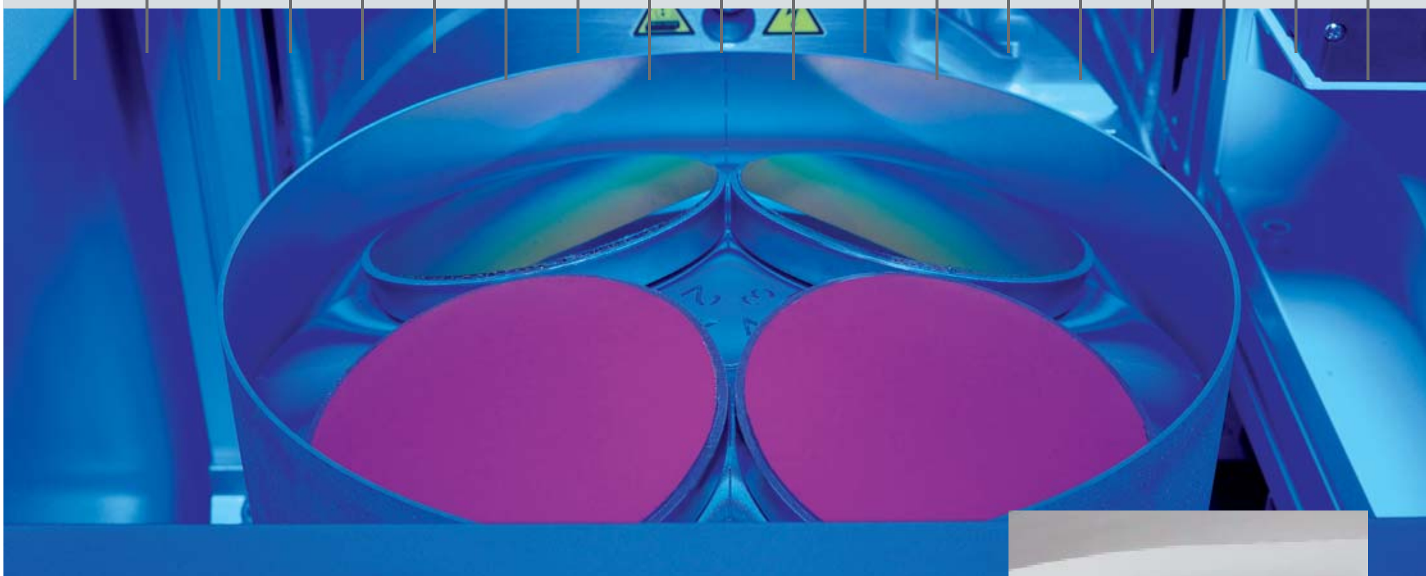


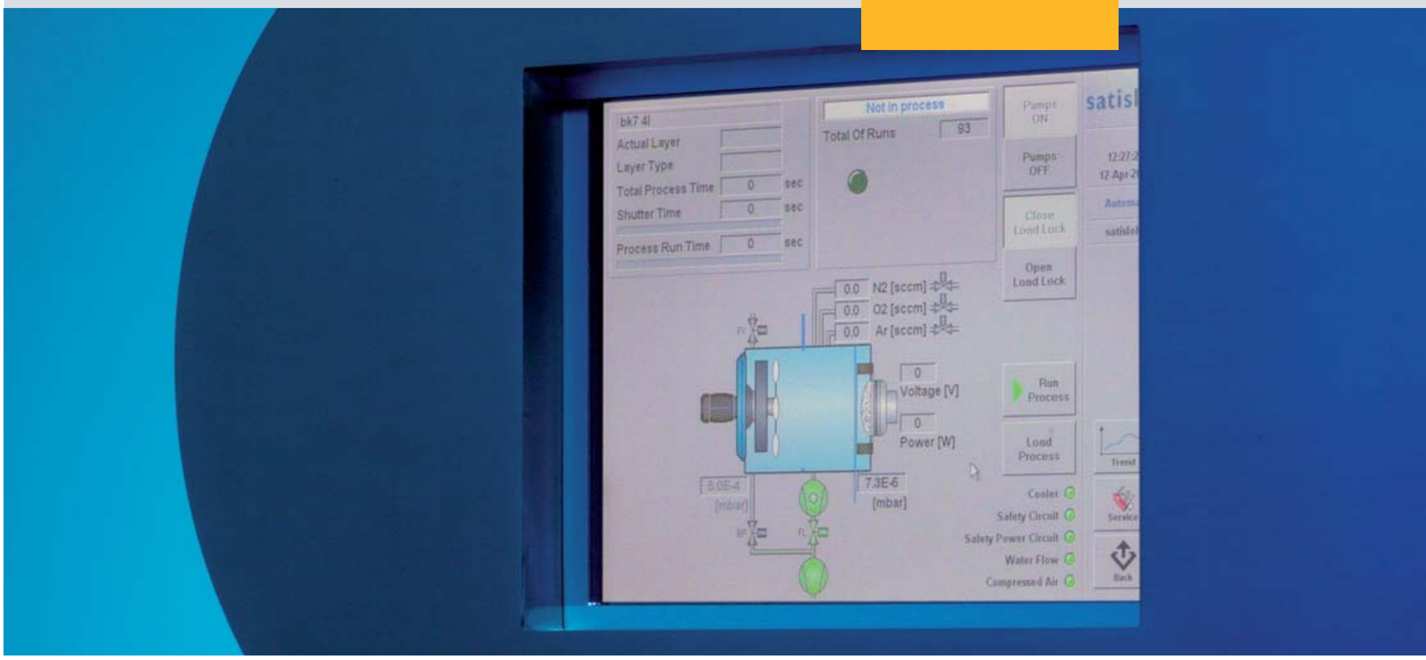
SP-100

Perfect Solution for Small Optics and Optoelectronics Applications

The SP-100 features a reliable and fast process for high performance optical coating.

satisloh®

SP-100
consistent uniform coatings, optimized deposition processes for different substrates, high deposition rates



SP-100
the benefits of reactive sputtering

The SP-100 is a very compact yet powerful optical coating system. Reactive sputtering provides outstanding process stability, simple operation and flexibility for process innovation. The impressive short process time makes the SP-100 an ideal tool for small batch production and micro-optics.

Pulsed-DC, reactive sputtering technology stands for a very stable thin film deposition process, creating high quality coatings. Both process stability and ease of process control are key advantages of sputtering, if compared to e-beam evaporation. By separating the sputter target from the substrate load-lock via a gate valve, thus keeping the target under vacuum all the time, optimum process stability and fast pump-down to process conditions are ensured.

The SP-100 is equipped with a single-target (typically Si), and three gas inlet systems (reactive gases typically O_2, N_2 and Ar). This enables high and low index stacked layers, but also gradient index ($Si_XO_YN_Z$) coatings. The refractive index can be varied between 1.46 and 3.5 (with Si target). The SiO_2 and Si_3N_4 layer combination features not only good optical performance, but also extraordinary mechanical properties. Examples include extremely scratch resistant hard AR coatings, for instance on sapphire, achieving a Vickers hardness of HV > 1200, as well as broad-band AR coatings on endoscope lenses with proven durability in > 500 autoclave cycles, where other coatings normally are destroyed due to delamination.

A software compensation of the target wear ensures high process stability over the life-time of the target, thus enabling very demanding coatings, e.g. exceeding 200 layers.
Excellent layer thickness uniformity (±0.25%) on flat or mildly curved substrates is facilitated by a compact planetary system with secondary rotation. The planetary system holds 4 planets of 100 mm (4“) diameter each; the use of a uniformity mask is optional.

SP-100

Typical Applications & Processes

BBAR coating

Broadband anti-reflective (BBAR) coatings for the visible wavelength range (380-780 nm) are the most common coating applications in the optical industry. In addition to glass materials and crystals (sapphire, YAG, etc), the SP-100 can produce BBAR coatings on other materials, e.g. semiconductors or even polymers.
Small batch production in micro-optics is the domain of the SP-100. Here it enables cost-effective and fast optical coatings, when a large coater cannot be filled frequently.

Reproducibility

Excellent reproducibility of the coatings is a key strength of the SP-100 (see fig. 1).

Very hard and durable BBAR coatings

Reactively sputtered SiO_2/Si_3N_4 layers reach very high hardness and durability. A typical application are scratch resistant sapphire substrate coatings, achieving a Vickers hardness of HV > 1200 (see fig. 2). Another key application is high performance BBAR coatings on endoscope optics (see fig. 3), which withstand > 500 autoclave cycles

NIR band-pass filter

Due to the excellent process stability of the SP-100, it is also used for filter coatings, where the process time can be several hours; fig. 4 shows a band-pass filter.

Dielectric Bragg mirror

The $Si_XO_YN_Z$ material combination opens a wide window of applications in the 1200 - 7500 nm range. Coatings with > 200 layers have been realized. A dielectric Bragg mirror on an InP wafer is shown in fig. 5. Besides achieving a reflectance R > 99.9% @ 2000 nm, this coating passed a 2000 hours 85/85 lifetime test with < 5 nm shift.

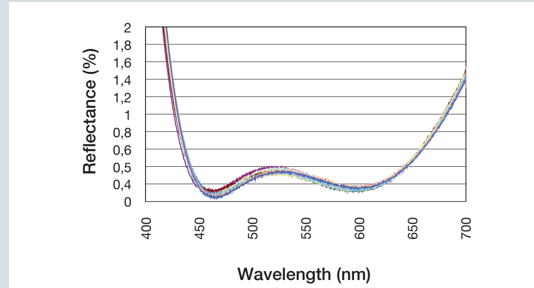


Fig. 1: The SP-100 produces BBAR coatings with excellent reproducibility, not only on glass, but also on polymers, as shown for 10 consecutive batches (4-layer BBAR on Zeonex 480R).

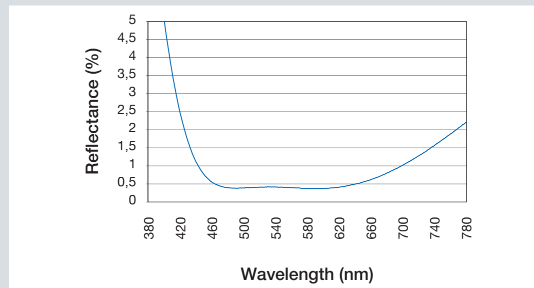


Fig. 2: Extremely hard (HV > 1200) AR coating on sapphire. This 4-layer design easily reaches the required specification of R < 1% (400-700 nm), and is completed in just 12 min., including pumping, plasma etching and coating.

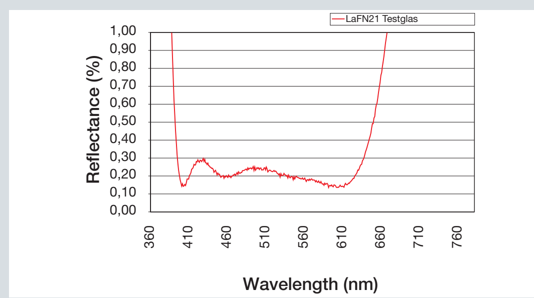


Fig. 3: Superior environmental stability (withstands > 500 autoclave cycles) of BBAR coatings on endoscope optics (10 layers).

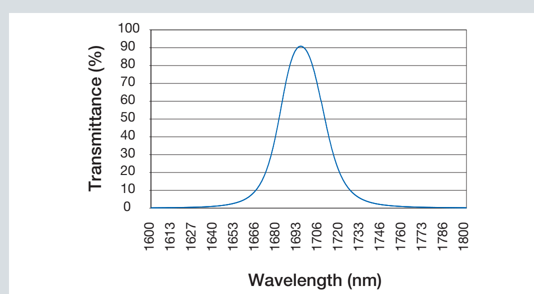


Fig 4: Narrow NIR band-pass filter at 1700 nm, FWHM approx. 30 nm, and very high transmission T > 90%. The two-cavity design with 16 layers of Si (n=3.5) and $Si_XO_YN_Z$ (n=1.78) was coated on BK7; total coating thickness 5.9 microns; process time < 3 hours.

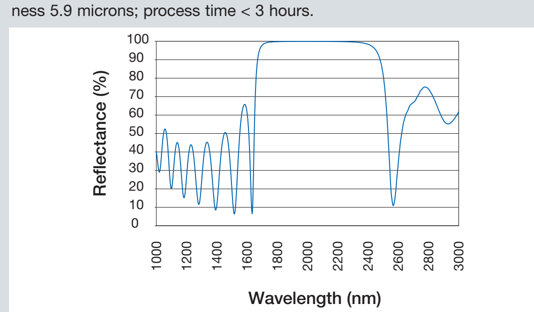
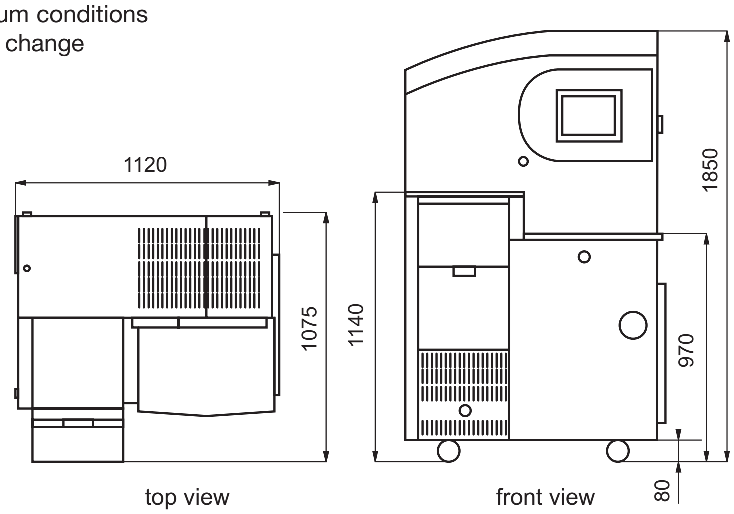


Fig 5: Dielectric Bragg mirror on InP wafer with a reflectance R > 99.9% @ 2000 nm (400 nm wide); total coating thickness 2.6 microns; process time 1.5 hours. (Passed a 2000 hours 85/85 lifetime test with < 5 nm shift.)

Features:

- Fast substrate exchange via a small-volume load-lock vacuum chamber
- Short process times due to rapid pumping (working pressure reached in approx. 4 minutes for simple AR applications) and high deposition rates
- Pulsed-DC reactive sputtering for consistent high quality, fast and uniform coating results
- Magnetron cooling by (integrated or external) chiller
- Easy-to-change target for minimum production downtime
- Easy adjustment of process parameters by gas inlet system controller
- Compact aluminum vacuum chamber with gate valve, shutter, target and magnetron
- Vacuum gate valve and load-lock enable the sputter target to remain under high vacuum conditions during substrate change



top view front view

Options & Accessories:

- Reactive pulsed-DC sputtering, target diameter 6”, standard target type Si (other on request)
- Refractive index range for Si:
  - Visible: n = 1.46 - 2.05
  - NIR: n = 1.46 - 3.5
- Sputtering gas Ar
- Reactive gases N_2, O_2
- Typical deposition rates: 0.5 - 2.2 nm/s, depending on process parameters
- Planetary substrate drive with 4 holders (max. 102 mm diameter)
- Load lock volume 8 l
- Built-in chiller (power 1.5 kW)

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