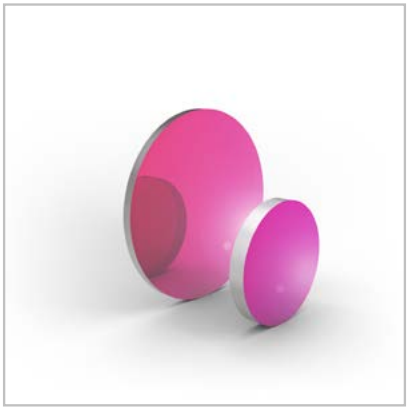
LASER COMPONENTS®

Dielectric Mirrors

Description



Dielectric mirrors feature high reflection values and very high laser damage thresholds.

Those mirrors with dielectric coatings can be produced at LASER COMPONENTS for all wavelengths from 248 nm to 3000 nm. Mirrors for a single wavelength, wavelength ranges and multiple wavelengths are possible. Multiple wavelength mirrors for example are used for the purpose to reflect several wavelengths across the same optical path or to have one optics that can be used for different laser, to reduce the different types of mirrors in the stock department.

Features / Characteristics

For dielectric mirror often a trade-off on specification of below features and characteristics is needed:

- LiDT:
  Dielectric coated mirrors are suitable for very high power. Depending on the design, coating material and coating technology the LiDT values vary. An optimization of the LiDT might result on reduced values on other coating specifications.
- Reflectivity:
  High reflectivity values of >99.99% are possible, for single wavelength. The reflectivity is however depending on the polarization, AOI and LiDT request.
- Angle of Incidence [AOI]:
  Dielectric mirrors are sensitive to the AOI, a range of AOI is possible, thus scanning mirrors can be done as well.
- Bandwidth:
  Dielectric coatings can be optimized to a certain bandwidth of wavelength or AOI, however there is a trade-off between bandwidth, reflectivity and LiDT that needs to be checked.
- Wavelength:
  High reflective optics are used for reflection of a specific wavelength or wavelengths ranges. For optics that reflect one wavelength and transmit another please see our data sheet on dichroic mirrors.

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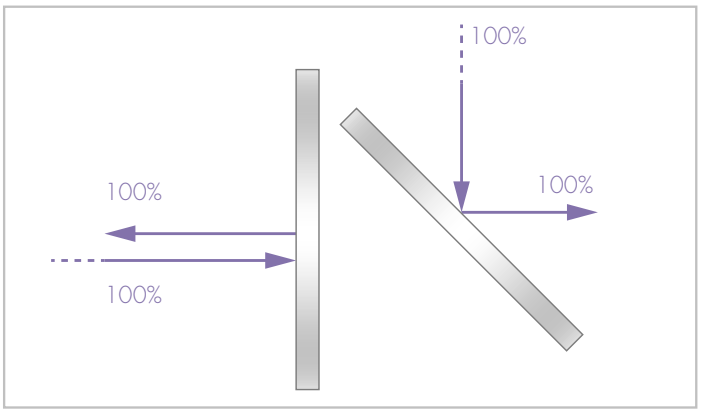
Applications

Mirrors for AOI = 0° are typically used within a laser resonator. Mirrors >0° are typically used within folded cavities or as beam delivery mirror.
In broadband and multiple wavelengths mirrors the reflection is typically somewhat lower and the angle of incidence is more sensitive. Some designs additionally require thicker layers, which can affect both the surface figure after coating and the damage threshold.

Special designs for scanning or applications with variable angles of incidence are also possible.

Single Wavelength High Reflective Mirror

Function



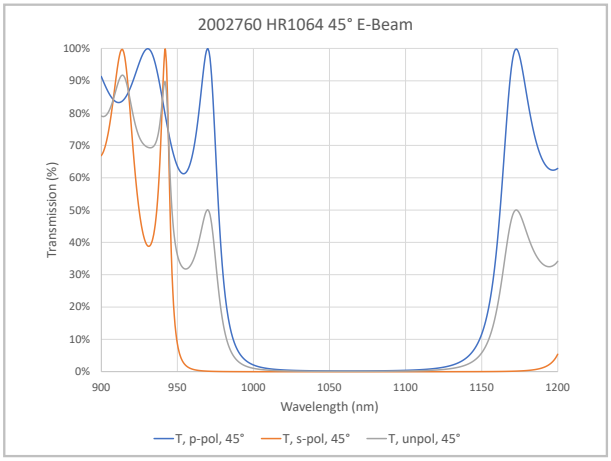
Specifications

HR1064 or HR1064/45

Typical Specifications for e-beam Coating

Degree of reflection:

Angle of incidence 0°	R > 99.8%
Angle of incidence 45°	R > 99.9% s-pol,
	R > 99.5% p-pol,
	R > 99.7% u-pol



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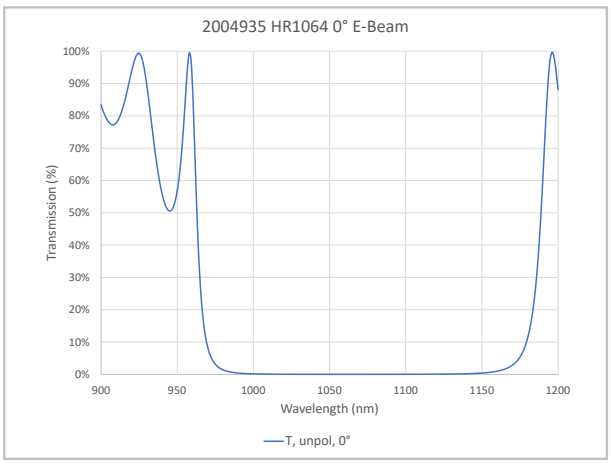
Typ. damage threshold:
LDT ≈ 30 J/cm² (10 ns)
LDT ≈ 5 MW/cm² (cw)



Typical simulation for HR mirror @AOI = 0°.
The typical FWHM of the HR spectrum is ±10% of the wavelength (Example: HR1064), however only in a specification mentioned wavelengths are tested and verified during the outgoing inspection.

Typical simulation for HR mirror @AOI = 45°.
The typical FWHM of the HR spectrum is ±6% for s-pol and ±3% for p-pol of the wavelength (Example: HR1064/45) however only in a specification mentioned wavelengths are tested and verified during the outgoing inspection.

Table 1: Single Wavelength High Reflective Coating, typical values

	UV 266 – 400	VIS 400 – 700	NIR 700 – 2000	IR 2000 – 3000
AOI = 0°	>99.0% – >99.5%	>99.8%	>99.8%	>99.8%
AOI = 45° u-pol	>99.3% – >99.5%	>99.6%	>99.7%	>99.7%
s-pol	>99.6% – >99.7%	>99.8%	>99.9%	>99.9%
p-pol	>99.0% – >99.4%	>99.4%	>99.5%	>99.5%
Typical coating	e-beam, IBS or IAD	e-beam, IBS or IAD	e-beam, IBS or IAD	only IBS or IAD
Typical substrate	f.s.	BK7, f.s.	BK7, f.s.	BK7, f.s., sapphire

Higher reflectivity is possible on request, measurement of R >99.95% are possible for 1064 nm, 532 nm and 355 nm with a CRD (cavity ring down) measurement at our facility.

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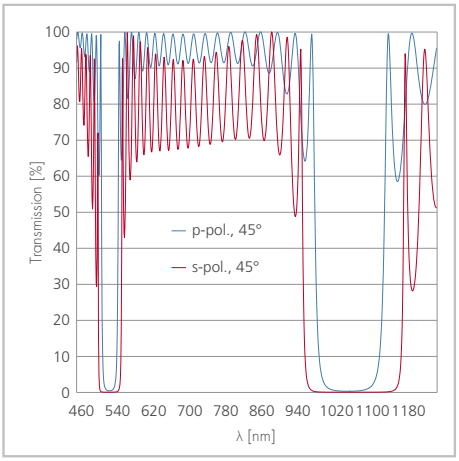
Multiple Wavelength High Reflective Mirror

Typical Specifications for e-beam Coating

HR1064 + 532/45

R_S (1064) > 99.8%,
R_P (1064) > 99.2%
R_S (532) > 99.7%,
R_P (532) > 98.5%



Curve2:
HR1064 + 532/45; AOI 45°; e-beam

Typ. Damage Threshold

1064 nm: LDT ~30J/cm² (10 ns)
532 nm: LDT ~15J/cm² (10 ns)

Table 2: Multiple Wavelength High Reflective Coating, typical values

	UV 266 – 400	VIS 400 – 700	NIR 700 – 2200
AOI = 45° u-pol	>99.0%	>99.1%	>99.5%
s-pol	>99.6%	>99.7%	>99.8%
p-pol	>98.5%	>98.5%	>99.2%
Typical coating	IBS	IBS or IAD	IBS or IAD
Typical substrate	f.s.	BK7, f.s.	BK7, f.s.

Optimizations e.g. higher reflectivity at one wavelength are possible on request, please define with your need which wavelength has the higher priority in your set up.

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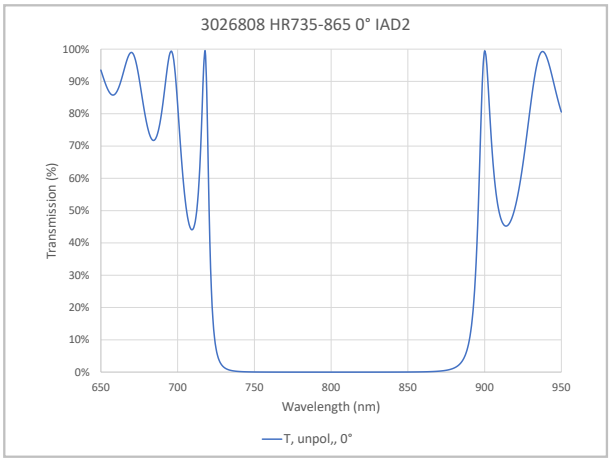
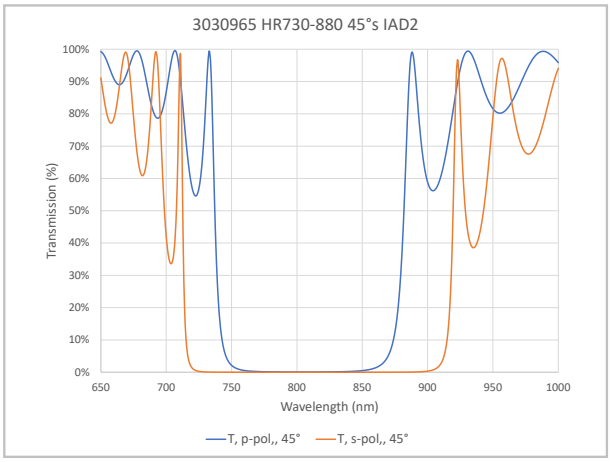
Broadband Wavelength High Reflective Mirror

Those mirrors are often used for fs-laser application, as the laser emits at a larger bandwidth. For those mirrors additionally the Group Delay Dispersion (GDD) is important.





Specifications

Typical Specifications for IAD Coating

Degree of reflection:
Angle of incidence 45° R > 99.9% s-pol,
R > 99.5% p-pol,
R > 99.7% u-pol

Typ. damage threshold:
LDT~30J/cm² (10 ns) @ 800 nm
LDT~8J/cm² (500 ps) @ 800 nm
LDT~0.4J/cm² (50 fs) @ 800 nm

Table 3: Broadband High Reflective Coating, typical values

Wavelenth range	VIS 400 – 700	NIR 700 – 2200
Typ. Bandwidth (CWL centre wavelength)	CWL ± 5%	CWL ± 5%
AOI = 0°	>99.5%	>99.7%
AOI = 45° u-pol s-pol p-pol	>98.3% >99.7% >97.0%	>98.3% >99.7% >97.0%
Typical substrate	BK7, f.s.	BK7, f.s.

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Wavelenth range	VIS 450 – 700	NIR 700 – 2200
Typ. Bandwidth (CWL centre wavelength)	CWL ± 10%	CWL ± 10%
u-pol s-pol p-pol	>99.53% >98.3% >99.7% >97.0%	>99.7% >98.3% >99.7% >97.0%
Typical coating	IBS or IAD	IBS or IAD
Typical substrate	f.s.	f.s.

Optimizations e.g. higher reflectivity or larger bandwidth and longer wavelengths, are possible on request.

In above mentioned table, you will find typical reflection values for single wavelength out of the listed wavelength ranges.

In "typical coating" you will find the coating techniques for which the reflection values in the table apply. Where E-beam is written also other techniques (IAD, IBS) are possible.

For higher reflectivity, larger bandwidth and combination of wavelengths, please contact our sales team to get detailed information on possible specifications.

The LiDT values can vary depending on the coating technology, material and design. In order to ensure the best economical solution, please provide the detailed laser data the optics is used for.

Special Mirrors

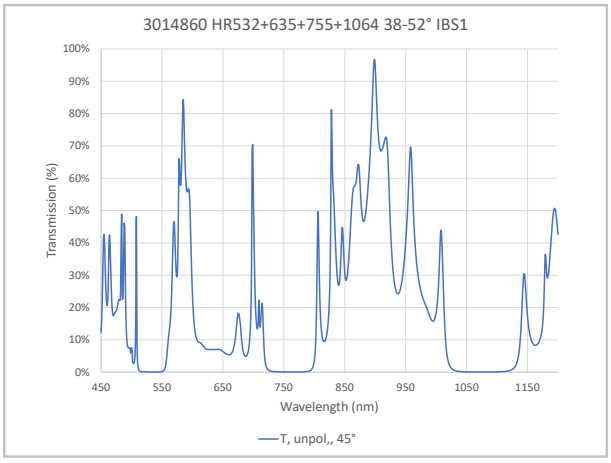
Example 1:
Mirrors for multiple wavelengths and AOI bandwidth.

LASER COMPONENTS also manufactures single or multiple wavelengths coatings for scanner application, were an AOI bandwidth is needed.

Example:

HR532+635+755+1064/38–52 with high reflectivity at
4 wavelength 532, 635, 755 + 1064 nm and for an AOI from
38 – 52 °

e.g. Ravg (532+750–760+1064) >99.5% and Ravg (630–640) >90% @ AOI 45°±7°



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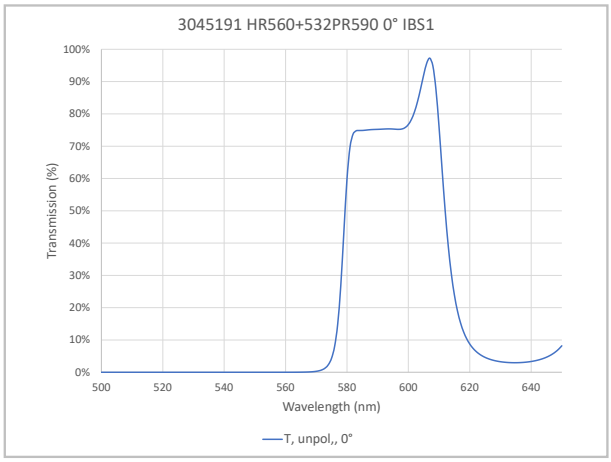
Example 2:
Mirror in combination with output coupler.

Upon request, we also check the possibilities of integrating other optical function into your laser mirror – for example additional output coupler or beam splitter function for another wavelength.

Example:

HR560+532PR590/25 with high reflectivity at 560+532 nm and a partial reflection of 25% at 590 nm, all at an AOI of 0°.

e.g. R(532+560)>99.9%, R(590)=25±5% @ AOI 0°, an AR coating will be added typically on the rear side.



Example 4:
Ultrabroadband mirror

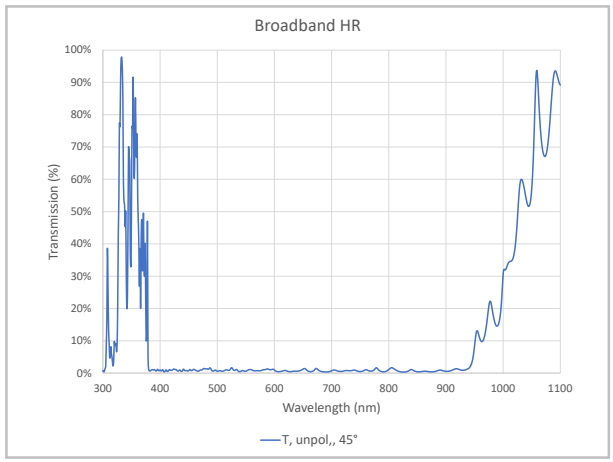
LASER COMPONENTS also manufactures ultra broadband mirrror coatings.

Reflectivity and durability are crucial quality features for the optical components for example of reflecting telescopes. In both aspects, dielectric mirrors are superior to their metallic counterparts: Their hard surfaces last longer and thus require less maintenance. A high reflectance leads to higher efficiency in mirrors and other optical components and results in more light being reflected to the eyepiece. The image becomes brighter, which makes it possible, for example, to even see less luminous celestial bodies.

Example:

HR390-950/45

e.g. Ru(390-950)>97% @ AOI 45°



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Good to know

Standard mirrors are optimized for a single wavelength and achieve the best reflection and damage threshold results. Designs for several wavelengths are also possible; however, these often have lower reflection values and bandwidths.

For all dielectric mirrors the achievable reflectivity depends on the wavelength and AOI – meaning if the mirror is used at a different wavelength or AOI the high reflectivity might not be possible. Additionally, if used at an AOI > 10° there is a difference in reflectivity between s- and p-polarized beam, reflectivity for s-pol is higher and shows a larger bandwidth – this should be considered when designing optical set ups. For unpolarized the reflectivity is the average between s- and p-pol.

In particular, the effect on the damage threshold and GDD in broadband mirror designs must be considered.

Customization:

We manufacture customized dielectric mirrors that are suitable for your individual application.
For a request for special mirrors here is a list of specifications we need to know:

- Wavelength
- Angle of Incidence
- R[%] at which wavelength and for polarization
- Additional reflection or transmission?
- Laser data (energy density, pulse duration, rep. rate)

Just fill out the online request or contact us by e-mail or phone.

https://www.lasercomponents.com/de-en/request/request-form-laser-optics/

Product Code

Nomenclature

HR – **wavelength** – **AOI** – **substrate**

Examples:

HR1064/45 PW1025UV

Bending mirror for 1064 nm with AOI 45°, substrate PW1025UV

HR1064+532 SM1-1.00C

Concave mirror with AOI 0° for 1064 and 532 nm, substrate SM1-1.00C

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