CATALOG 2011

LAYERTEC®
OPTICAL COATINGS · OPTICS

CONTENTS

FRONT SURFACE SILVER MIRRORS

400 – 4000 nm

BROADBAND SILVER MIRRORS FOR THE VIS AND NIR

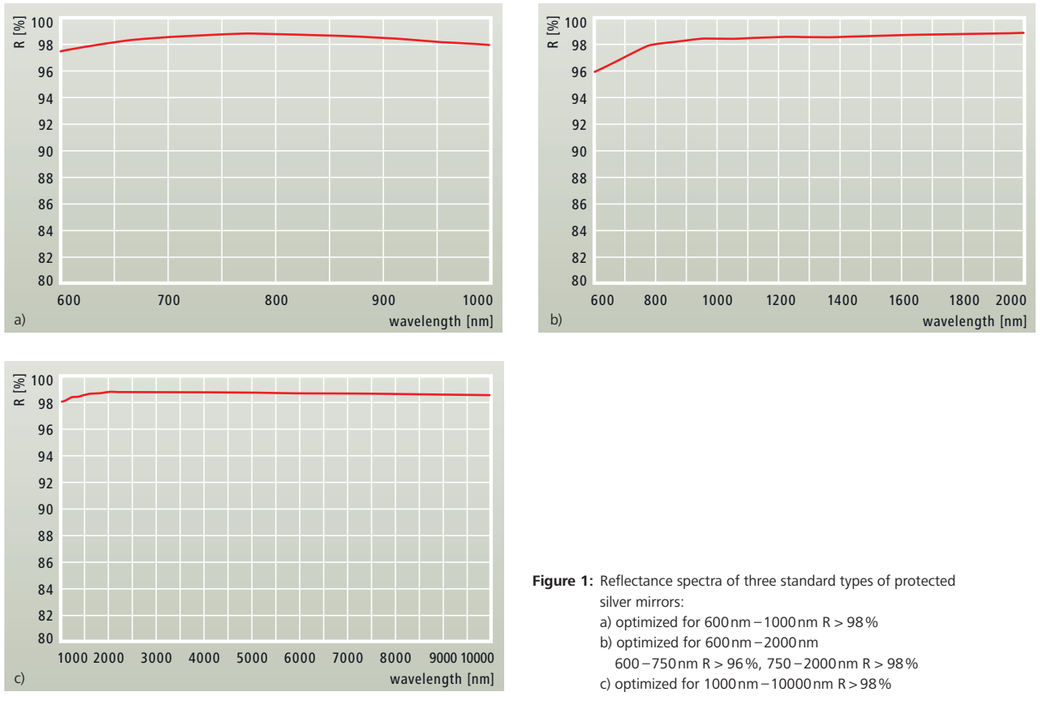


Figure 1: Reflectance spectra of three standard types of protected silver mirrors:
a) optimized for 600 nm – 1000 nm R > 98 %
b) optimized for 600 nm – 2000 nm
600 – 750 nm R > 96 %, 750 – 2000 nm R > 98 %
c) optimized for 1000 nm – 10000 nm R > 98 %

Optical properties:

- R > 98 % throughout the specified wavelength range (except type b).
- R = 94…97% in the VIS outside the specified wavelength range.
- R > 97% in the NIR outside the specified wavelength range.

Special features:

- Silver has the highest reflectance of all metals in the VIS and NIR
- Sputtered protective layers yield very stable optical parameters
- Lifetimes of more than 10 years in normal atmosphere were demonstrated although unprotected silver is chemically unstable
- The high atomic density of sputtered coatings guarantees that also very thin protective layers (~20 nm) provide a good protection against the atmosphere
- The thickness of the protective layer can be used to optimize the reflectance of the mirrors for different wavelength ranges (see figure 1)
- Sputtered silver mirrors show extremely low straylight losses (TS ~ 3 x 10^{-5} in the VIS and NIR)
- Optimized silver mirrors are ideal for use with femtosecond lasers (see pages 72 – 73)
- Silver mirrors with defined transmission (e.g. T = 0.01%) on request (see pages 72 – 73)
- Mechanical stability of protected silver mirrors is tested according to MIL-M-13508C § 4.4.5
- Maximum diameter: 500 mm, especially for astronomical applications

SILVER MIRRORS WITH ENHANCED REFLECTIVITY

The reflectivity of silver mirrors can be enhanced for selected wavelengths or wavelength regions by a dielectric overcoat. Figures 2–5 show examples for such silver mirrors with enhanced reflectivity. Such mirrors combine very high reflectivity at the wavelengths of interest with a relatively high reflectance throughout the VIS which makes them ideal for use with a pilot laser.

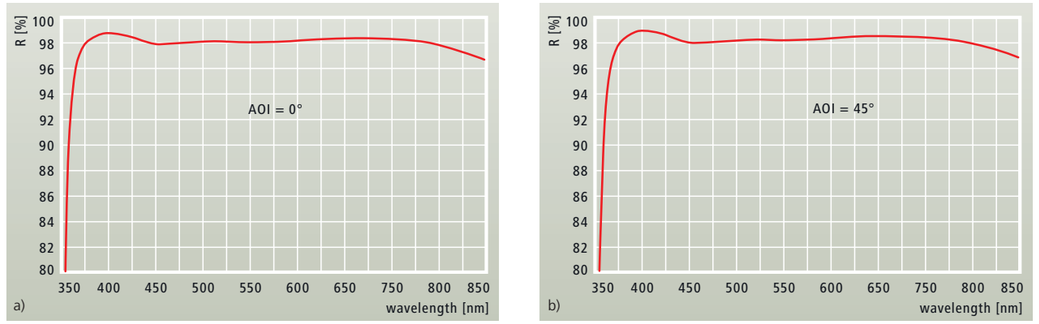


Figure 2: Reflectance spectra of an enhanced silver mirror which shows R ≥ 98% throughout the visible spectral range: a) AOI = 0°, b) AOI = 45°, unpolarized light

Enhanced silver mirrors of this type are ideal for applications in astronomical devices.

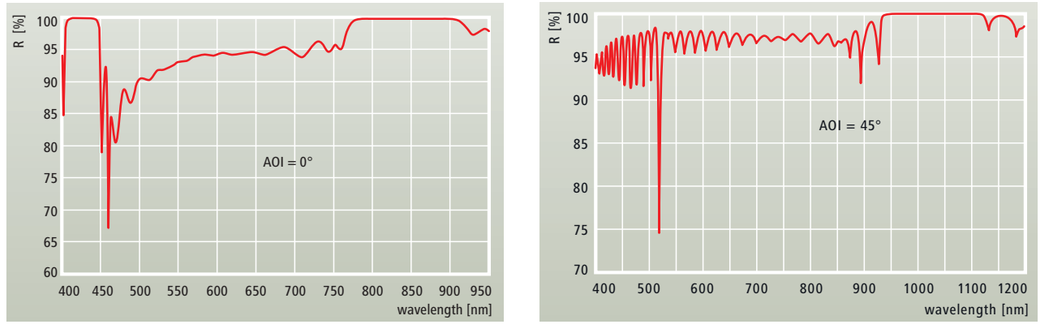


Figure 3: Silver mirror with enhanced reflectivity at 425 and 850 nm (R > 99.5 %)

Figure 4: Silver based turning mirror for 1030 nm with R > 80 % for a pilot laser in the red spectral range

Especially the mirror in figure 4 was tested for very high LIDT values of cw- and ns-radiation. This makes it a cost effective alternative for all-dielectric mirrors for high power Yb:YAG- or Nd:YAG-lasers.

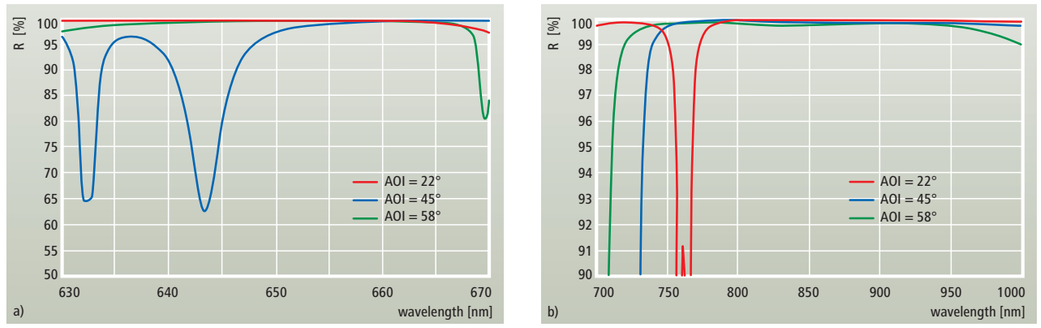


Figure 5: Reflectance spectra of a silver based scanning mirror for laser diodes in the NIR:
HR (22° – 58°, 805 – 940 nm) > 99.3 % combined with R > 50 % between 630 and 670 nm

For more information on enhanced silver mirrors see pages 42 – 43, 72 – 73 and 92 – 93.

FRONT SURFACE ALUMINUM MIRRORS

150 – 900 nm

BROADBAND MIRRORS FOR THE UV, VIS AND NIR

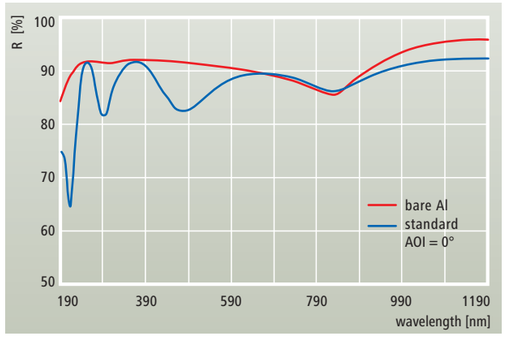


Figure 1: Reflectance spectra of bare aluminum and of a standard protected aluminum mirror

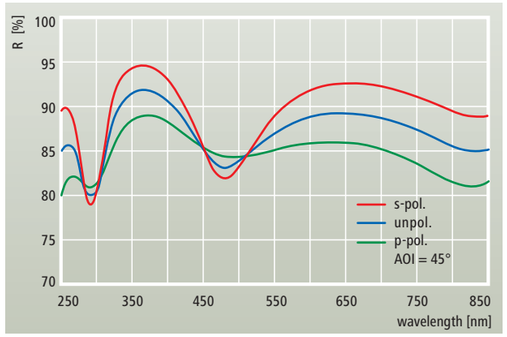


Figure 2: Reflectance spectra of an aluminum mirror optimized for Rr >85 % at 266 nm, 400 nm and 800 nm (AOI=45°)

Optical properties:

Bare aluminum: R>80 % at 193 nm
R=92 % at 248 nm
R>85 % from 200 nm to 950 nm (R>90 % from 230 nm to 600 nm)
R>90 % for λ>1 µm

Standard mirror: R=82 … 92 % from 240 nm to 550 nm
R=85 … 92 % for 550 nm to 950 nm
R>92 % for λ>1 µm

The position of the minima and maxima of the reflectance depends on the design of the protective layer system and on the angle of incidence (AOI). Please specify AOI and the wavelengths of interest to optimize the reflectance as far as possible.

Figure 2 shows the reflectance spectra of a mirror which was optimized for high reflectivity at 266 nm, 400 nm and 800 nm at AOI = 45°.
Maximum diameter: 500 mm, especially for astronomical applications

OPTIMIZED ALUMINUM MIRRORS FOR THE DUV AND VUV

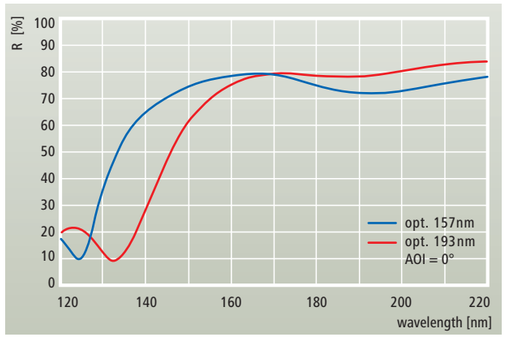


Figure 3: UV optimized Al: reflectance spectra of Al mirrors optimized for 157 nm and 193 nm (0°)

Optical properties:

Special coating design depending on the wavelengths of interest
Optimized for 157 nm: R=74 … 78% for 157nm (R>70% from 150 to 200 nm)
Optimized for 193 nm: R=75 … 80% for 193 nm
Optimized for 248 nm: R>90% for 248 nm

OPTIMIZED ALUMINUM MIRRORS FOR THE DUV AND VUV

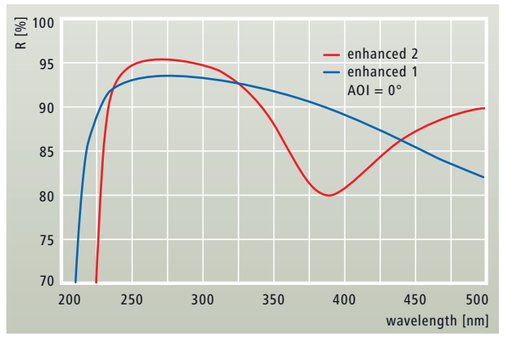


Figure 4: Reflectance spectra of aluminum mirrors with different designs for enhanced reflectivity for the third harmonic of the Ti:Sapphire laser (AOI = 0°)

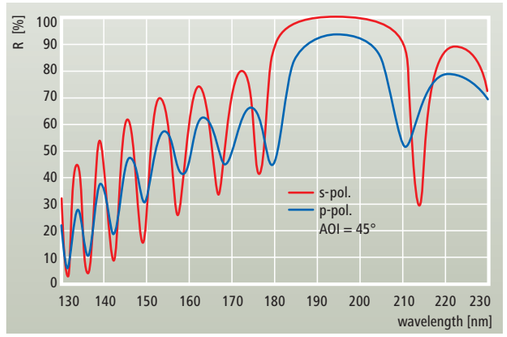


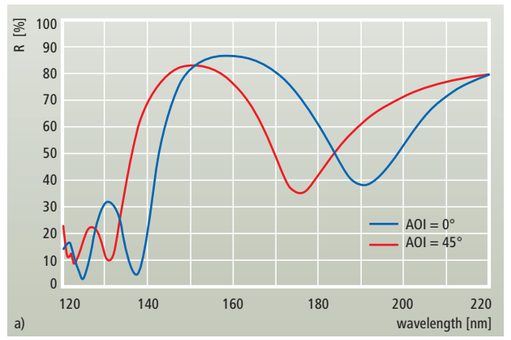
Figure 5: Reflectance spectra of an aluminum mirror with enhanced reflectivity for 193nm (AOI = 45°, Rr > 95%)

Special features:

- High reflectivity in the wavelength range specified
- Extremely low straylight losses of protected aluminum mirrors (TS < 10^{-4} at 633 nm, TS < 10^{-3} at 248 nm, TS 5 x 10^{-3} at 193 nm)
- Standard mirrors can be cleaned using ethanol or acetone and are resistant to moderate abrasion (tested according to MIL-M-48497A § 4.5.4.2 and § 4.5.3.3)
- VUV optimized mirrors should be treated with extreme care
- All mirrors are resistant to humidity (tested according to MIL-M-13508C § 4.4.7)
- Highly stable optical parameters because of sputtered SiO_2 protective layer

ENHANCED ALUMINUM MIRRORS FOR 157nm

- Reflectance at 157 nm can be further improved by dielectric overcoatings (up to R>94 %)
- Reflectance in the VIS: R = 60 … 80 %. This can be used for a pilot laser
- Especially mirrors with R = 85 … 90 % can be used at a wider range of AOI than all dielectric mirrors of this reflectivity



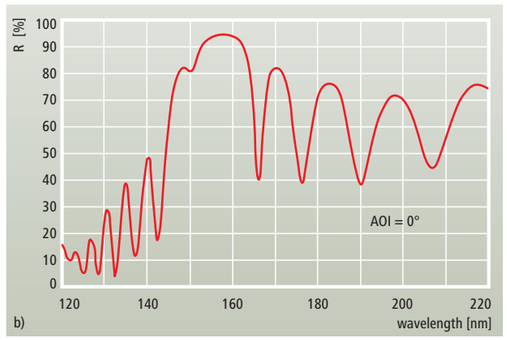


Figure 6: Reflectance spectra of two types of enhanced Al mirrors for 157nm: a) R > 80% for AOI = 0° … 45°, b) R > 94%

SPECIAL METALLIC COATINGS

CHROMIUM COATINGS FOR OPTICAL APPLICATIONS

Chromium coatings are used for lithographic process applications and other special optical applications. LAYERTEC offers chromium coatings with extremely low pinhole density on mask blanks and silicon wafers. Typical substrates sizes are 6 inch x 6 inch, but uncommon sizes up to diameter 500 mm are also possible.

Batch processes of mask blanks

LAYERTEC uses specialized coating processes of the sputtering technique for a very efficient industrial production, which are able to optimize and control the intrinsic properties of chromium coatings such as:

- Low pinhole density
- High optical density
- Low mechanical stress
- High electrical conductivity.

Besides the availability of efficient coating plants LAYERTEC has preserved its capabilities for flexible production of small volumes such as OEM components or components for the research and development. Do not hesitate to contact us for your special request.

400 – 10000 nm

GOLD MIRRORS FOR THE NIR

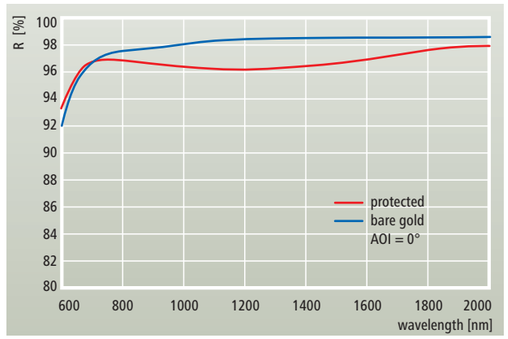


Figure 1: Reflectance spectra of protected and unprotected gold mirrors

Optical properties:

bare gold: R > 97 % from 700 nm to 1 µm
R > 98 % for λ > 1 µm

Protected: R > 96 % from 700 nm to 2 µm
R > 98 % for λ > 2 µm

Special features:

- High reflectance in the NIR and IR
- Extremely low straylight losses (TS < 10^{-4} at 633 nm)
- Gold mirrors are chemically stable and can thus be used without protective layer
- Unprotected gold is soft and is easily scratched if it is touched
- Protected mirrors can be cleaned (tested according to MIL-M-13508C § 4.4.5)

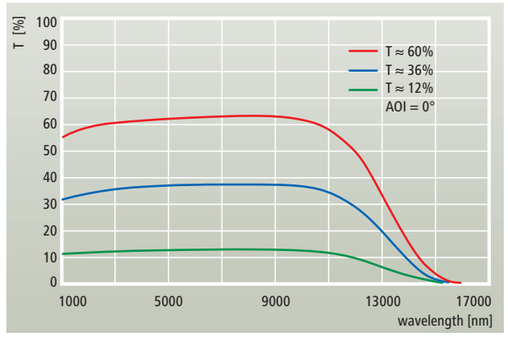


Figure 2: Transmittance spectra of broadband neutral density filters with different transmittance values

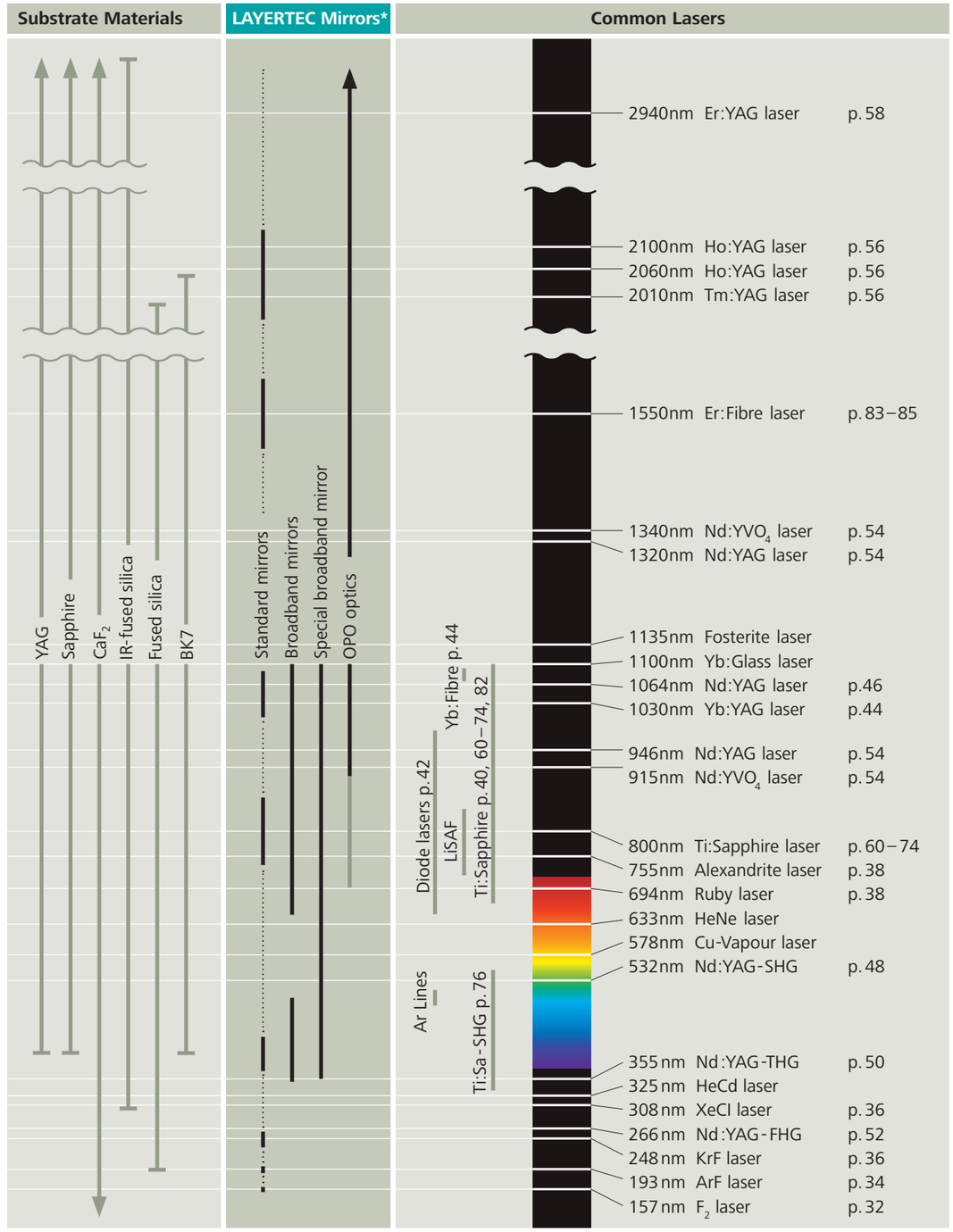
- Broad wavelength range of nearly constant transmittance (1000 nm to 10 µm)
- Substrate: BaF_2
- Other transmittance values on request

OTHER METALLIC COATINGS

- Zirconium for use as filter for EUV radiation
- Molybdenum, platinum and copper, nickel and nickel/chromium according to customer specification

REGISTER

LAYERTEC MIRRORS



*Bandwidths of selected LAYERTEC mirrors

Interference Optics

The plumage colours of some kinds of hummingbirds result from interference effects.
These effects are also the active principle of optical coatings.

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