

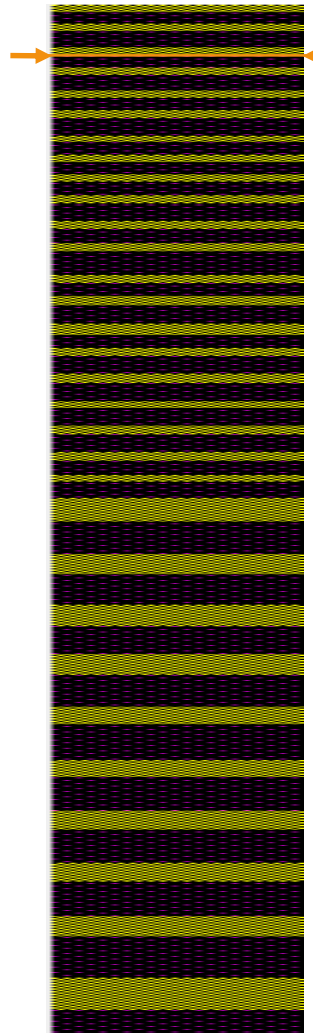
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
57
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

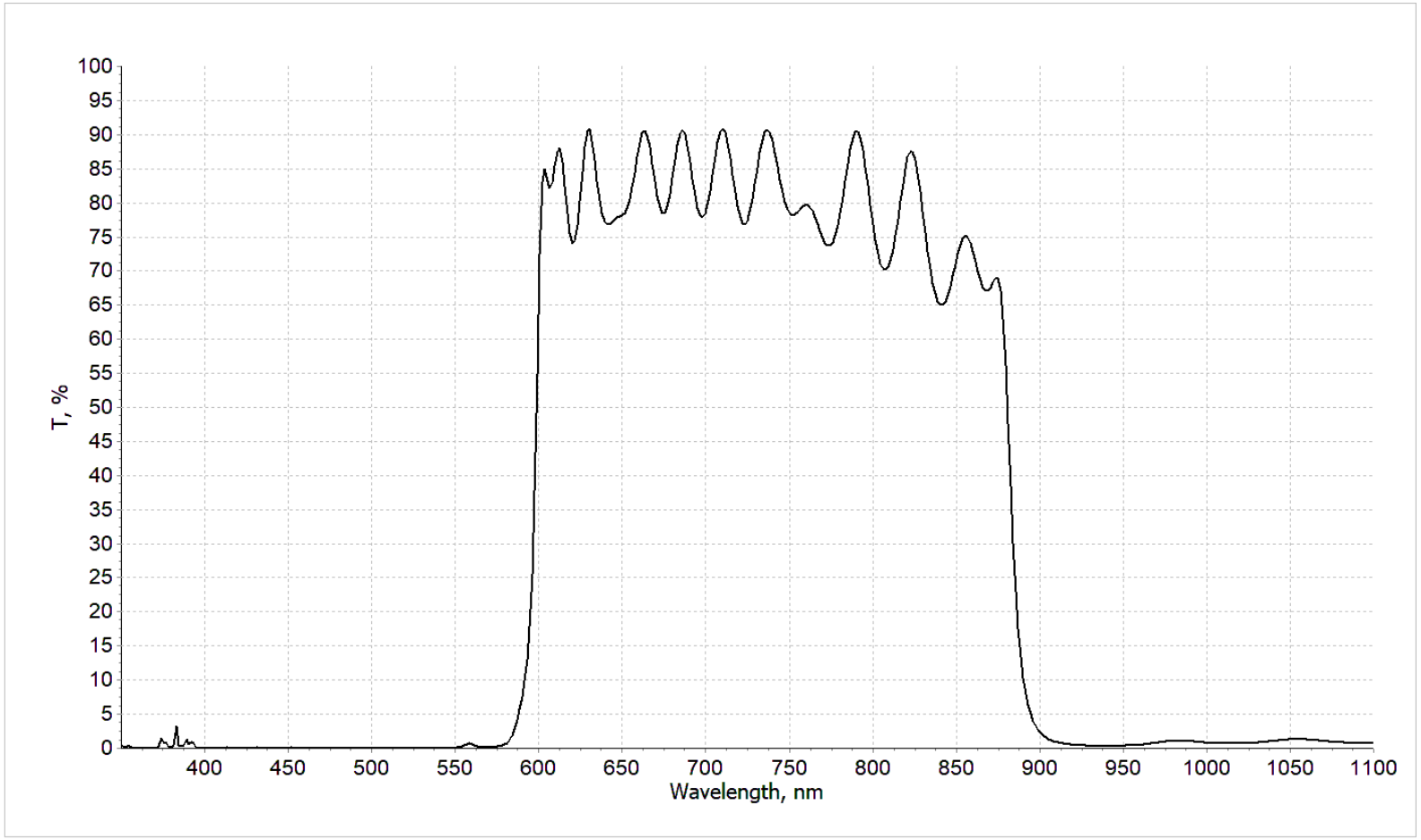
Incident angle: 0.0000

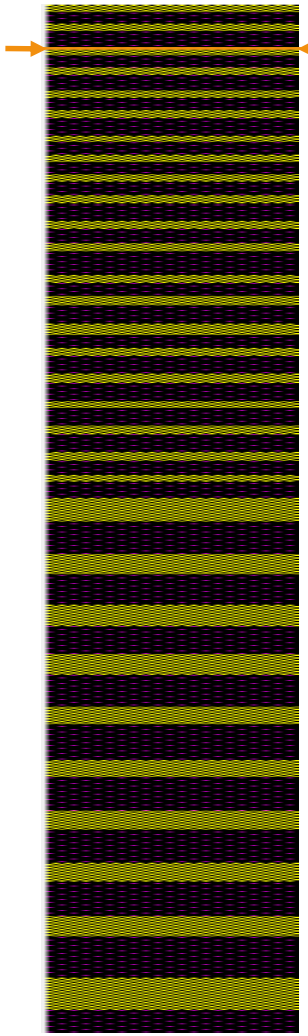
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 58
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

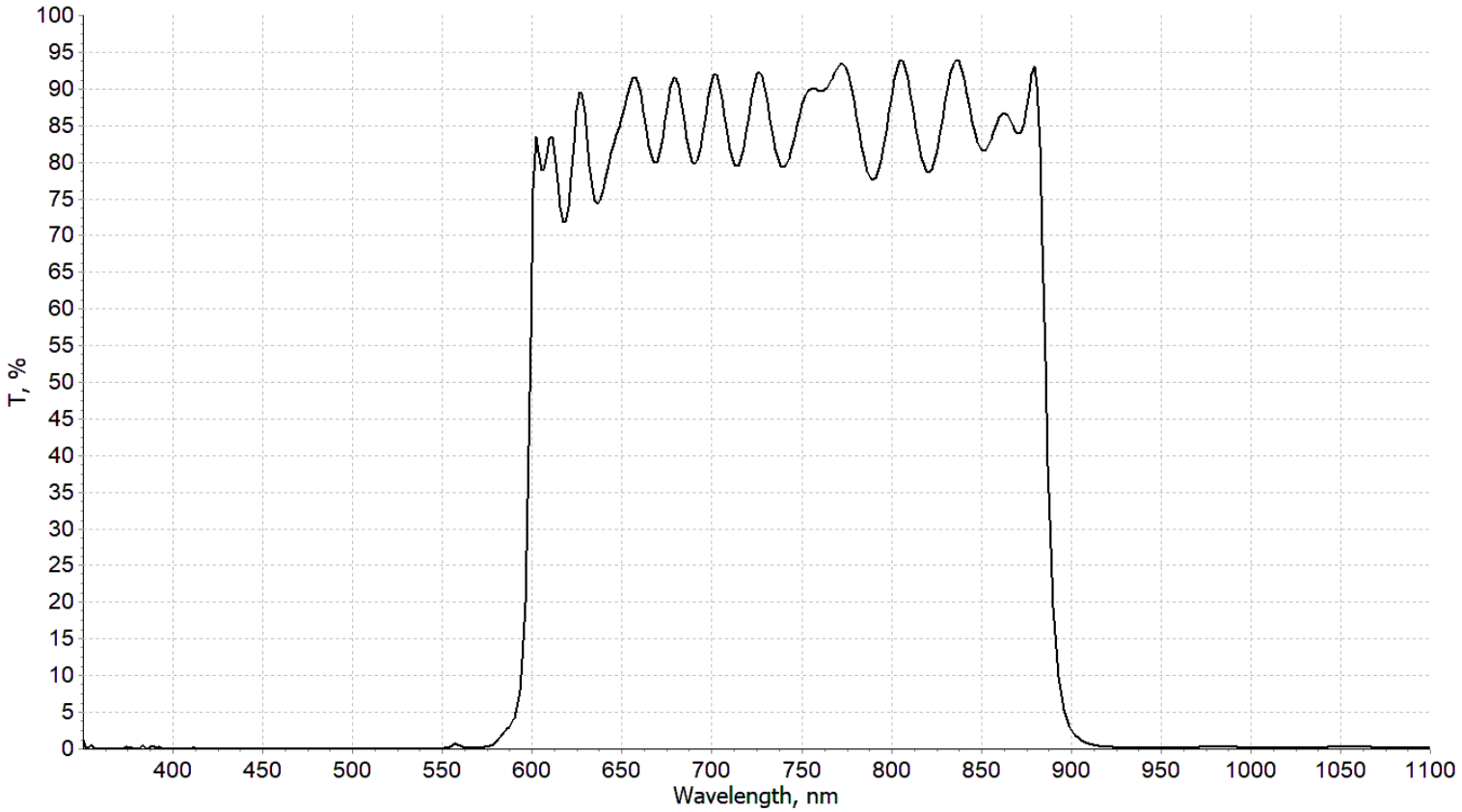
Incident angle: 0.0000

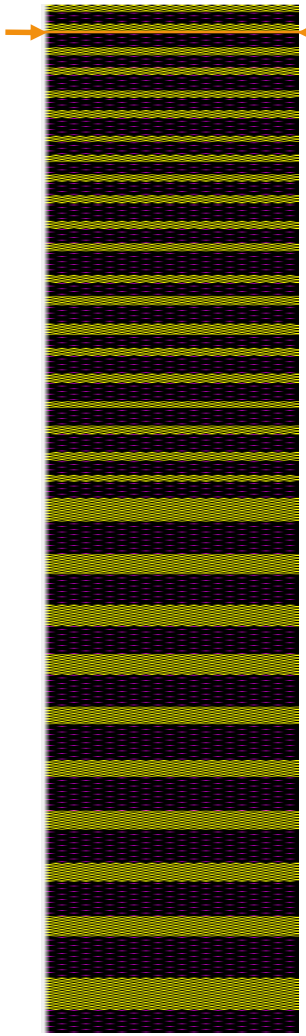
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 59
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

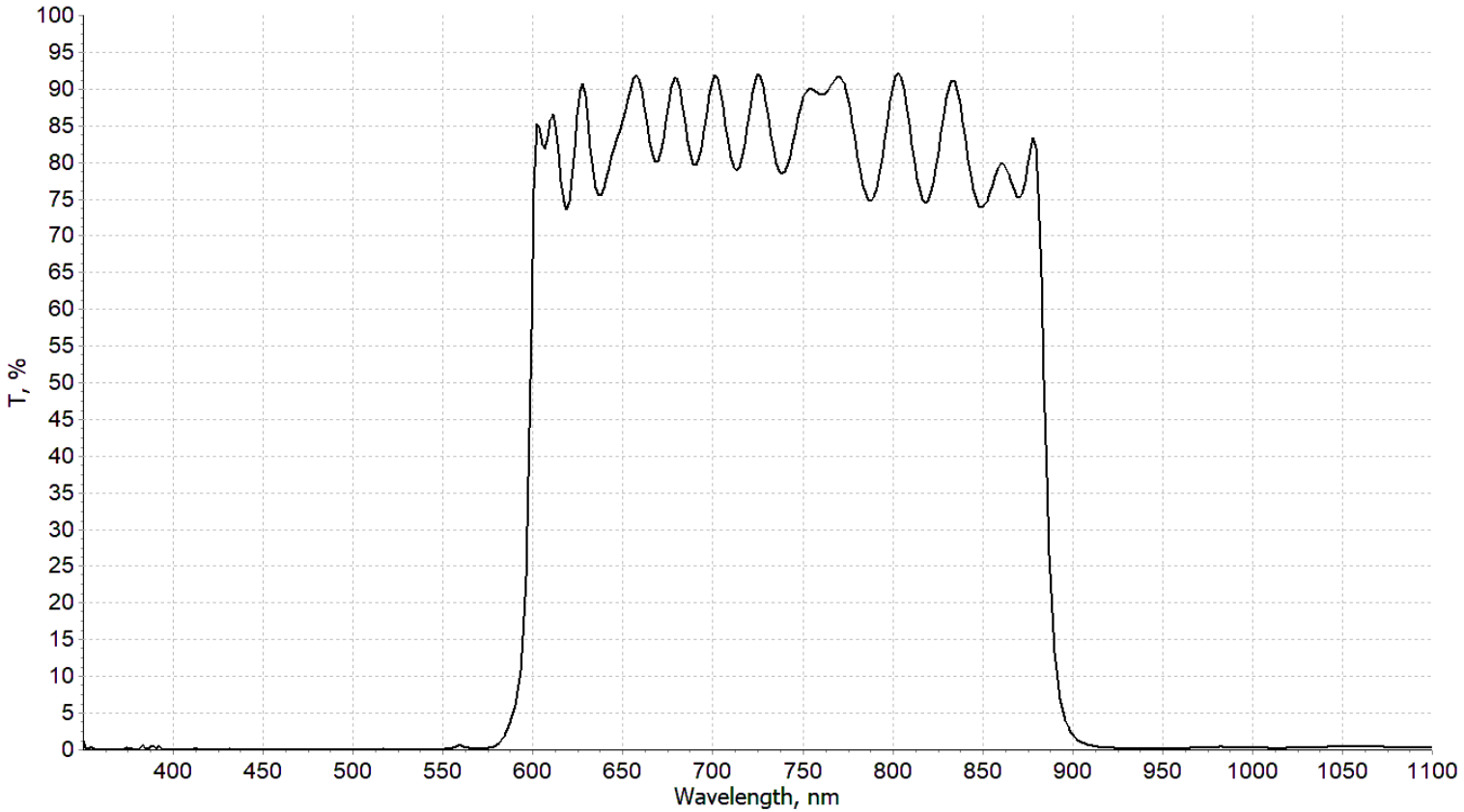
Incident angle: 0.0000

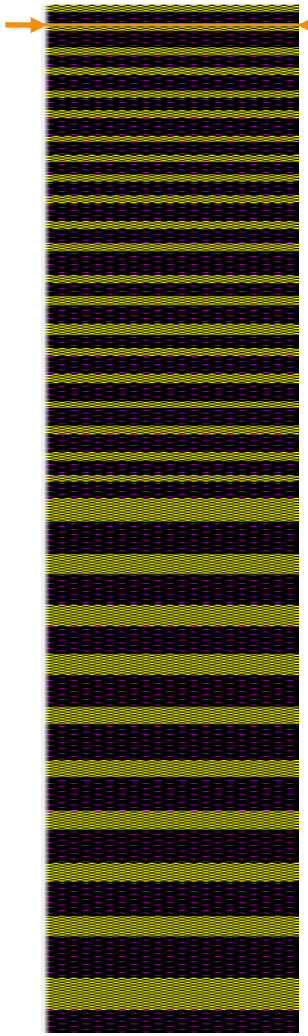
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer: 60
Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

TS

Incident angle:
0.0000

Scan interval, s:
1.00

Band:
Wavelength min:
350.000

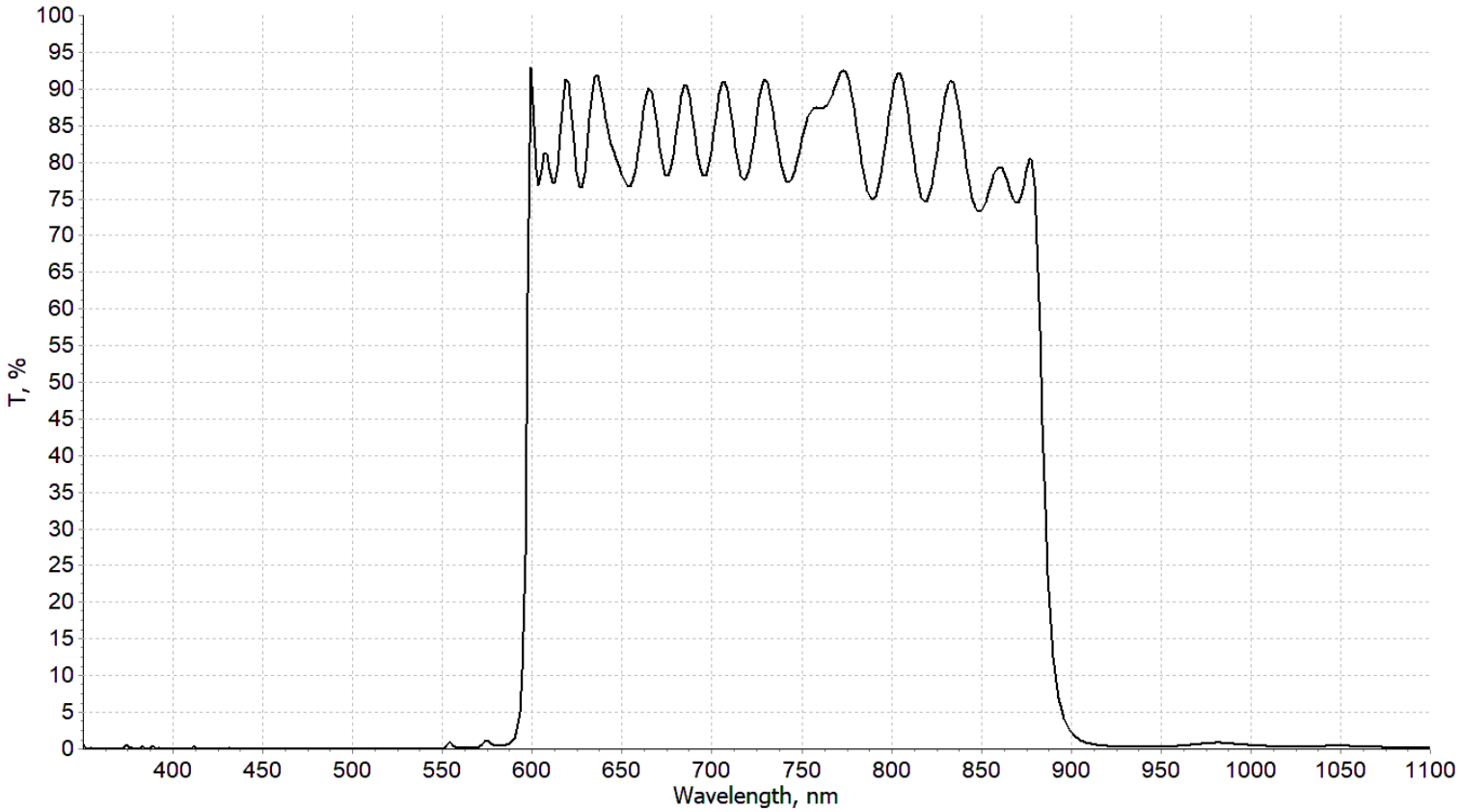
Wavelength max:
1100.000

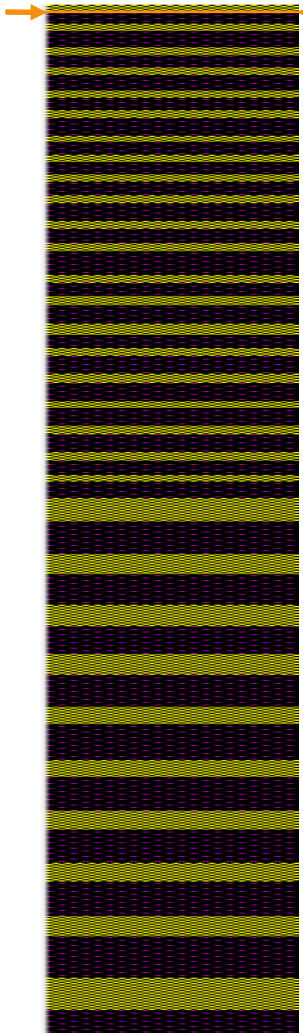
Points: 501

Preview Layer:
61

Update

Y Axis Scale:
Auto 100%





Layerstack

Shaping light with an interference filter

Sensing is life.

TS

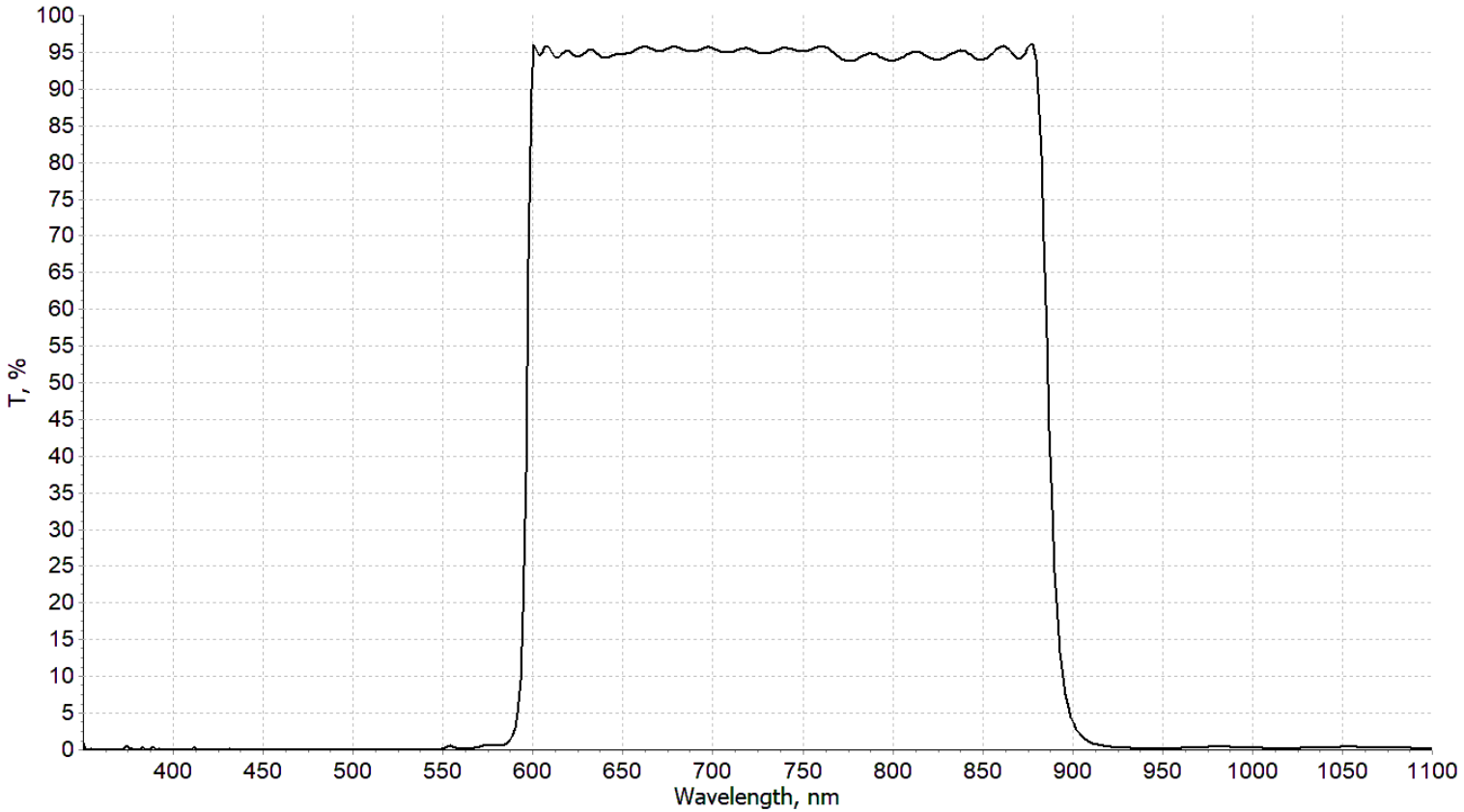
Incident angle: 0.0000

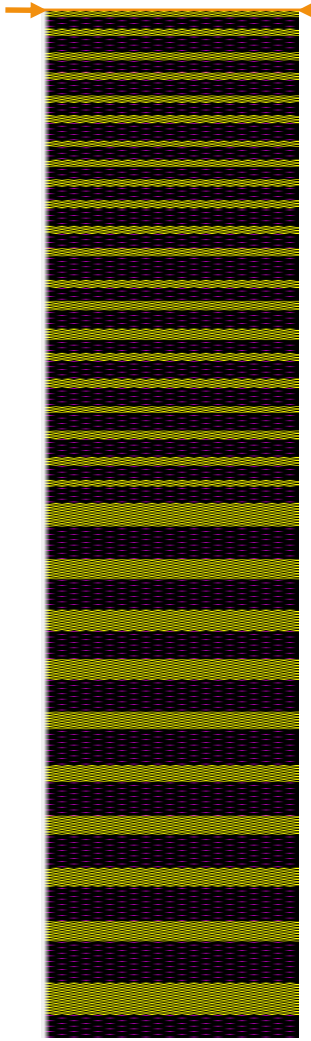
Scan interval, s: 1.00

Band:
Wavelength min: 350.000
Wavelength max: 1100.000
Points: 501

Preview Layer:
62
Update

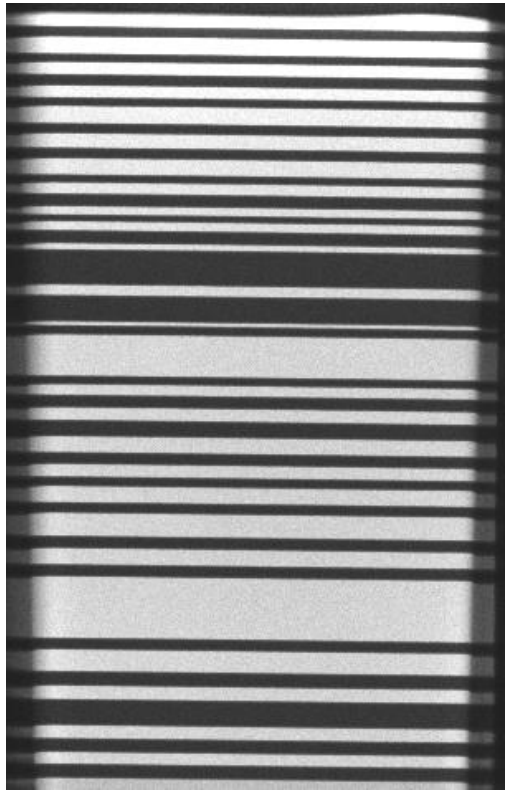
Y Axis Scale:
Auto 100%

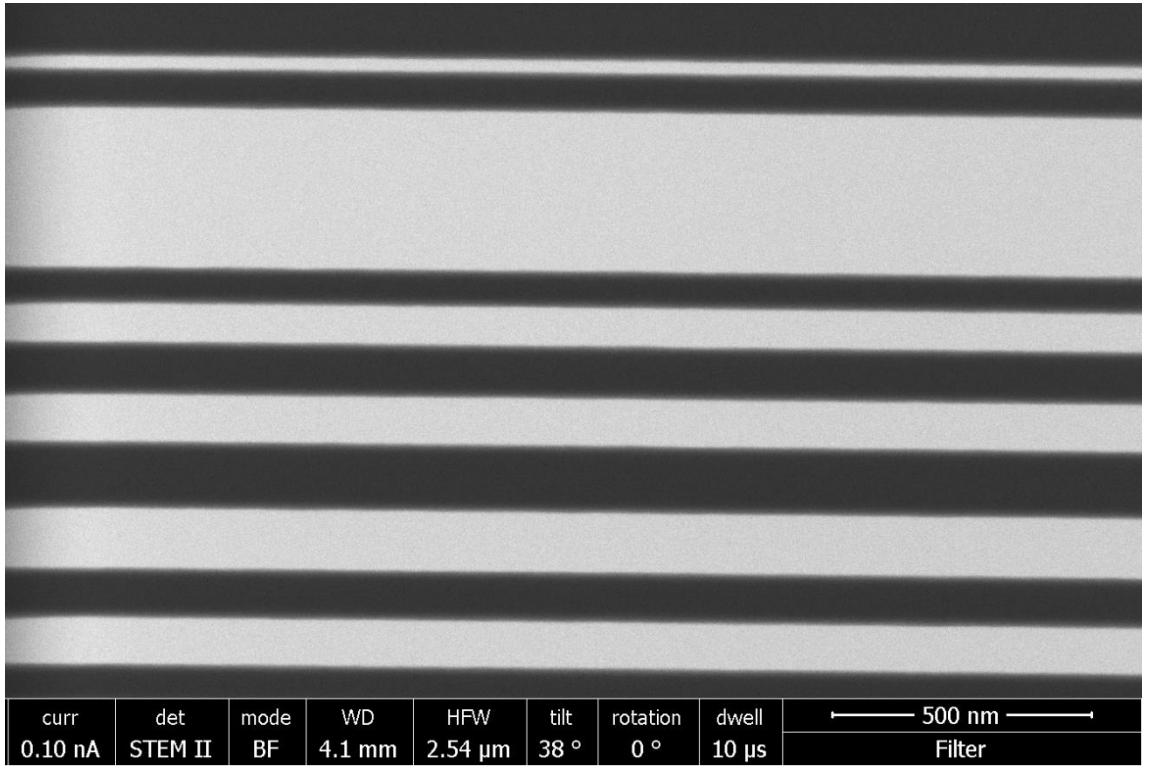




Layerstack

Interference filters – Microscopic structure





TEM cross section of an all dielectric interference filter (H-index: Nb_2O_5; L-index:SiO_2). The individual layers have a fully amorphous appearance and are virtually free of any interface roughness.

layer materials

All-dielectric filters are offering a number of advantages such as low absorption, environmental robustness, thermal stability and good reproducibility of the transmission characteristics.

For challenging optical requirements it can be beneficial to use materials with tailored optical properties. Typical applications are enhanced stopband performance either in VIS or NIR, wide field of view illumination and filters showing reduced angular shift.

metal oxides	**metals**	**organic coatings**
Nb_2O_5	Nb	R/G/B
SiO_2	Al	longpass filters
HfO_2	a-Si	
Si_3N_4	a-Si:H	
Al_2O_3	Ag	
ITO	Ge	
SiO_x	Ti	

Due to the capability of co-sputtering synthetic materials with optimized optical properties can be generated.

Outline

Shaping the Light – How and Why

Optical filter working principle

High performance Interference filter applications

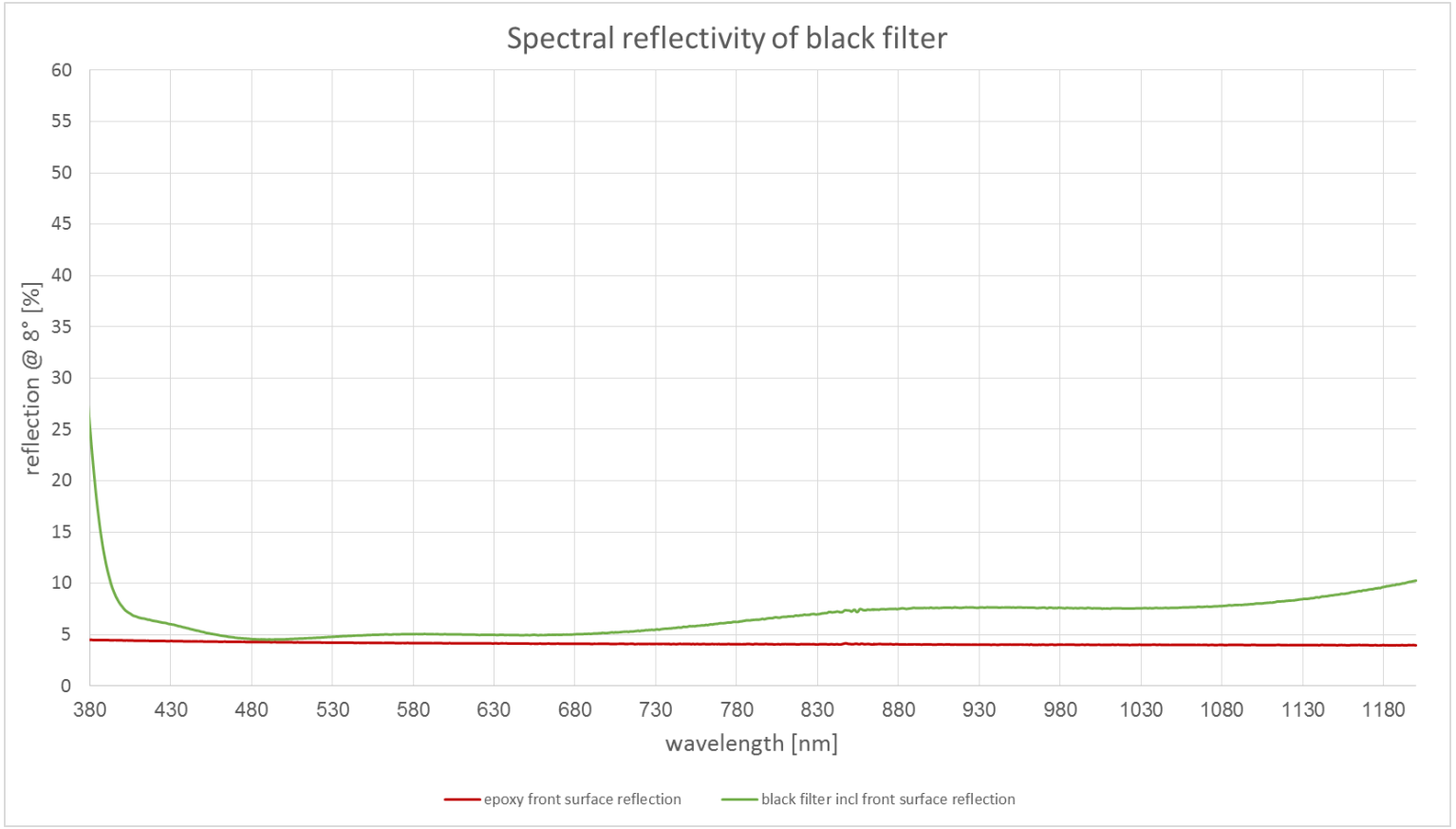
Interference filters for different applications

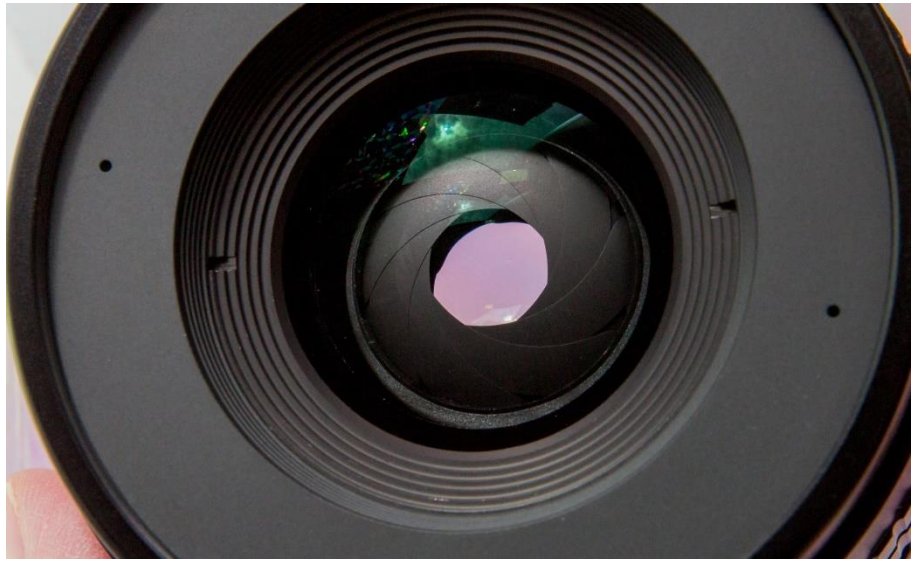
- Many different kinds of optical filters can be designed with interference filters. Most popular are

  anti reflective coatings
  high reflectance mirrors
  beam splitters
  edge filters
  band pass filters
  notch filters
  color filters

  Depending on the spectral requirements these stacks have a more or less sophisticated design. While only 20 layers are needed to design simple filters one need more than 100 layers for high end multi notch filters.

Black filter





A black filter designed for having a high optical density blocking in transmission (>OD4) and a low reflectivity. The high OD blocking helps to prevent light leakage and the low reflectivity suppresses effects caused by stray light. The filter is designed for having the optimum performance in an epoxy package.

Enable new automotive applications

Assisted & autonomous driving, driver identification & monitoring, decorative lighting

Automotive trends

LiDAR

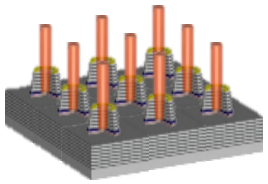
Driver monitoring

Electrification

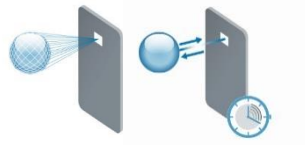
Adv. Lighting

ams solutions

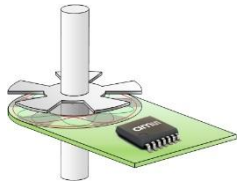
VCSEL/
array & drivers



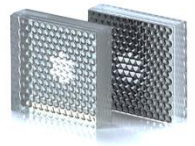
3D imaging
ToF, structured light



Position sensors
magnetic, inductive



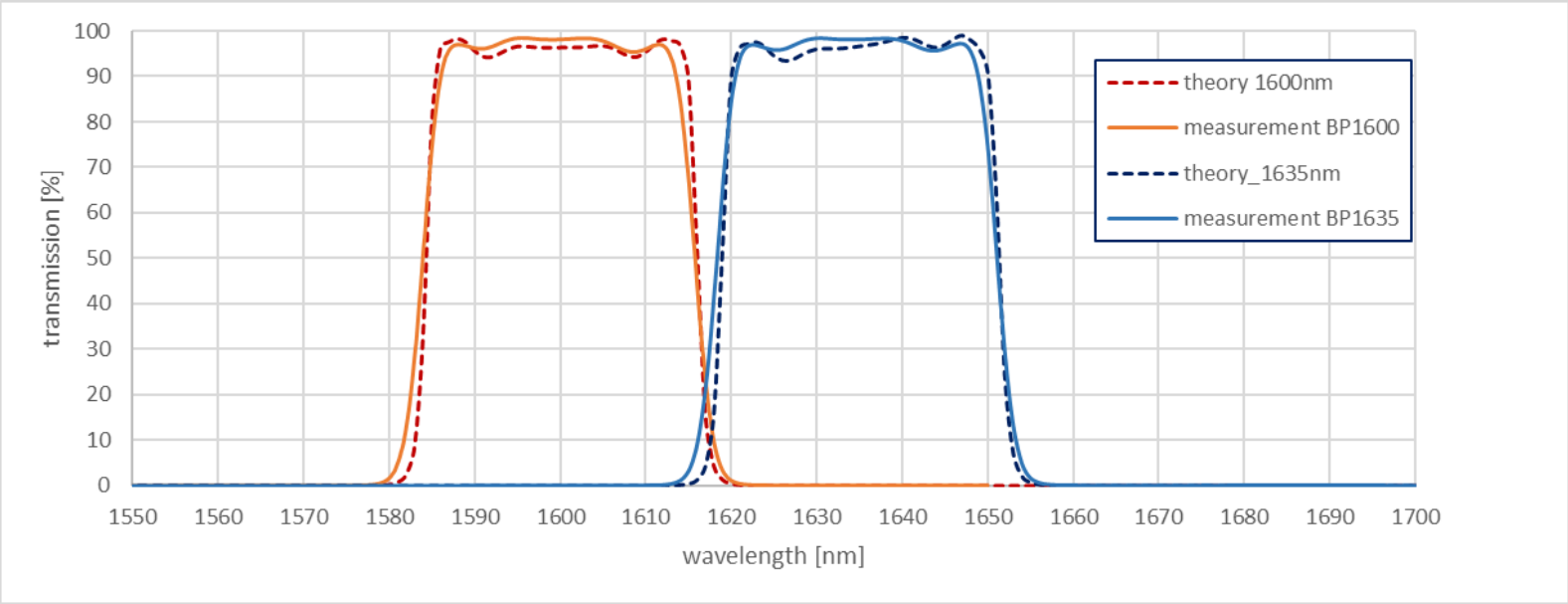
Micro Lens
Array



MIR filters

extending filter capabilities up to 5µm

- Extending into the near- and mid- infrared wavelengths opens up the possibility of offering sensor solutions for the MIR with a rich variety of applications in LIDAR, gas detection, medical sensing, environmental monitoring and industrial process control.
- Several layer materials like SiO_2, Nb_2O_5, a-Si, a-Si:H, Al_2O_3 and HfO_2 that have favorable optical properties for the NIR to MIR spectral range up to ~ 5µm are used in these filters.



Transmission characteristic of two bandpass filters with a CWL of 1600nm resp. 1635nm and a FWHM of 30nm deposited on a sapphire substrate. The transition from T(10%) to T(90%) takes less than 3nm.

MIR filters

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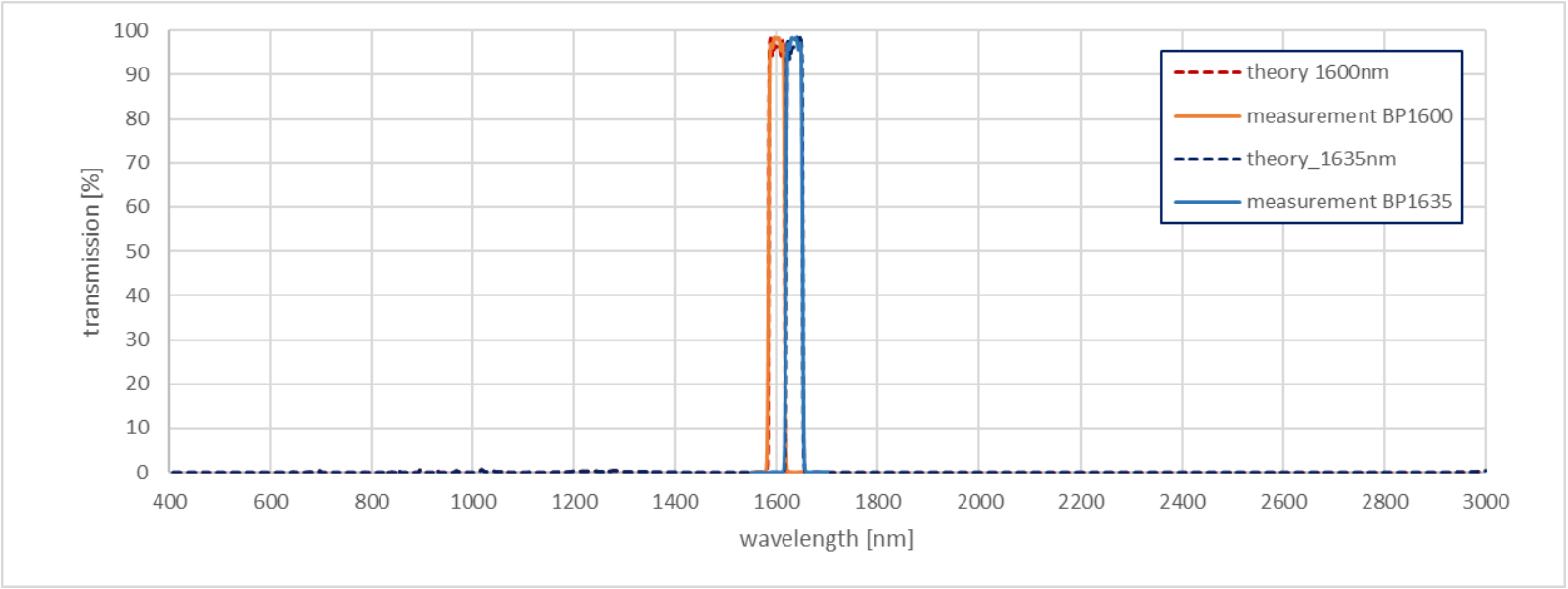

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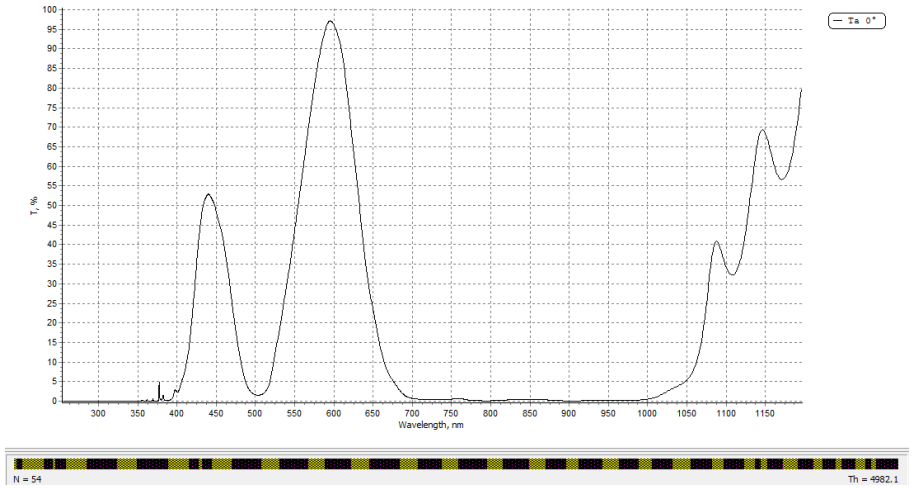
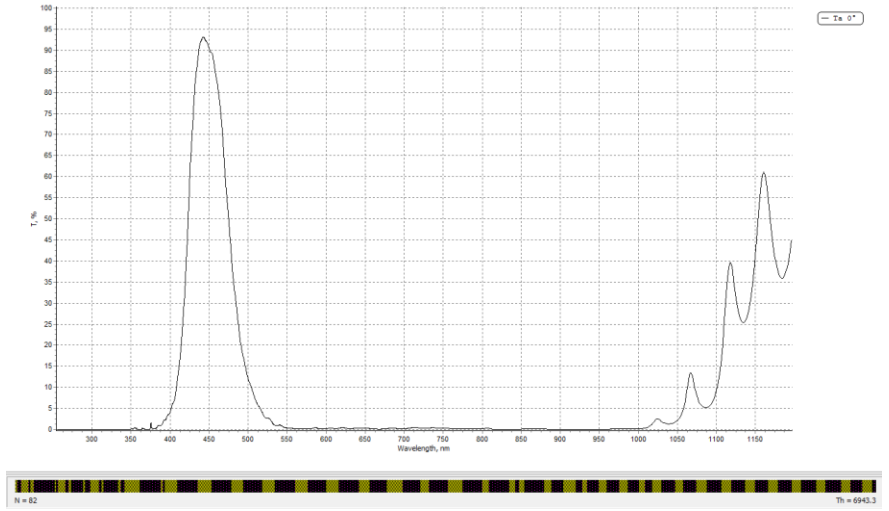
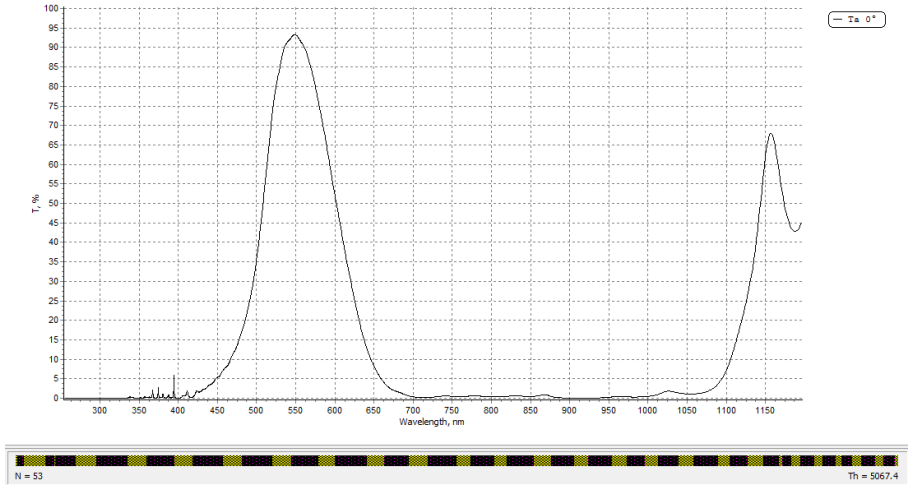
True Color spectral sensing

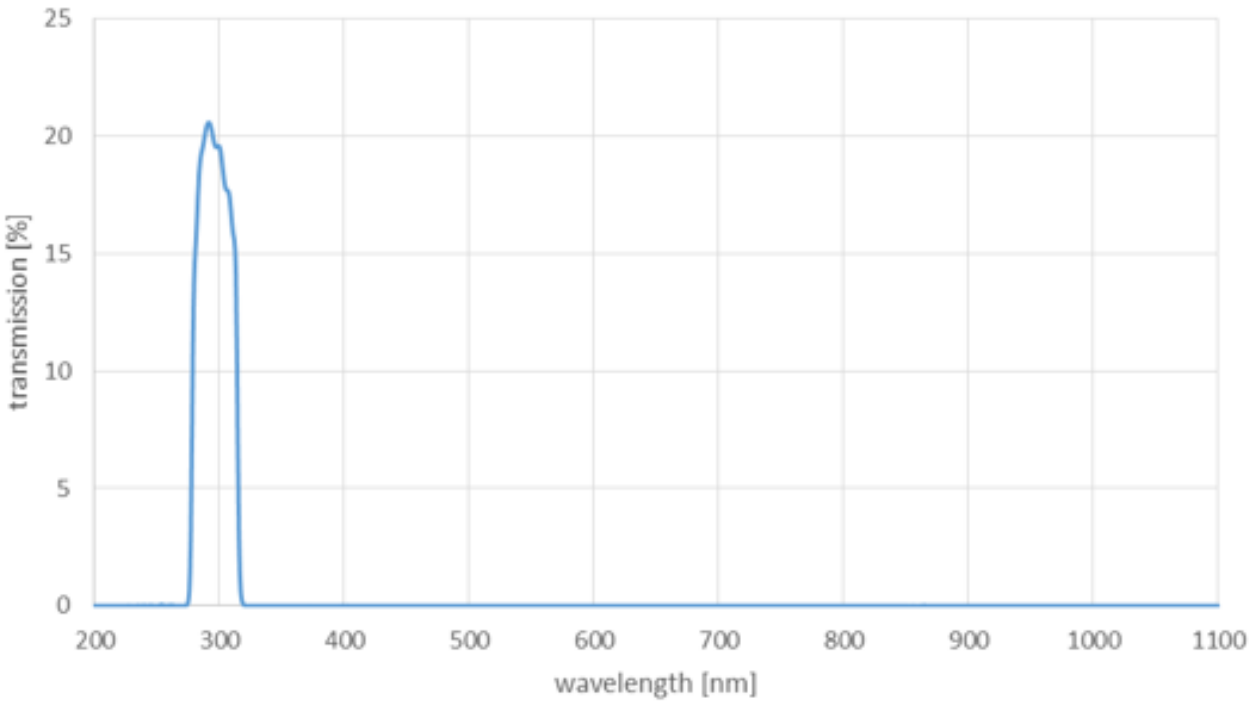
For highest performance display management “paper-like” viewing experience

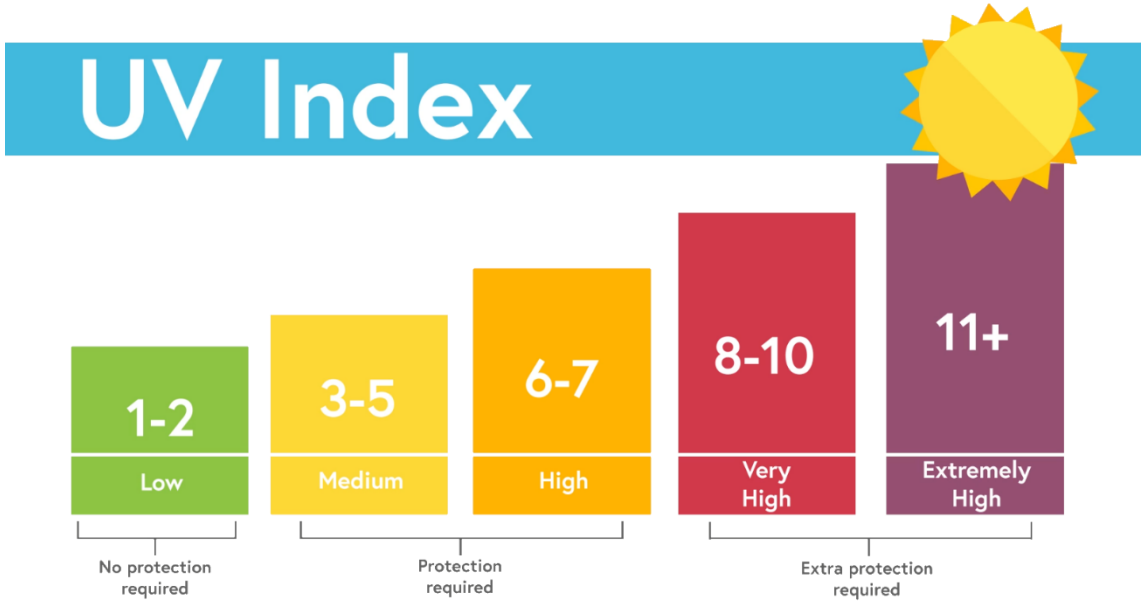






Filters for UV applications



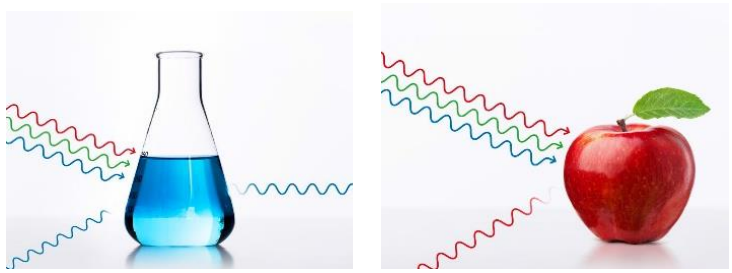


Filters that have a reasonable transmission in the UV and a high stopband blocking are based on a hybrid filter technology that combines dielectric and absorbing materials. The measurement data are showing the transmission characteristics of a UV B bandpass filter using HfO_2, SiO_2 and metallic aluminum.

Spectral sensing: unleash knowledge through light

Light interacts specifically with materials, generating optical fingerprints

Filters on ams detectors sample optical fingerprints – i.e. the reflected or transmitted spectrum



Matching the optical fingerprints enables many applications

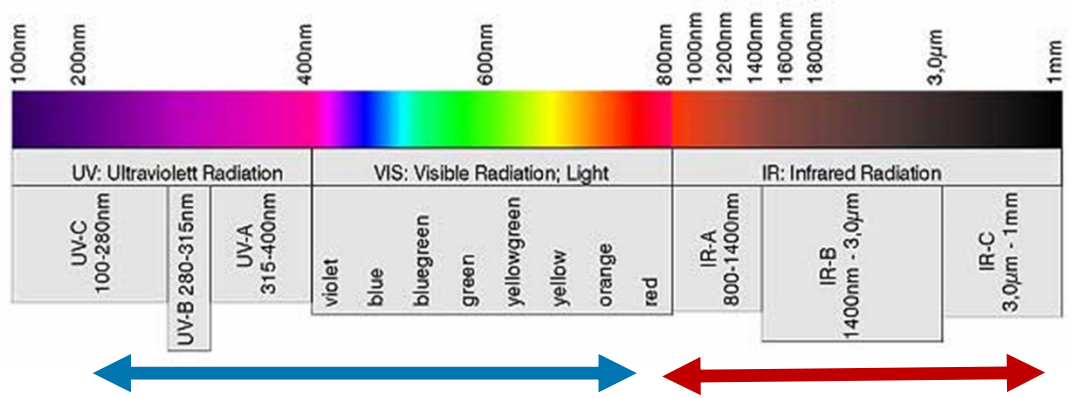
- Color measurement
- Food type, food quality
- Bacteria contamination
- Detect counterfeit products

For specific usage cases:

- Smart Lighting in homes and buildings
- Home appliances
- Medical and wellness
- Industrial
- Consumer

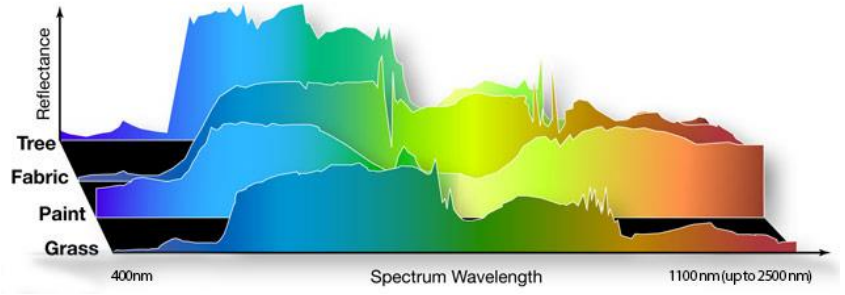
Optical Spectrum Coverage

Capability to deliver high-volume and performance devices to the consumer

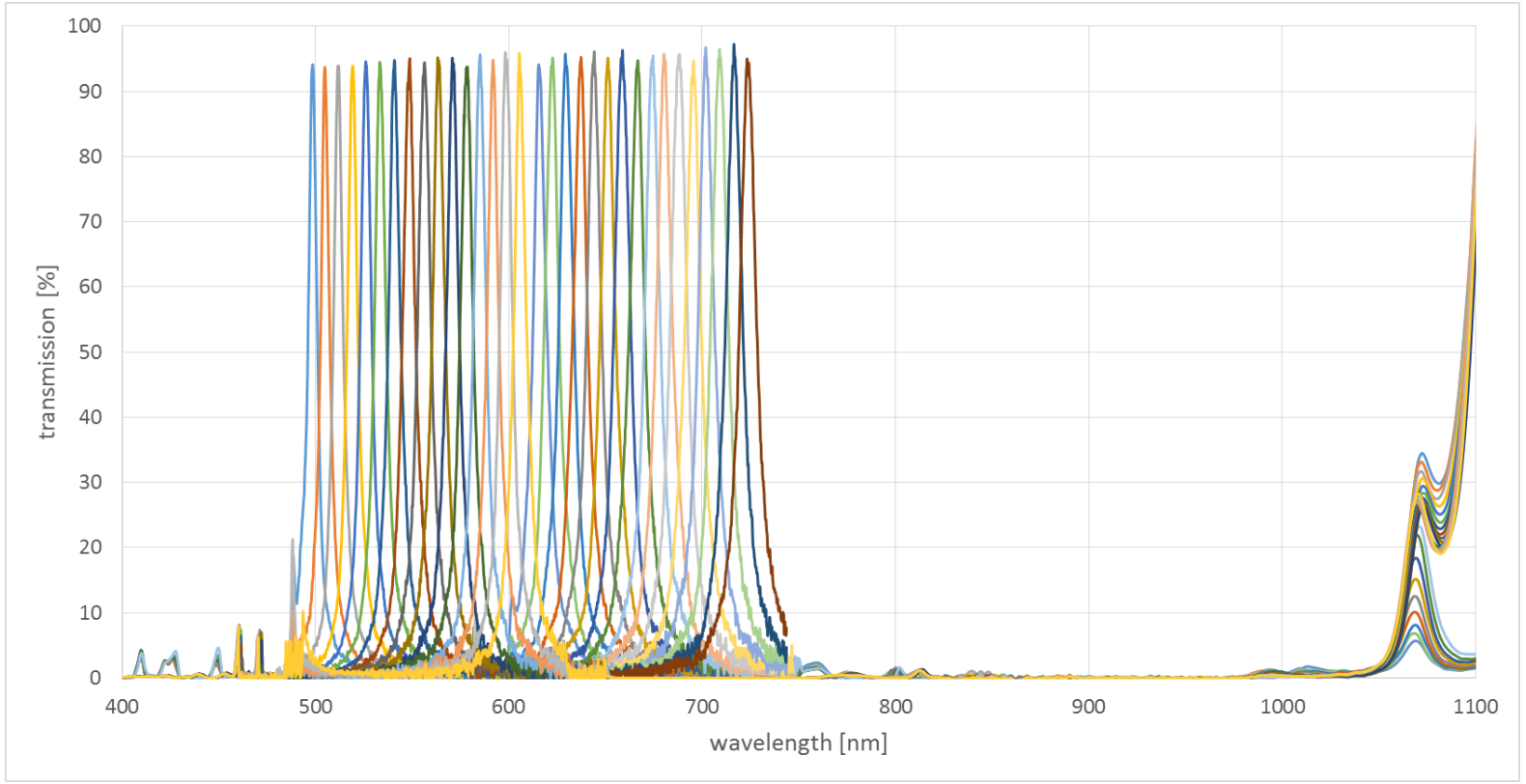


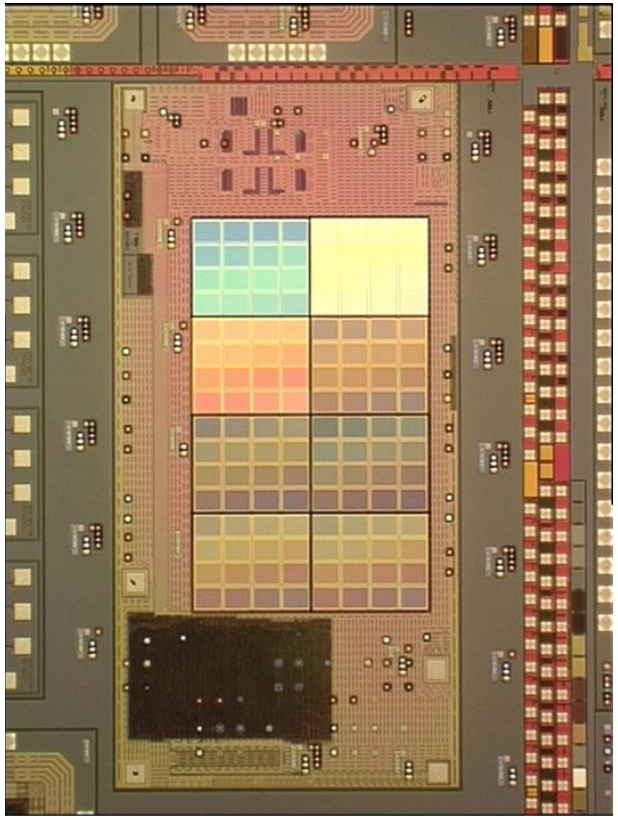
Silicon technology for 0.28-1.05µm

Area of interest and development 1-14um



Hyper spectral filters





after etalon deposition

Measurement result of a hyperspectral study with 32 optical channels. The measurements have been performed on glass substrates with collimated light (AOI=0°, light source: FWHM=0.2nm, measurement step = 0.2nm). The blocking capability is integrated in the Fabry-Perot filter structure

Conclusions

- High performance optical sensors need highly specialized filter elements to tailor the wavelength sensitivity of the semiconductor sensor element
- Extending these capabilities into UV and IR are opening completely new application fields in the Consumer, Automotive and IoT Space
- The electromagnetic spectrum shaping capabilities are a vital component of an optical sensor and represent a key unique selling proposition for our products.

Thank you!

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www.ams.com