LASER COMPONENTS®

Coating Processes

LASER COMPONENTS has manufactured hard dielectric coatings for optical components in the laser industry since 1986 and is among the top manufacturers in this field.

The coatings we manufacture fall in the wavelength range between 193 nm and 5 µm. Our core competency are coatings for the YAG wavelengths 1064 nm, 532 nm, 355 nm, and 266 nm as well as the wavelengths 800 nm, 1550 nm, 2100 nm and 2940 nm.

Highest Damage Thresholds

Just as comparisons made by various institutes and laser manufacturers continue to prove, we have the highest damage thresholds in the industry thanks to an optimized manufacturing process.

We will introduce the processes and standard specifications for our coatings in the following pages.

Coatings are manufactured for individual pieces and series either according to the standard catalog or customer-specific specifications. We also perform job coatings that are applied to substrates delivered by the customer.

E-Beam Coating

The E-beam process, also referred to as the PVD process (**P**hysical **V**apour **D**eposition), is the most commonly used coating technology in the field of laser technology. Due to their fast layer growth and flexible capacity, coatings can be produced with high damage thresholds at reasonable prices.

E-beam Coating Process

In the e-beam process, dielectric coating materials are vaporized in a vacuum at substrate temperatures of around 200 °C. An electron beam source or, alternatively, a shuttle heated by a strong current flow serves as a source of energy. The molecules that are set free in the process are deposited in clusters on the surface of the substrate at an energy of approximately 0.1 eV. The resulting layers feature a low dispersion and are suitable for high levels of laser power.

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

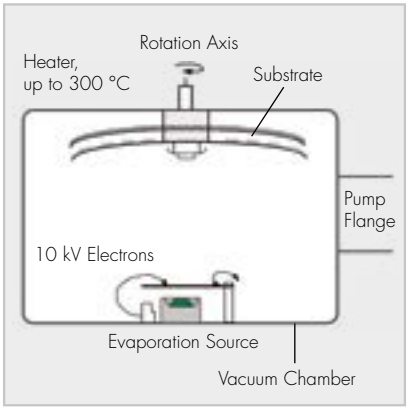
United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com

Coater Parameters

- Maximum substrate diameter: 200 mm
- Typical batch size: 100 substrates with ∅ 1.0“
- Quick coating times at temperatures of around 200 °C
- Maximum flexibility
  - Simultaneous production of mirrors with different levels of reflectivity in one batch
  - Simultaneous production of different substrate sizes
  - Simultaneous production of different angles of incidence



E-Beam Coating

Features

With this process it is possible to produce cw/fs coatings in addition to various high power coatings. This is achieved through the deposition of different materials.

The modified coating can affect the bandwidth, dispersion behavior, scatter losses, and the damage threshold.

IAD Coating

For applications in which high levels of power are used and in which a low wavelength drift, high mechanical resilience, or low dispersion layers are required, we recommend applying the IAD (ion-assisted deposition) process. Moreover, IAD coating has the advantage that it can be performed at low temperatures, which makes it possible for sensitive substrates or optical fibers to be coated.

IAD Coating Process

The IAD process is a PVD process in which the condensing layers are hit with a low energy ion beam. The impact of the ions, on the one hand, provides the layers’ molecules with additional kinetic energy, which leads to a more compact and mechanically resilient layer structure, more homogeneous layers, and low dispersion surfaces. On the other hand, the high chemical reactivity of the radicals produced by the source can positively influence layer composition and stoichiometry, which helps reduce absorption losses.

IAD Sources

Depending on coating requirements, two different IAD sources are available at LASER COMPONENTS:
An ECR source (**e**lectron **c**yclotron **r**esonance) predominantly delivers ions in the range of under 100 eV. Because of the relatively (to the cold cathode sources) low ion energy, the coatings produced with this source have a low remaining porosity. This allows **high damage thresholds** to be achieved, particularly in the nansosecond range.

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

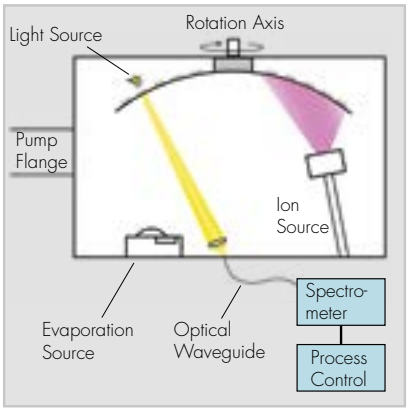
USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com

Alternatively, a cold cathode source is available that provides energy in the range of up to 200 eV, through which extremely compact layers can be produced that completely avoid water retention. Layers of this kind are characterized by just a **marginal thermal drift**.

Online Monitoring System

In addition to layer thickness control through oscillating crystals and monochromatic optical detection, LASER COMPONENTS also has an optical broadband monitoring system available. During the coating process, the entire visible spectrum is monitored and the layer thickness precision increased to over 0.1%. This makes the production of complex coating systems significantly easier.

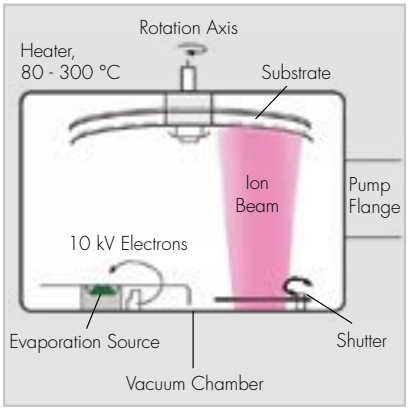
In conjunction with the low drift layers of the IAD coating process, this monitoring system can expand the product spectrum and significantly increase the reliability of the coating process.



Online Monitoring System

Coater Parameters

- Use of a Balzers BAK coater
- Maximum substrate diameter: 90 mm
- Typical batch size: 80 substrates at ∅ 1.0"
- Compared to the E-beam process, similar coating times at a lower temperature (starting at 80 °C)



IAD Coating

IBS Sputter Coating

- Ion beam sputtering (IBS) is an extremely precise and reproducible coating method. Unlike in any other coating technology, process parameters, such as application of energy, layer growth rate, and oxidation level, can be independently and exactly regulated. This leads to compact layers with the lowest possible wavelength drift.

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com

Sputter Coating Process

In the sputtering method, noble gas ions are shot at the coating material. The impact of the ions disperses the material, which subsequently settles on the substrate to be coated.

Due to their extremely high kinetic energy the impacting particles are very mobile. This mobility aids in the filling of holes and the avoidance of any defects in the growing layer.

This ultimately leads to the formation of exceedingly smooth and, in their optical properties, particularly homogeneous layers.

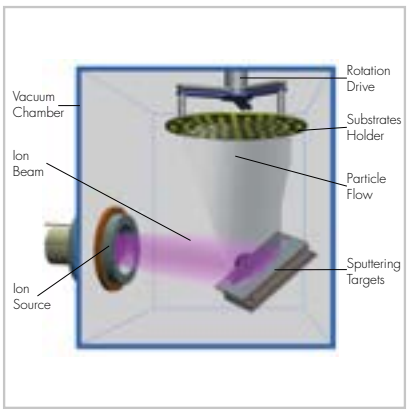
Using this coating method several hundred layers may be placed on top of each other, creating optical coatings for selected requirements.

Characteristics

- Lowest scatter loss and very high reflection (R > 99.99%)
- High packing density, no water retention, and thus extremely low temperature drifts
- Smooth surfaces with marginal roughness
- "Cold" coating method and thus suitable for temperature and moisture-sensitive substrates,
- Nonlinear or laser crystals and laser diodes
- Stable and reproducible process for complex layer designs such as, for example, in steep edge filters

Coater Parameters

- Batch capacity depends on the desired homogeneity of the coated optics
- For the most part, lower batch capacity compared to PVD and IAD processes
- Long coating times



Ion Beam Sputtering (IBS)

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com

Comparison of Coating Methods

Coating Method	E-Beam	IAD	Sputtering
Capacity	100 pcs at ∅1.0" 28 pcs at ∅ 2.0" 8 pcs at ∅ 4.0" 4 pcs at $∅_{Max}$ 200 mm	80 pcs at ∅ 1.0" 24 pcs at ∅ 2.0" 8 pcs at $∅_{Max}$ 90 mm	Depends on the process
Advantage	- High damage threshold - Reasonably-priced production method - Fast layer growth - Combination of different orders in one batch possible	- Very high damage threshold - Small wavelength drift - Fast layer growth - Limited combination of different orders in one batch	- Low scattering loss - Smallest wavelength drift - Compact layers - Slow layer growth

Surface Figure and Surface Quality

To reach high damage thresholds for the coatings, the highest demands are made not only of the optimized coating process but of the substrates as well.

Substrates

The standard substrates at LASER COMPONENTS are specified with a surface figure of λ/10 (3/0.2) and a surface quality of scratch dig 10-5 (5/4 x 0.025 for 1.0" substrates). Incoming inspection constantly monitors the substrate supply. For more details, please refer to the corresponding substrate descriptions.

Coating

If the above-mentioned substrates are used, surface qualities of 5/4x0.025,C2x0.16 and better are achieved after the coating of highly reflective mirrors. You will find detailed values on this in the corresponding coating specifications.

Germany & Other Countries
Laser Components Germany GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

France
Laser Components S.A.S.
Tel: +33 1 39 59 52 25
Fax: +33 1 39 59 53 50
info@lasercomponents.fr
www.lasercomponents.fr

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

Nordic Countries
Laser Components Nordic AB
Tel: +46 31 703 71 73
Fax: +46 31 703 71 01
info@lasercomponents.se
www.lasercomponents.se

USA
Laser Components USA, Inc.
Tel: +1 603 821 – 7040
Fax: +1 603 821 – 7041
info@laser-components.com
www.laser-components.com