# LIDIZ®

## IBS Vacuum systems

# Content

# About I-Photonics

I-Photonics long year experience in working on Ion Beam technology and Thin Film physics and the related R&D works on thin film coatings and coating hardware developments testimony the importance of defining and improving continuously coating processes and provided over the years a consistent process portfolio which defines I-Photonics as an attractive and competitive solution provider.

Following the global market demands we developed Magnetron Sputtering Technology (MS, RMS, PARMS), Diamond Like Carbon Technology for IR optics (DLC by PECVD), E-Beam Evaporation (IBAD), Ion Beam Sputtering (IBS, RF IBS) for precision optics.

Being focused on optical coatings we developed automatic optical process control systems OCP BroadBand an OCP SingleWave that allow to make high precision multilayer optical coating for UV, VIS, NIR, Mid IR ranges with high yield.

Ongoing updates on behalf of the requirements for coatings from the customer demanded from us incessant R&D, which lead to a constant improvement of our equipment and defined the role of the entire company not only as a developer of equipment, but more as a developer of coating solution provider.

The accumulated experience in processes and methods of thin films coatings helps I-Photonics to be specialized in coating services as well. It also positioned I-Photonics as company which provides technological support for each customer and shares the knowledge in thin films.

With each customer our aim is to possibly establish long-term cooperation based on our experience and continuous improvements as a solution provider.

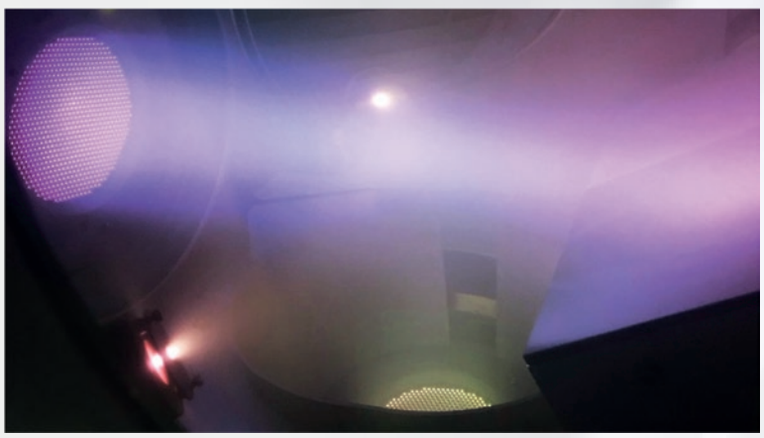
# LIDIZ®

## IBS sputtering systems for ultra-high precision optics

LIDIZ vacuum systems family is the result and embodiment of 50 years' experience in Ion Beam Sputtering (IBS) technology. IBS technology is well known for its extremely low-loss optical coatings. LIDIZ IBS Sputtering Systems is an effective tool for deposition of optical coatings for a wide range of applications. LIDIZ is equipped with RF grid ion-beam sputtering source, RF grid ion-beam source for substrates pre-cleaning, surface activation, sputtering assisting and RF neutralizers. LIDIZ is designed to get thin films from a wide range of materials with high accuracy and excellent quality. Unique optical process control system OCP SingleWave and OCP BroadBand with intellectual real-time optimization of optical coatings design provides automation of complicated filters coating with high accuracy and repeatability.

## Main Features

- RF Grid high-power IBS for deposition with RF neutralizer to ensure high deposition rates and film quality
- RF IBS assist with RF neutralizer to ensure maximum stoichiometry control and substrate pre-cleaning and activation
- Automatic Optical control system OCP in various configuration:
  - OCP BroadBand,
  - OCP SingleWave,
  - OCP Duo with 2 control types in one system
  - OCP Laser
- Multiple choice of substrate holders to provide maximum product flexibility and to match productivities needs:
  - Single disk
  - Planetary system
  - High speed single disk



# LIDIZ®

## IBS sputtering systems for ultra-high precision optics

**HIGH YIELD** and **RELIABILITY** in deposition of multilayer coatings for precision optics and lasers

**REAL-TIME PROCESS OPTIMIZATION OF OPTICAL STRUCTURE**

The intellectual OCP BroadBand real-time optimization function controls the current result of coating and in case of deviation from the target it recalculates and makes correction in next layers in order to correct mistake and deviation

### Film quality

- High purity
- Low scatter and absorption loss
- High laser damage threshold
- Low surface roughness
- High density
- Excellent adhesion
- Low humidity sensitivity

### Markets

- Telecommunication
- Laser based instrumentation
- Internet of things (IoT)
- Light identification detection and ranging (LIDAR)
- Fluorescence microscopy
- Hyper-spectral imaging
- Raman spectroscopy
- High power lasers
- Biomedical filters

### Application

- Laser mirrors
- Bandpass filters
- Multi-band bandpass filters
- Notch filters
- Multi-notch filters
- Rugate filters
- Steep edge filters
- Low scatter and absorption loss optics
- Thin-film polarizers
- Wide-angle anti-reflection coatings
- Coatings on fibers
- AR coatings on laser diodes
- Coatings with low defects
- Low loss HR or AR coatings (total loss is less than 10 ppm)
- Multi-layers filters (>100 layers) with high requirements to precision and thickness control

# LIDIZ® 700

## IBS sputtering systems for precision optics

### Applications

- Laser optics with low optical loss
  - High power lasers
  - Laser gyroscope
  - Various AR/HR and filters for laser application
- Internet of things (IoT)
- Light identification detection and ranging (LIDAR)
- Medical equipment and measurement devices
  - Beam splitters
  - Band pass filters
  - Edge filters
  - Notch filters

## Technical data

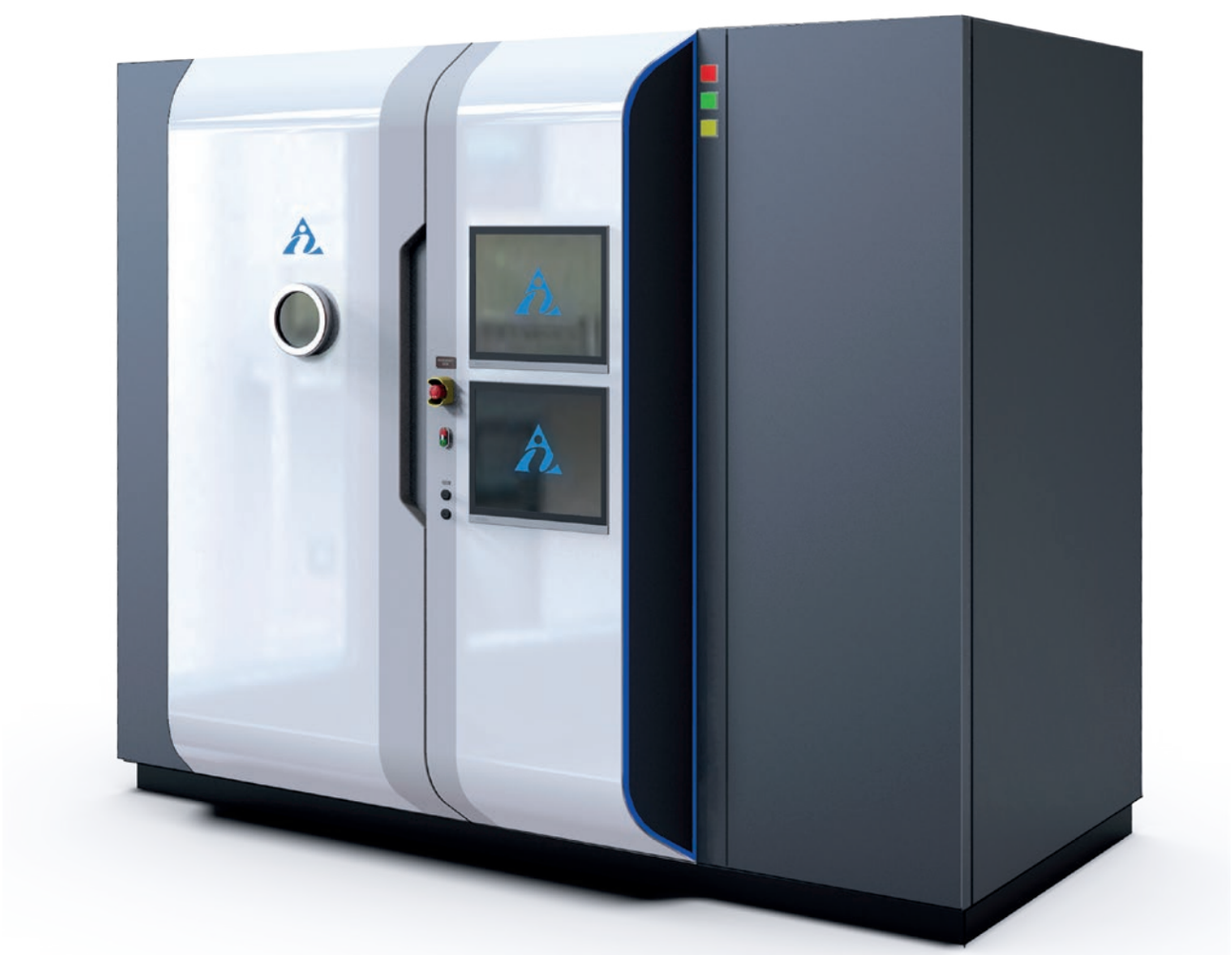
| | |
|---|---|
| Installation area | 3540×1840×2000 mm (L×W×H) |
| Weight | 3500 kg |
| Sputtering source | RF Grid IBS with RF neutralizer |
| Assistance source | RF Grid IBS with RF neutralizer |
| Substrate holder and coating area | Single disk Ø320 mm (area 700 $cm^2$)<br>Planetary 4x Ø210 mm (area 1256 $cm^2$)<br>and planetary 3×Ø320 mm (area 2100 $cm^2$) |
| Load lock | For single disk substrate holder |
| Coating uniformity | ≤±0.25% for planetary 4x Ø210 mm<br>≤±0.5% for single disk Ø320 mm<br>≤±0.5% for planetary 3×Ø320 mm |
| Process control system | Automatic optical control system OCP:<br>OCP BroadBand,<br>OCP SingleWave, OCP Duo (BB and SW 2 in 1) |
| Substrate materials | glass ceramics, chromatic and achromatic optical glass, quartz, potassium fluoride, sapphire, etc. |
| Number of targets, max. | 4 pcs. |
| Sputtering targets | Ti, Ta, Nb, Zr, Hf, AI, Si, $SiO_2$ etc. |
| Coating rate | Up to 5 Å/sec (depends on the material) |
| Substrate temperature during the process (without heater) | <100°C |
| Substrate heating system temperature | <250°C |
| Substrate heating uniformity | ±2°C |
| Ultimate pressure | 5E-5 Pa |
| Time to reach ultimate pressure | 12 hours |
| Base pressure | 8E-4 Pa |
| Time to reach base pressure | 30 min (without load lock)<br>≤8 min (with load lock) |
| Pumping system | Dry mechanical pump & cryogenic pump<br>Turbo molecular pump is optional |

# LIDIZ® 1100

IBS vacuum coating system for precision optics with high throughput

## Applications

- Laser optics with low optical loss
  - High power lasers
  - Laser gyroscope
  - Various AR/HR and filters for laser application
- Internet of things (IoT)
- Light identification detection and ranging (LIDAR)
- Medical equipment and measurement devices
  - Beam splitters
  - Band pass filters
  - Edge filters
  - Notch filters



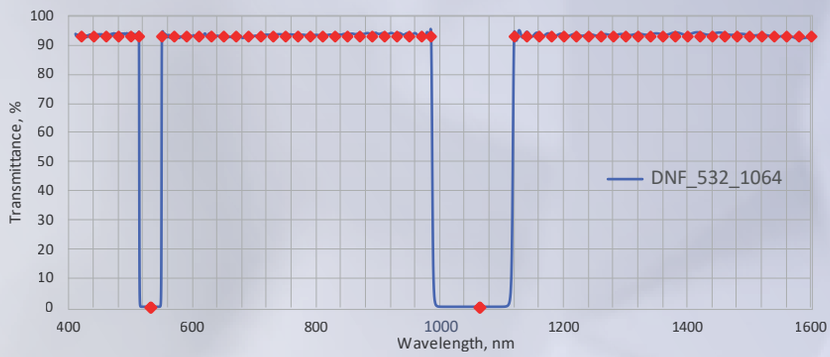
## Technical data

| | |
|---|---|
| Installation area | 3490×2730×2460 mm (L×W×H) |
| Weight | 4500 kg |
| Sputtering source | RF Grid IBS with RF neutralizer |
| Assistance source | RF Grid IBS with RF neutralizer |
| Substrate holder and coating area | Single disk Ø440 mm (area 1520 $cm^2$)<br>Planetary 7x Ø210 mm (area 2200 $cm^2$)<br>Planetary 4x Ø350 mm (area 3840 $cm^2$)<br>Other planetary by request |
| Coating uniformity | ≤±0.25% planetary 7x Ø210 mm<br>≤±0.5% planetary 4x Ø350 mm<br>≤±0.5% for single disk Ø440 mm |
| Process control system | Automatic optical control system OCP:<br>OCP BroadBand,<br>OCP SingleWave, OCP Duo (BB and SW 2 in 1) |
| Substrate materials | glass ceramics, chromatic and achromatic optical glass, quartz, potassium fluoride, sapphire, etc. |
| Number of targets, max. | 4 pcs. |
| Sputtering targets | Ti, Ta, Nb, Zr, Hf, AI, Si, $SiO_2$ etc. |
| Coating rate | Up to 4 Å/sec (depends on the material) |
| Substrate temperature during the process (without heater) | <100°C |
| Substrate heating system temperature | <250°C |
| Substrate heating uniformity | ±2°C |
| Ultimate pressure | 5E-5 Pa |
| Time to reach ultimate pressure | 12 hours |
| Base pressure | 8E-4 Pa |
| Time to reach base pressure | 40 min |
| Pumping system | Dry mechanical pump & cryogenic pump<br>Turbo molecular pump is optional |

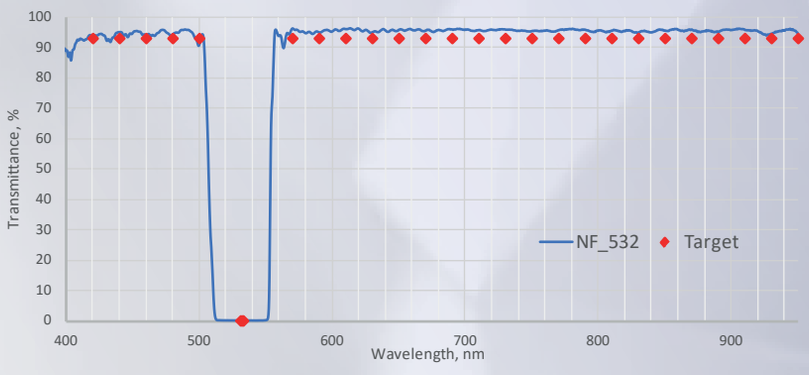
# Coating examples

## Notch filter

| | |
|---|---|
| λCWL | 532 + 1064 nm |
| Transmission band 1 | Tavg > 93% 400 – 513 nm |
| Transmission band 2 | Tavg > 93% 550 – 985 nm |
| Transmission band 3 | Tavg > 93% 1120 – 1600 nm |
| Blocking band 1 | ODabs > 6 λ=532 nm |
| Blocking band 2 | ODabs > 6 λ=1064 nm |
| Full width-half max FWHM (nm) | 35 λ=532; 130 λ=1064 |
| Coating | Hard coated |
| Surface quality | 60-40 |
| Durability | MIL-C-48497A |

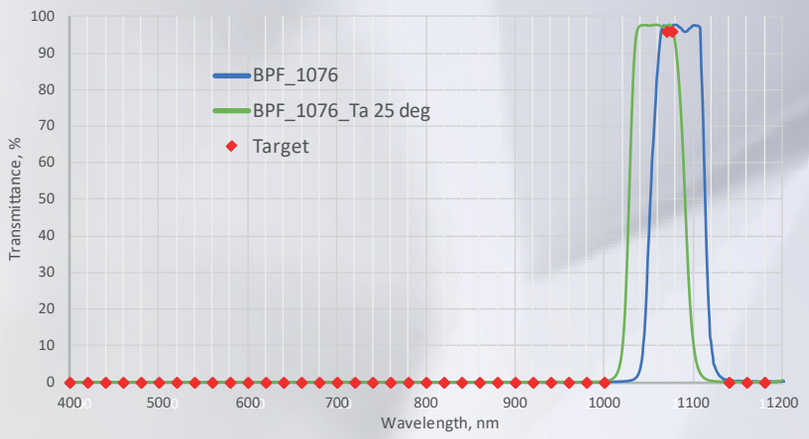



| | |
|---|---|
| λCWL | 532 |
| Transmission band 1 | Tavg > 93% 400 – 500 nm |
| Transmission band 2 | Tavg > 93% 565 – 965 nm |
| Blocking band 1 | ODabs > 4 532 nm |
| Full width-half max FWHM (nm) | 45 @532 |
| Coating | Hard coated |
| Surface quality | 60-40 |
| Durability | MIL-C-48497A |

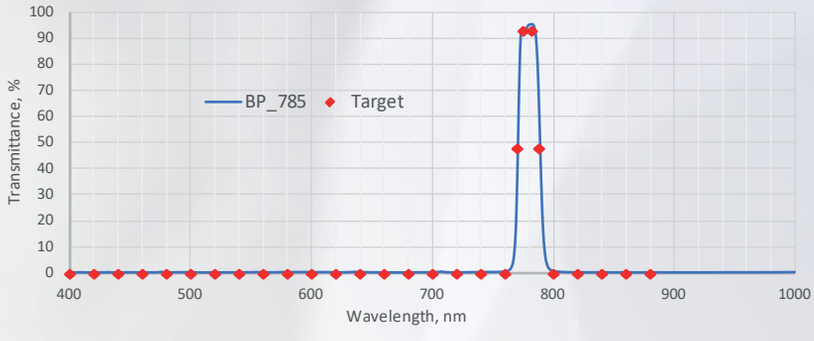



## Band pass filters

| | |
|---|---|
| λCWL | 1076 |
| Tr, % for λ=1076 nm | >98 for incident angle 0-25° |
| Blocking band 1 | ODabs <3, 400-1000 nm |
| Blocking band 2 | ODabs < 2, 1140-1250 nm |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | RG850 |

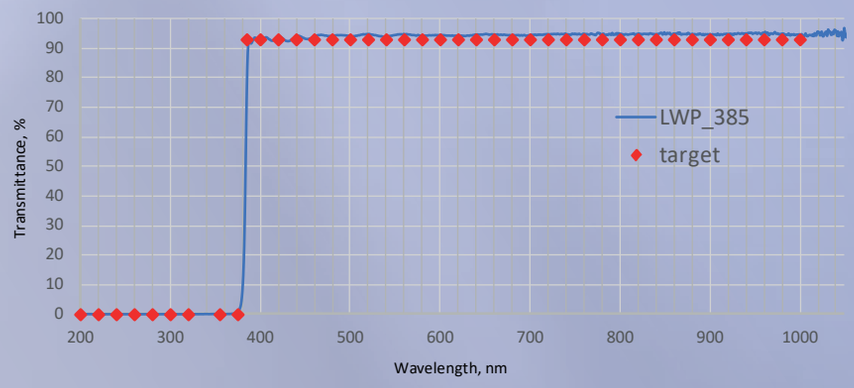



| | |
|---|---|
| λCWL | 780 |
| Tr, % for λ=1076 nm | >93 without back side AR |
| Full width-half FWHM (nm) | 18 |
| Blocking band 1 | ODav <3, 400-760 nm |
| Blocking band 2 | ODav < 3, 805-1000 nm |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | BK7 |

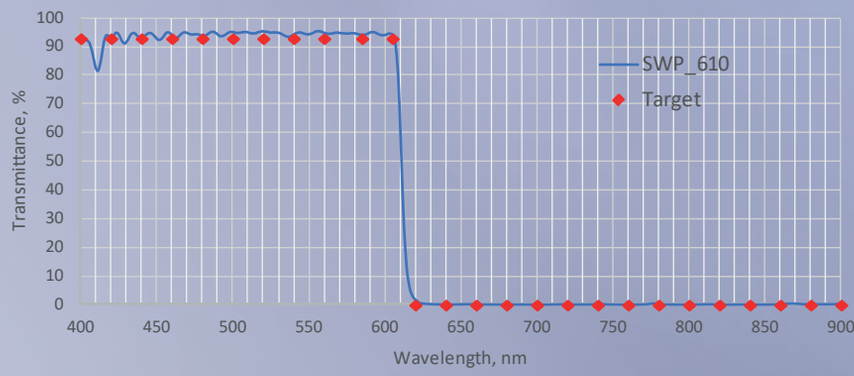


## Cut filter

| | |
|---|---|
| $\lambda_{CWL}$, nm | 385 |
| Tr av, % | >93, λ=385-1050 nm |
| Blocking band | ODav>3, λ=200-380 nm |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | Fused silica |

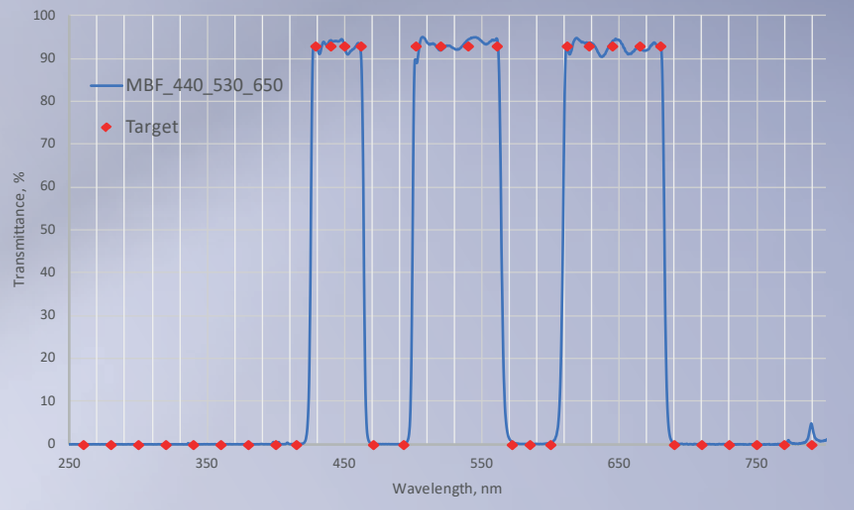



| | |
|---|---|
| $\lambda_{CWL}$, nm | 610 |
| Tr av, % | >93, λ=400-605 nm |
| Blocking band | ODav >2, λ=620-900 nm |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | BK7 |



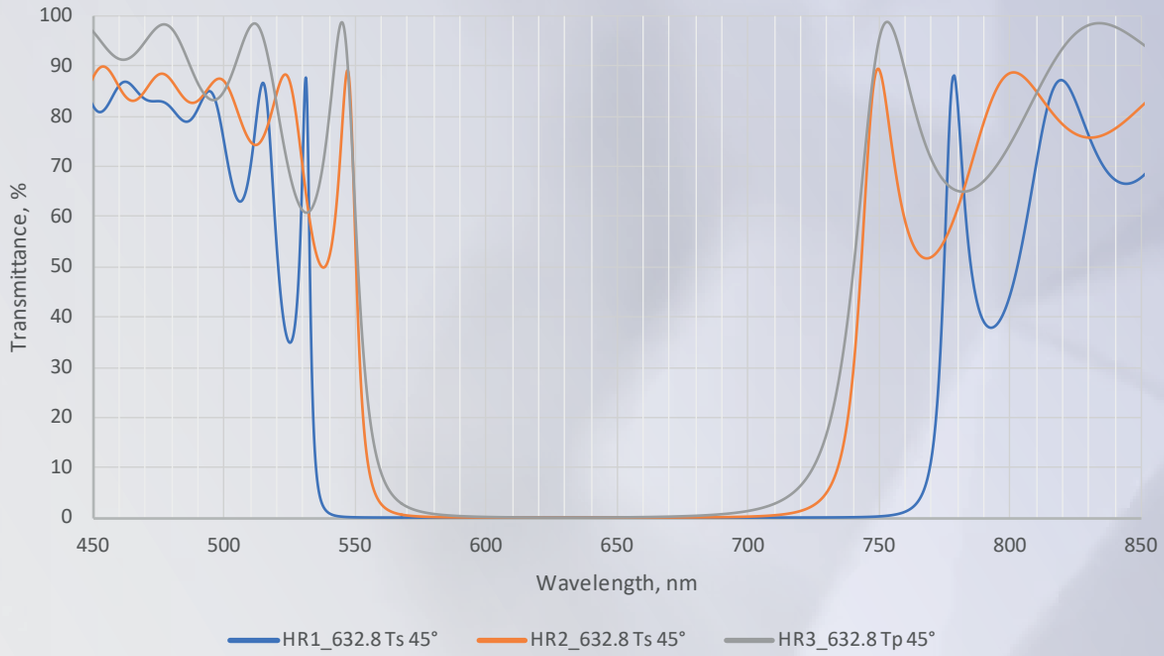

## Multispectral filter

| | |
|---|---|
| $\lambda_{CWL}$, nm | 446, 532, 646 |
| Transmission band 1 | $T_{avg}$ > 93% , λ=429– 462 nm |
| Transmission band 2 | $T_{avg}$ > 93%, λ=502 – 561 nm |
| Transmission band 3 | $T_{avg}$ > 93%, λ=612 – 680 nm |
| Blocking band 1 | ODav > 4, λ=200-415 nm |
| Blocking band 2 | ODav > 3, λ=469-471 nm |
| Blocking band 3 | ODav > 3, λ=571-598 nm |
| Blocking band 4 | ODav > 3, λ=690-800 nm |
| Coating | Hard coated |
| Surface quality | 40-20 |
| Durability | MIL-C-48497A |
| Substrate | BK7 |



# Coating examples

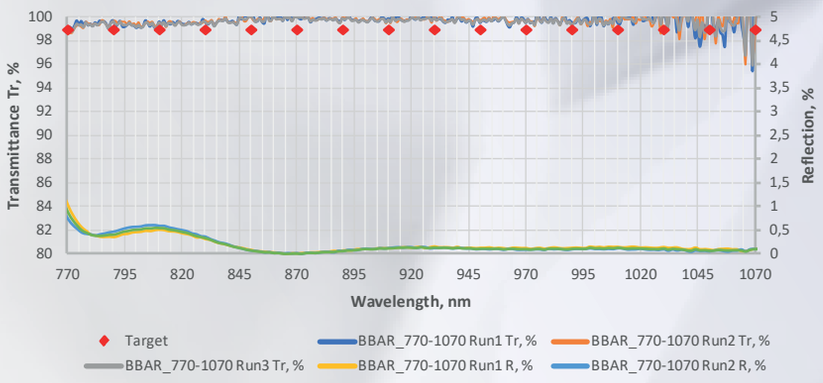
## Low loss laser mirrors



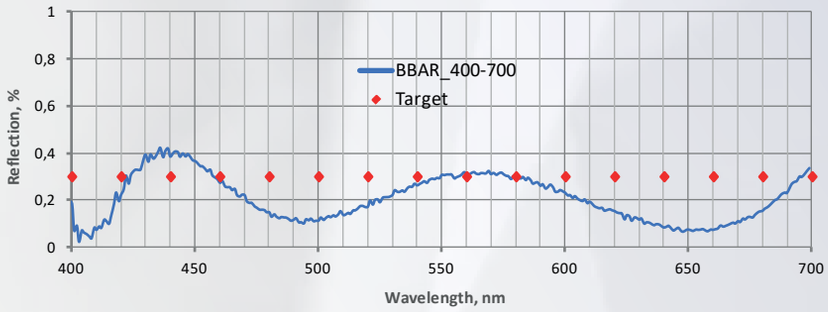

| Coating name | HR1 | HR2 | HR3 |
|---|---|---|---|
| λcwl, nm | 632,8 | 632,8 | 632,8 |
| Rs, % | >99.995 | >99.98±0.004 | >99.8 |
| Incident angle | 45° | 45° | 45° |
| Total losses | <50 ppm | <50 ppm | <50 ppm |
| Phase anisotropy | ±0,11 | ±0,11 | ±0,11 |
| Durability | MIL-C-48497A | MIL-C-48497A | MIL-C-48497A |
| Substrate | Sitall CO-115M | Sitall CO-115M | Sitall CO-115M |

## High efficiency broad band anti-reflection (BBAR)

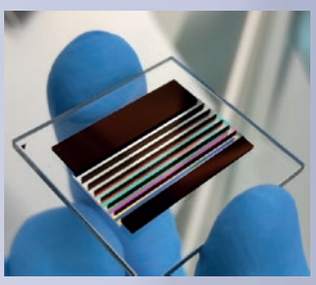
| λ, nm | 770-1070 |
|---|---|
| Tr av, % | >99.5 double side coated |
| Rav, % | <1% for incident angle 0-30° |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | BK7 |

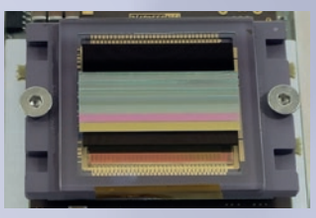


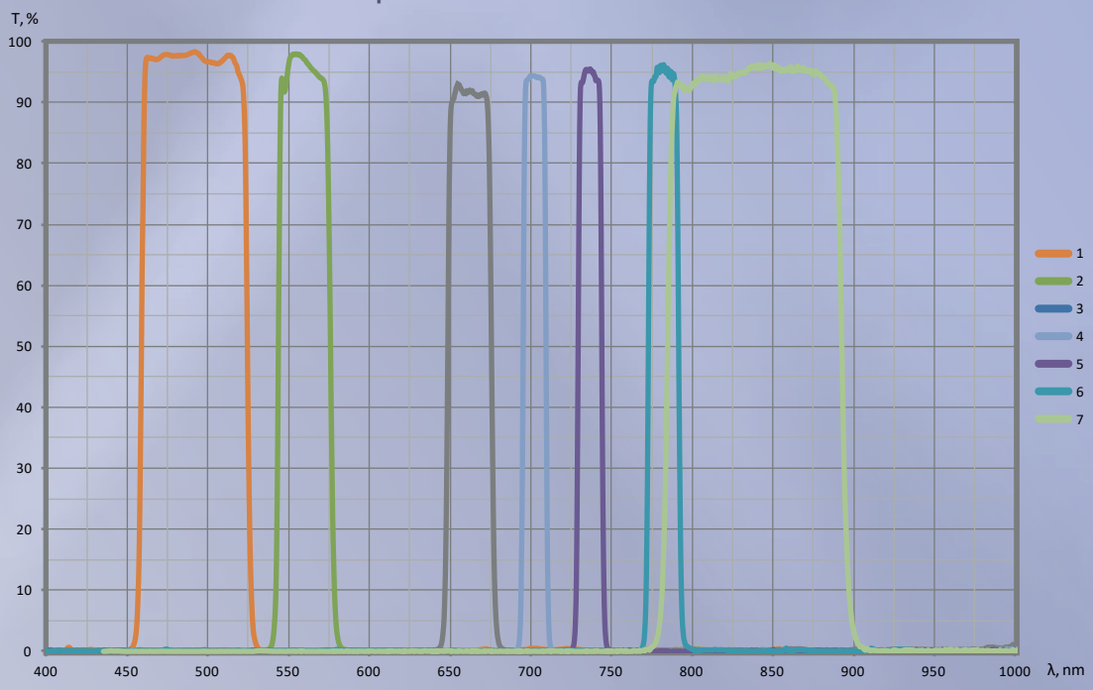

| λ, nm | 400-700 |
|---|---|
| Rav, % | < 0.3 double side coated |
| Coating | Hard coated |
| Surface quality | 20-10 |
| Durability | MIL-C-48497A |
| Substrate | BK7 |



## Multi zone optical filters

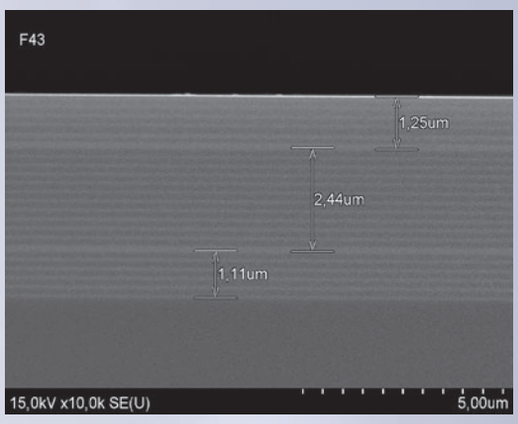




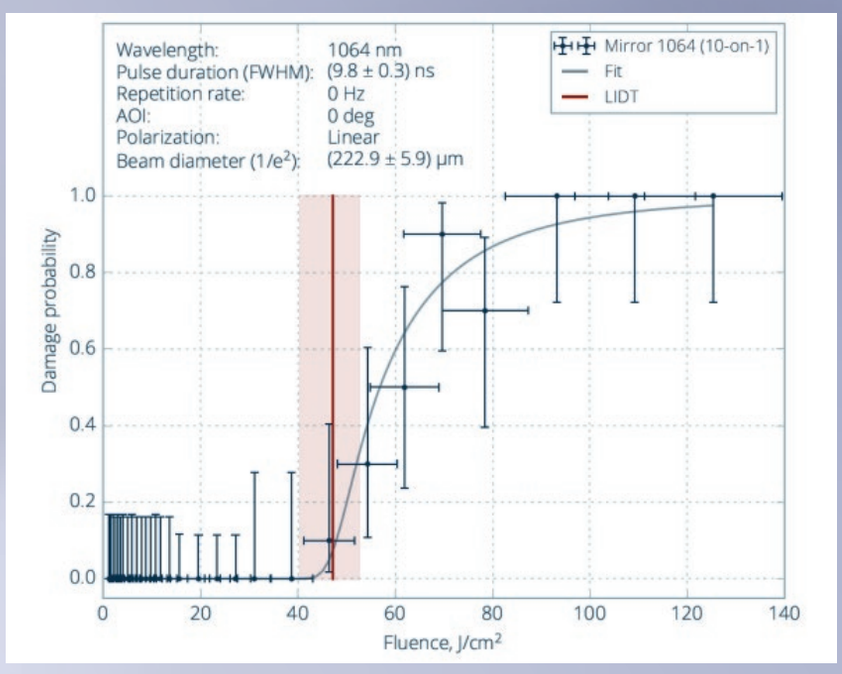



| | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Zone 7 |
|---|---|---|---|---|---|---|---|
| Bandpass, nm | 460-525 | 545-575 | 650-675 | 695-710 | 730-745 | 775-795 | 785-895 |
| Transmission, % | >90 | >90 | >90 | >90 | >90 | >90 | >90 |
| Blocking range, nm | 300-1100 | 300-1100 | 300-1100 | 300-1100 | 300-1100 | 300-1100 | 300-1100 |

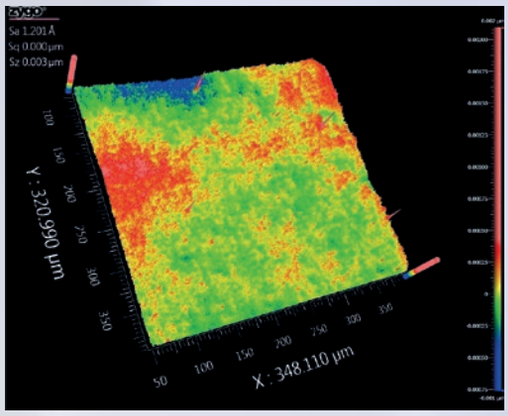
## Coating quality




High film density




High LIDT

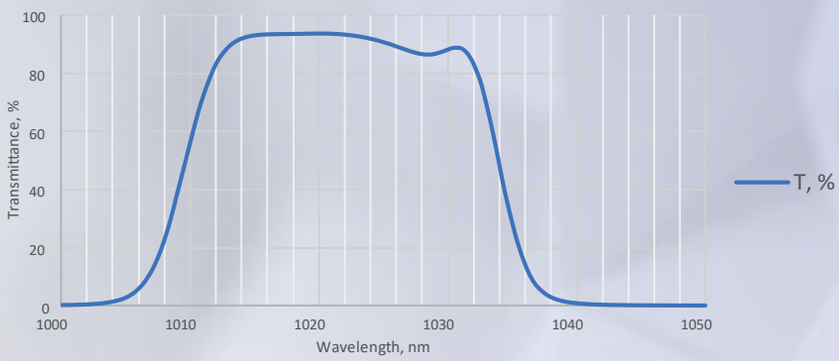


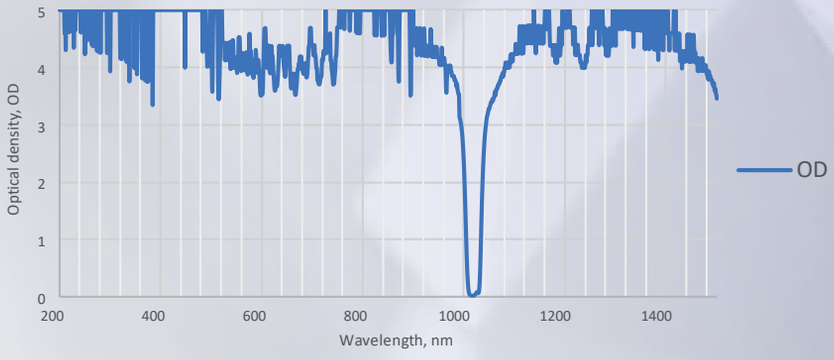

Small roughness 1.2 Å

# Coating examples

## FBP_1025nm

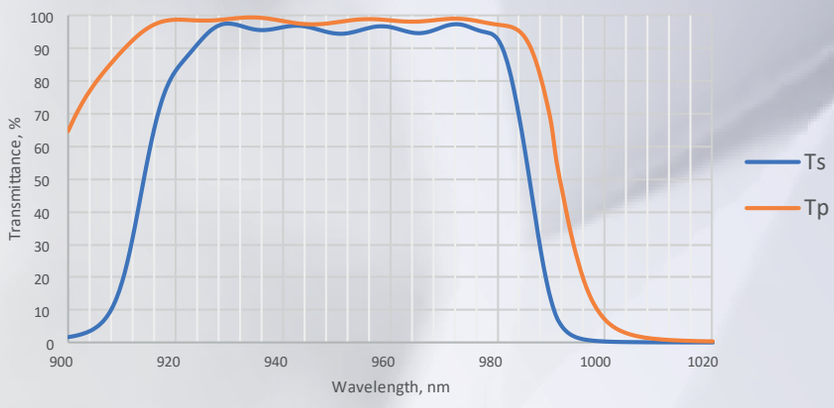
| | |
|---|---|
| Thickness (S1+S2) | 27 µm |
| Quantity of layers (S1+S2) | 239 |
| Center Wavelength CWL | 1022 nm |
| Full Width Half Max FWHM | 25.0 nm |
| Blocking (Avg) ≥ OD 4.0 | from 200-975 nm |
| Blocking (Avg) ≥ OD 4.0 | from 1075-1500 nm |
| Blocking (Abs) ≥ OD 3.0 | from 200-960 nm |
| Blocking (Abs) ≥ OD 3.0 | from 1090-1500 nm |
| T (Avg) ≥ 90% | over minimum of 20 nm bandwidth within the FWHM |

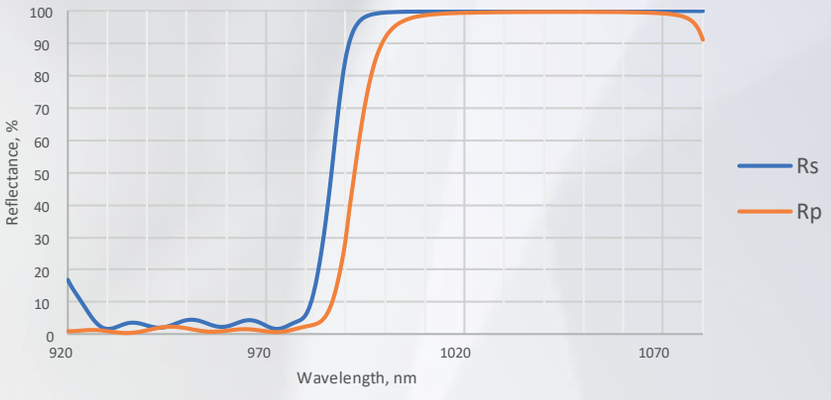



## HR_1020-1070_45deg

| | |
|---|---|
| Thickness (S1+S2) | 11.5 µm |
| Quantity of layers (S1+S2) | 60 |
| Rs (λ=1020-1070 nm) | > 99.6 % |
| Rp (λ=1020-1070 nm) | > 99.2 % |
| Ts (λ=940-980 nm) | > 93 % |
| Tp (λ=940-980 nm) | > 97 % |
| Material | UVFS |



## NF_532+635_45deg

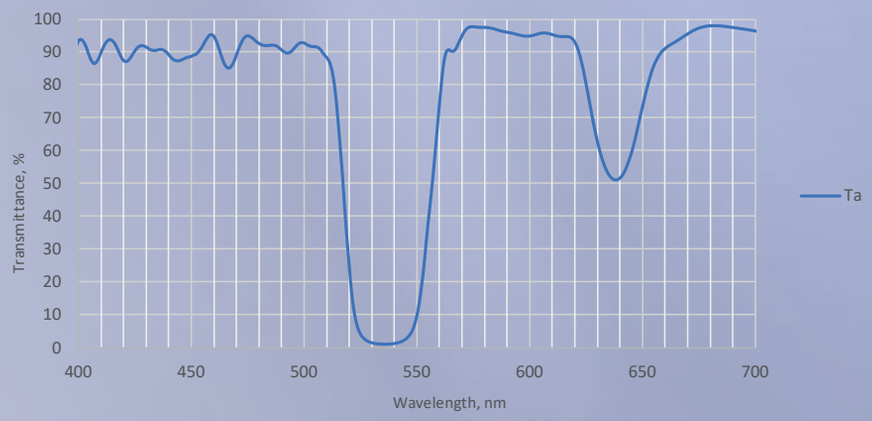
| | |
|---|---|
| Thickness (S1+S2) | 6.8 µm |
| Quantity of layers (S1+S2) | 56 |

**S1 – surface**

| | |
|---|---|
| Type | Dielectric coating |
| Wavelength range | 400-700 nm |
| Transmission | > 95 % 400-510 nm, 655-700 nm |
| Reflection | > 99.5 % 532±, ~50 % 635± |
| Polarization | 532 nm S-pol, 635 nm unpolarized |
| Incident angle | 45 ± 3 degrees |

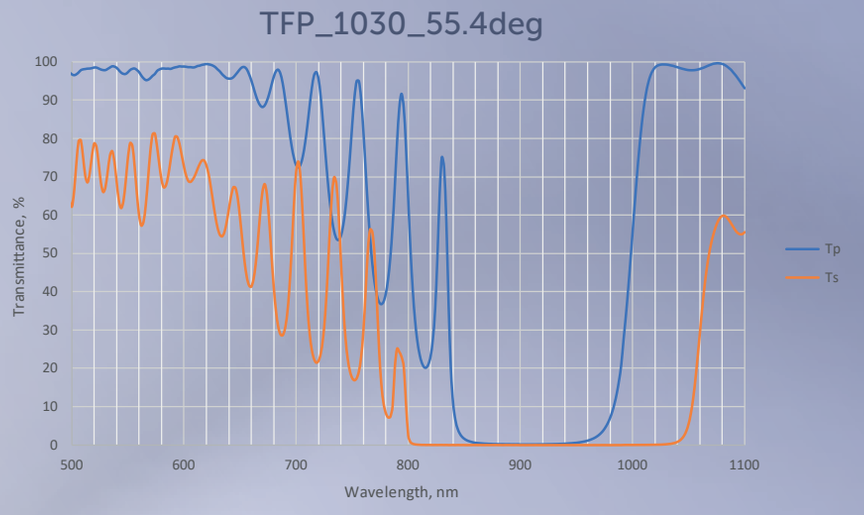
**S2 – surface**

| | |
|---|---|
| Wavelength range | 400-700 nm |
| Reflection | < 2 % |
| Polarization | unpolarized |
| Incident angle | 45 ± 3 degrees |




## TFP_1030_55.4deg

| | |
|---|---|
| Thickness (S1) | 5.5 µm |
| Quantity of layers (S1) | 41 |
| Tp 1030 nm | > 99 % |
| Ts 1030 nm | < 0.1 % |
| Material | UVFS |




## WHR_39-51deg

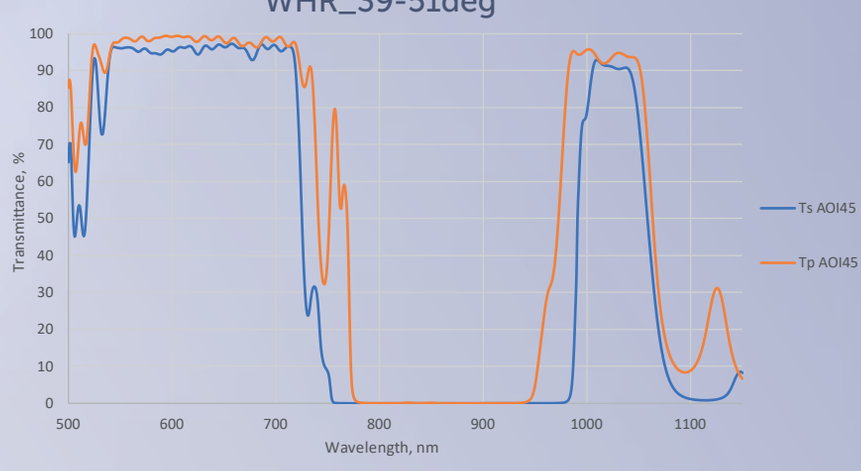
| | |
|---|---|
| Thickness (S1+S2) | 9 µm |
| Quantity of layers (S1+S2) | 70 |

**S1 – surface**

| | |
|---|---|
| Dichroic coating | AOI 45° ± 6° |
| T > 90 % | 550-700 nm, Tp=Ts |
| R = 99 % | 800-890 nm, Rj=Rs |
| Tavg > 90 % | 1000-1030 nm, AOI 45° |

**S2 – surface**

| | |
|---|---|
| AR coating 400-1000 nm | AOI 45° |



I-Photonics UAB
Parko g. 3, Avizieniai, Vilniaus raj., 14198, Lithuania
Company code: 305907047
VAT number: LT100014457816
E-mail: info@i-photonics.lt
Web:
www.i-photonics.lt
www.i-coatings.lt