LASER COMPONENTS®

AR Coatings

Antireflex AR coatings are used to reduce this power loss. The power loss is caused by backscatter which can create dangerous focal points. The AR coatings are used, for example, on windows and lenses or on the rear side of dichroic mirrors or beam splitters.

All of LASER COMPONENTS' AR coatings are optimized for high power lasers and are available for the wavelength range from 193 nm to 5000 nm. Both the bandwidth (depending on the wavelength) and the effectiveness of the coating are influenced by the various designs and different coating materials.

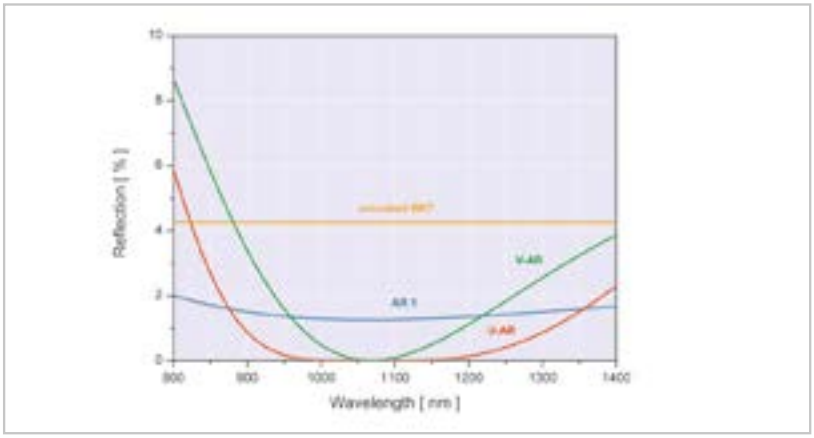
In general, AR coatings are available for angles of incidence of 0° on lenses or for 45° on the rear side of beam splitters. Although it must be pointed out that a coating that has been optimized for an angle of incidence of 45° is optimal at 0° for another wavelength range and vice versa.

Other angles of incidence and angle ranges can be manufactured upon request.

General Specifications for AR Coatings

The typical surface quality of 1.0" substrates after coating is as follows:

- 5/4x0.025, C2x0.10 according to ISO 10110
- 20-10 according to MIL-O-1380A (for a 10-5 substrate)



Back reflection of a coated/uncoated surface on a BK7 substrate

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MgF_2 Single Layer AR1

This coating is the simplest type of AR coating. It consists of a single MgF_2 layer with a thickness of λ/4. This coating is best suited, above all else, for materials with a high refractive index, such as for sapphire or SF6 glass.

AR1 Coating; Angle of Incidence 0°

AR/AR1	-2940	PW1011SA
Antireflective coating on both sides	Wavelength in nm	Substrate

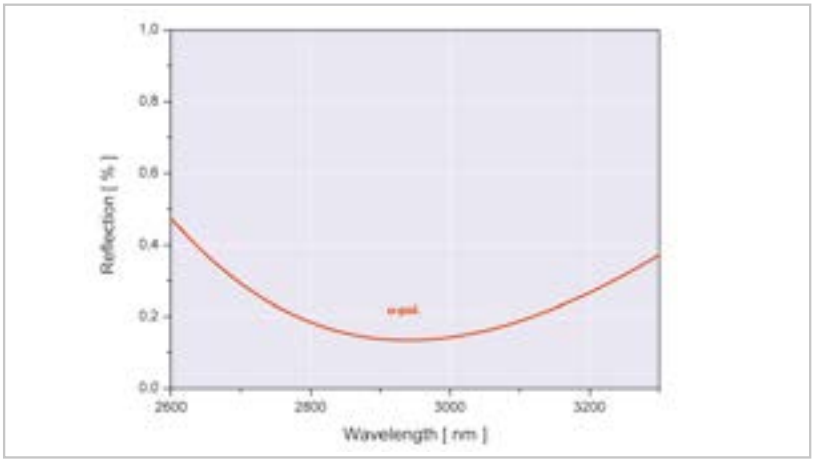
Specifications AR1-Coating

Degree of reflection (on sapphire) Angle of incidence 0° Angle of incidence 45°	 2940 nm 2940 nm	 R < 0.2 % R < 0.2 % p-pol R < 1.0 % s-pol R < 0.6 % u-pol
Typ. damage threshold	2940 nm	LDT ≈ 5 J/cm² (10 ns)

Further Specifications

If the coating is optimized for s-pol at 45° AOI, better values than those mentioned above are achievable.

Specifications for other wavelengths or additional materials are available upon request.



AR1 2940 nm / 0°

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Optimized AR Coatings V-AR and U-AR Coatings

The majority of AR coatings are optimized for one wavelength. They are often used on materials such as BK7 or fused silica.

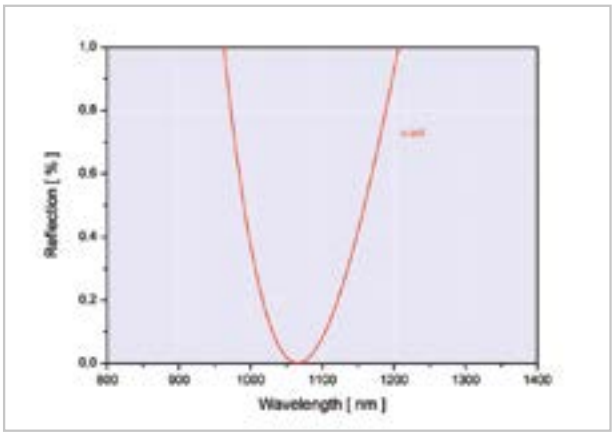
There is a difference between U-AR coatings, which have a wider spectral effect, and V-AR coatings, which are more narrow banded. The U-AR coatings also have a smaller back reflection, but the coating costs are somewhat higher. Both versions are multi-layered, dielectric coatings that are available for all central wavelengths from 193 nm to 5000 nm.

V-AR-Coating; Angle of Incidence 0°

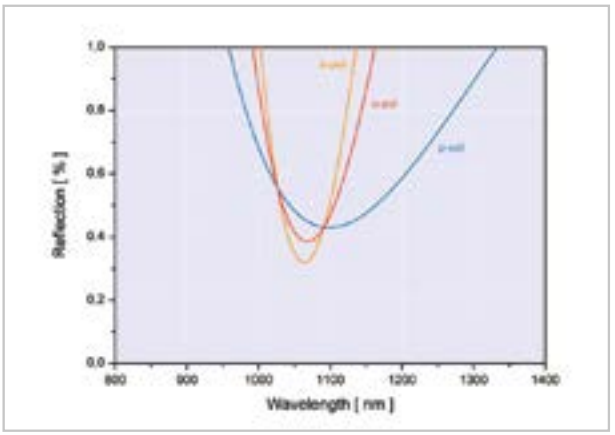
AR/AR	-1064	PLCX-25.4/51.5C
Antireflective coating on both sides	Wavelength in nm	Substrate

Specifications V-AR Coating

- **Degree of reflection:**
  Angle of incidence 0°
  532 nm to 1064 nm R < 0.2 %
  248 nm to 355 nm R < 0.3 %
  193 nm R < 0.5 %
- **Typ. damage threshold:**
  1064 nm LDT ≈ 20 J/cm² (10 ns)
  532 nm LDT ≈ 10 J/cm² (10 ns)
  193 nm LDT ≈ 2 J/cm² (10 ns)



V-AR 1064 nm / 0°



V-AR 1064 nm / 45° u-pol

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U-AR-Coating; Angle of Incidence 0°

UAR/UAR	-1064	PLCX-25.4/51.5C
Antireflective coating on both sides	Wavelength in nm	Substrate

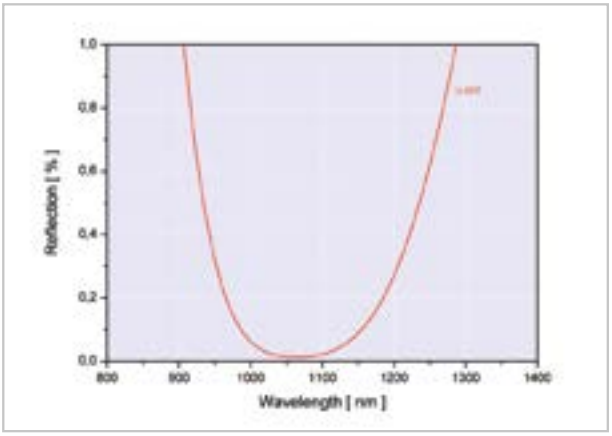
Specifications U-AR Coating

For BK7 and fused silica substrates

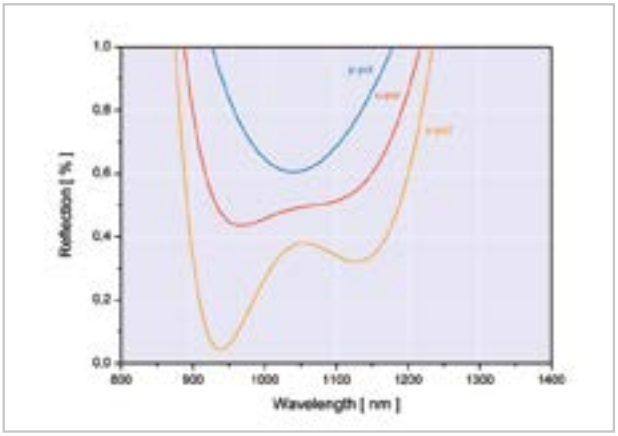
- **Degree of reflection:**
  Angle of incidence 0°
  355 nm to 1064 nm R < 0.1 %
- **Typ. damage threshold:**
  1064 nm LDT ≈ 10 J/cm² (10 ns)
  532 nm LDT ≈ 5 J/cm² (10 ns)

Good to know

The coatings can be optimized for p-pol, s-pol, or u-pol.



U-AR 1064 nm / 0°



U-AR 1064 nm / 45° u-pol

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Multiple AR Coatings

Special AR coatings are needed for frequency-multiplied laser systems. These coatings exhibit optimal transmission not only for the fundamental wavelength, but also for additional harmonic wavelengths.

Double AR coatings such as 1064 + 532 nm or 800 + 400 nm are the most popular. Another established standard coating is one which features a special design for all common Nd:YAG laser lines. This coating is optimized for the wavelengths 1064 + 532 + 355 + 266 nm.

All versions are multi-layered, dielectric coatings that are suitable for high power laser systems. Upon request, special designs can be produced for the desired substrate. Specifications for 45° or other wavelength combinations are also available.

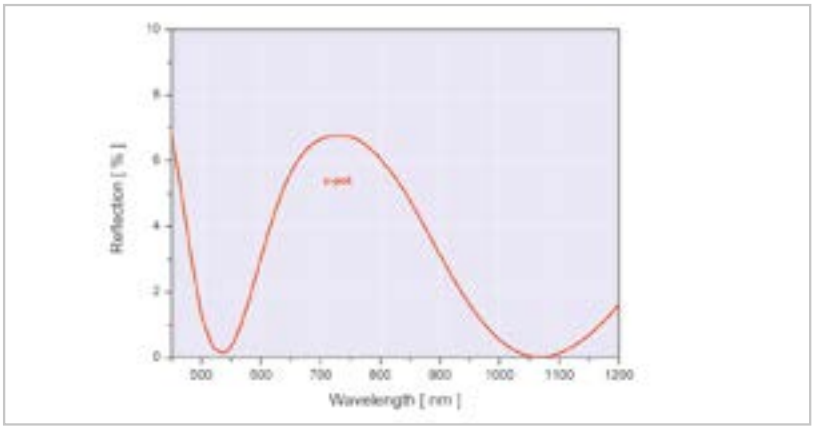
Double/Multiple AR Coatings

DAR	1064 + 532	/45	PP0525UV
Double Antireflective coating	Wavelength in nm	Angle of incidence (AOI) in degree. If AOI is not specified it is automatically 0°.	Substrate

Specifications DAR1064+532 or DAR800+400

For BK7 and fused silica substrates

- **Degree of reflection:**
  Angle of incidence 0°
  1064 nm or 800 nm R < 0.3 %
  532 nm or 400 nm R < 0.4 %
- **Typ. damage threshold:**
  1064 nm or 800 nm LDT ≈ 10 J/cm² (10 ns)
  532 nm or 400 nm LDT ≈ 5 J/cm² (10 ns)



DAR 1064+532 nm / 0°

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Specifications AR1064+532+355+266

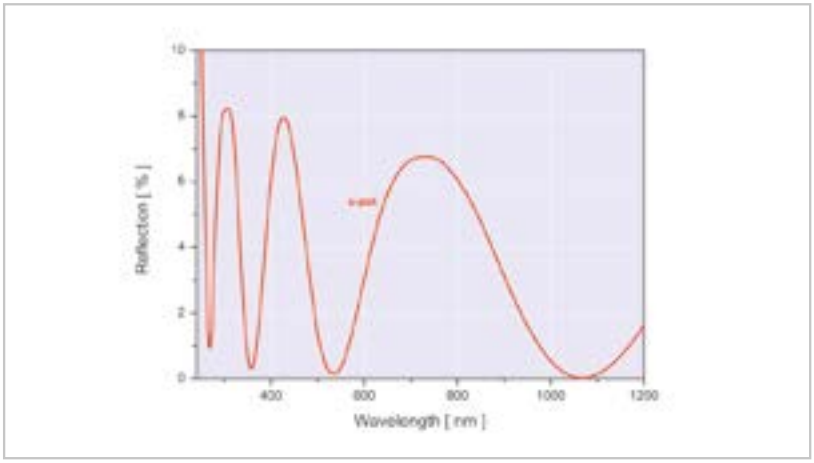
For fused silica substrates

- **Degree of reflection:**
  Angle of incidence 0°

1064 nm	R < 0.3 %
532 nm	R < 1.0 %
355 nm	R < 1.0 %
266 nm	R < 2.0 %

- **Typ. damage threshold:**

1064 nm	LDT ≈ 10 J/cm² (10 ns)
532 nm	LDT ≈ 5 J/cm² (10 ns)



AR 1064+532+355+266 nm / 0°

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Broadband AR Coatings (BBAR Coatings)

If optimal AR coatings for a wide wavelength range are required, then special multi-layered, dielectric coatings are used. With the help of a single coating the transmission for a wide wavelength range can be enhanced.

Using different coatings it is possible to cover the entire wavelength range from 193 nm to 2100 nm. The following table shows the ranges offered on a standard basis by LASER COMPONENTS. Special versions or customer-specific ranges can also be manufactured.

All BBAR coatings are available as a standard version for angles of incidence of both 0° and 45°. Other angles of incidence are available upon request. At an angle of incidence of 45°, it is possible to optimize for different polarizations (u-pol, s-pol, or p-pol).

Specifications for 45° or other wavelength combinations are available upon request.

Broadband AR Coating (BBAR Coating)

BBAR	633 + 1064	/45	PW2037UV
Broadband Antireflective coating	Wavelength in nm	Angle of incidence (AOI) in degree. If AOI is not specified it is automatically 0°.	Substrate

Standard Broadband ARs

BBAR-Type	BBAR-U	BBAR-A	BBAR-B	BBAR-C	BBAR-D	BBAR-E	BBAR-F
Wavelength Range [nm]	193 - 308	248 - 355	355 - 532	400 - 700	633 - 1064	800 -1300	1050 -1600
Average Remaining Reflection AOI 0°	<1.0%	<0.5%	<0.4%	<0.4%	<0.4%	<0.4%	<0.4%

Specifications

For BK7 and fused silica substrates

- **Degree of reflection:**
  Angle of incidence 0° — See table
  Angle of incidence 45° — Data upon request (optimized for u-pol, s-pol or p-pol)
- **Typ. damage threshold:**
  1064 nm — LDT ≈ 10 J/cm² (10 ns)
  532 nm — LDT ≈ 5 J/cm² (10 ns)

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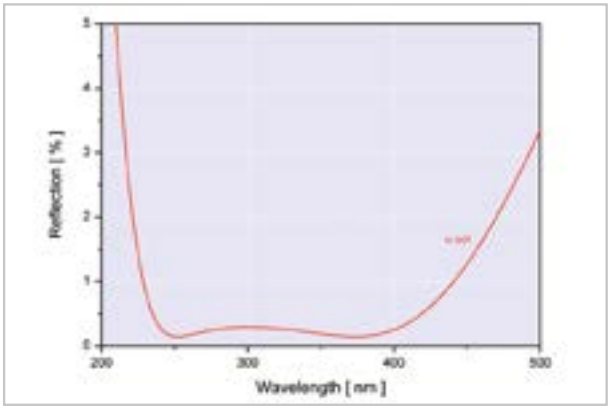
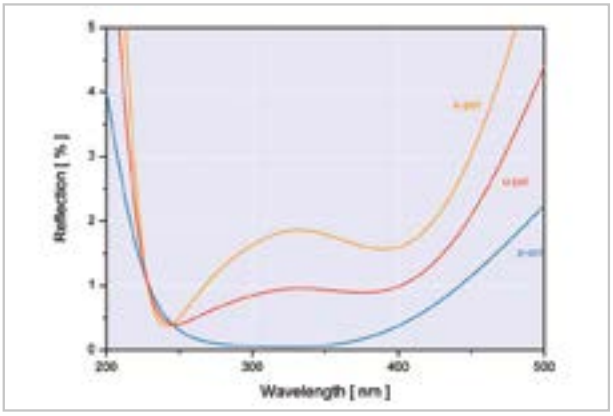
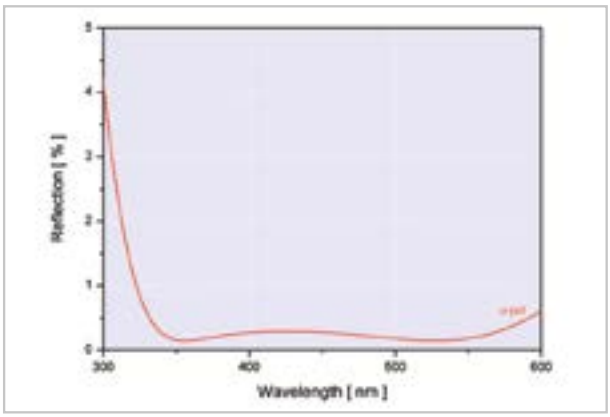


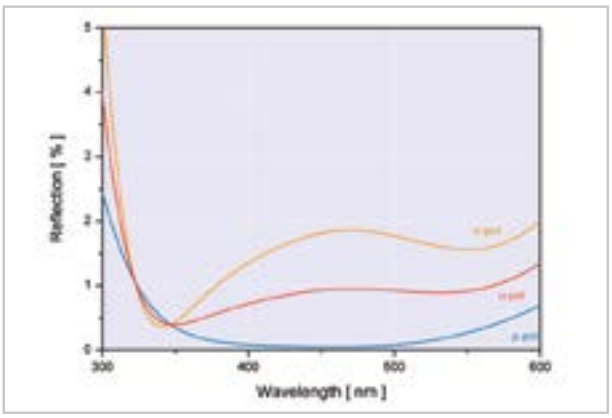
BBAR 248 – 355 nm / 0°



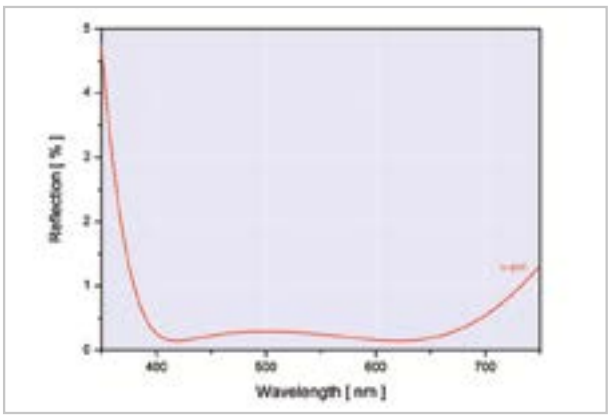
BBAR 248 – 355 nm / 45° u-pol



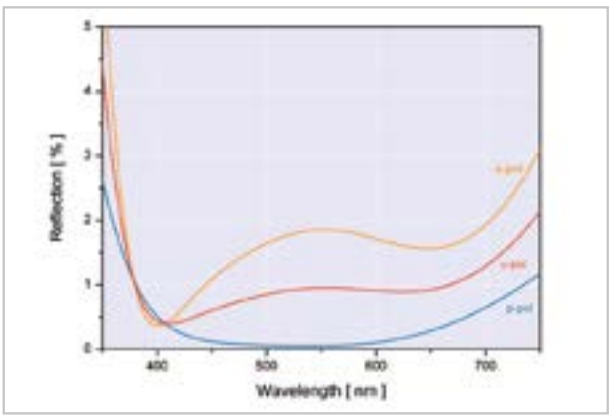
BBAR 355 – 532 nm / 0°



BBAR 355 – 532 nm / 45° u-pol



BBAR 400 – 700 nm / 0°



BBAR 400 – 700 nm / 45° u-pol

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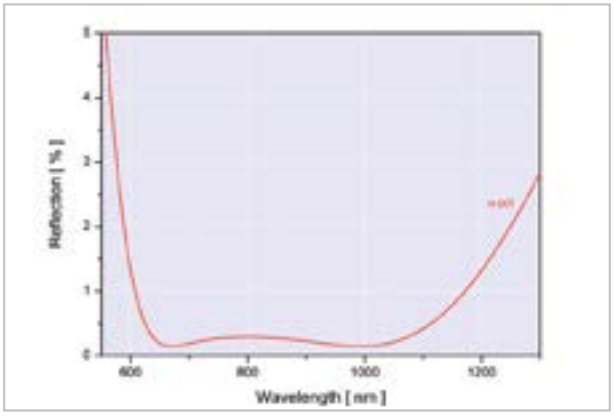
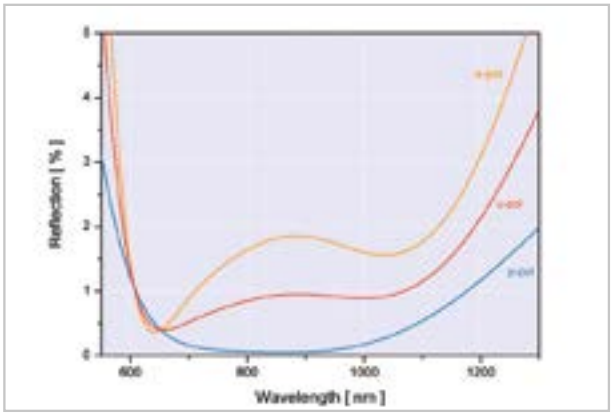
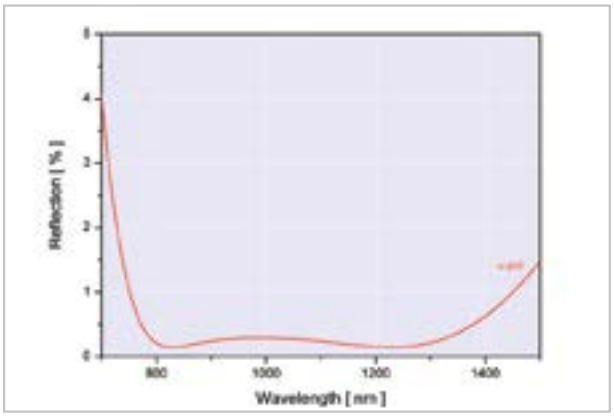


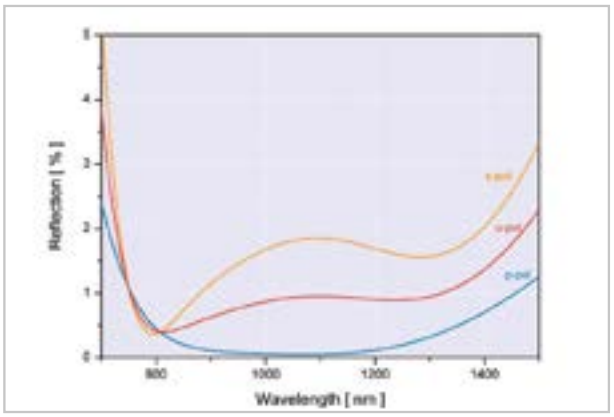
BBAR 633 – 1064 nm / 0°



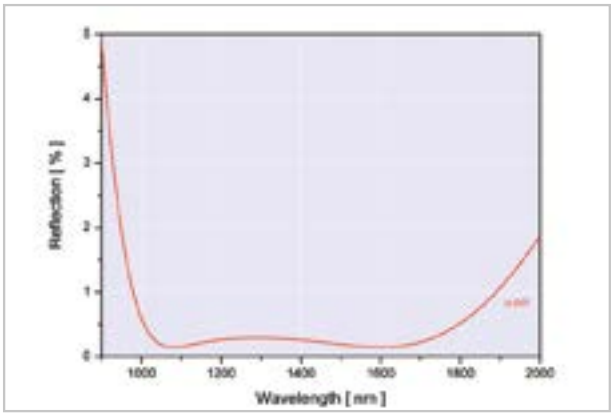
BBAR 633 – 1064 nm / 45° u-pol



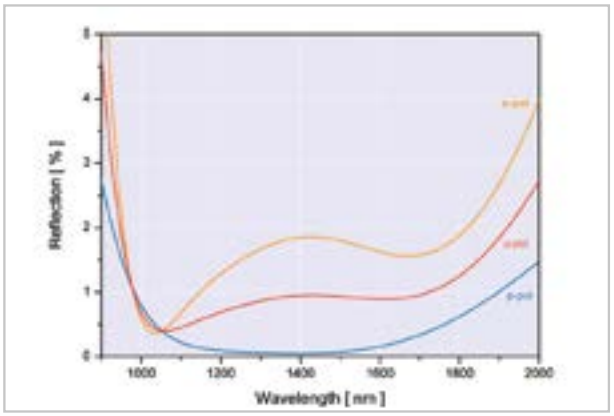
BBAR 800 – 1300 nm / 0°



BBAR 800 – 1300 nm / 45° u-pol



BBAR 1050 – 1600 nm / 0°



BBAR 1050 – 1600 nm / 45° u-pol

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AR Coatings for Temperature-sensitive Optics

To equip sensitive optics, such as for example GRIN lenses, with AR coatings, a special coating method is required, the process temperatures of which should be kept as low as possible.

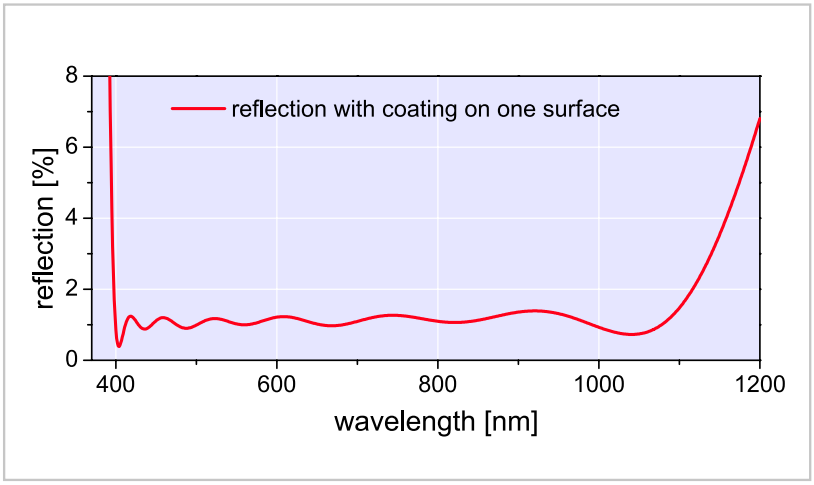
The ion beam sputtering (IBS) method opens up new possibilities. At coating temperatures below 100 °C, the material properties of the layer can be maintained – making AR coatings possible!

These anti-reflective (AR) coatings are available for a wavelength range from 400 nm to more than 1100 nm. The standard angle of incidence is 0°. Broadband and other angles of incidence are available upon request. Let us know your requirements when you send your request!

The reflection values per coated side depend on the refractive index of the material to be coated. The rest reflection is higher than is normally the case for coatings that are applied at high temperatures. The advantage over uncoated optics, however, is immense.

Specification

- **Degree of reflection (on grin lens):**
  Angle of incidence 0°
  400 – 1100 nm: R < 1.5 % average



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