



Tailor made filters and coatings

Optical thin-film products are used to obtain loss-free filtering of colours, loss-free transmission or polarization of light. The thin-film consists of multiple layers of various materials in various thicknesses. The interference between forward and backward travelling light determines its optical properties. The finished thin-film may consist of more than 100 layers but is only a few microns thick.

DELTA has more than 30 years of experience in developing and manufacturing of optical interference filters for industrial and scientific applications. We have specialized in high quality multi-layered interference filters for the visible and near infrared wavelength ranges according to customer specifications.

DELTA also offers development of optical equipment where thin-film optics play an important part.

Designed for your products

The theoretical design of thin-film requires specialized knowledge, advanced software, and intuition, all of these based on experience. We develop our own software and, on the basis of our research and experience, continuously improve it. This unique and advanced software ensures a fast and efficient design process resulting in an optimal product.

Special designs made to meet customers' requirements account for approximately 70% of our thin-film production. More than 90% of the production is exported. Our specialists are experienced in co-operating with customers and dealing with their design problems, a cooperation which exploits optical technology to an optimum and often leads to innovative and unique products. In most cases we are involved already in the development stage of a new product, in a true partnership with the customer, to develop the optimal solution.

High performance and quality

Years of experience in the development of optical filters, lighting equipment, and optoelectronic instruments and sensors give us a unique background and understanding of the challenges that our customers – mainly instrument manufacturers – are facing.

DELTA is especially known for its filters for fluorescence microscopes and other fluorometric equipment. Our customers in this field have very high demands concerning transmission, blocking and optical performance. As a result, we are working to meet very high standards when it comes to the design and production of high-quality thin-film components; not just for microscopes but for all applications.

SMART coatings

SMART coatings are DELTA's trade name for a family of thin film products, each of which performs functions usually requiring two or more separate components.

SMART coatings are a specialty of DELTA's and the product family is continuously enlarged, as customers recognize the potential for savings in space and money.



Filter types

Multi band fluorescence filters

DELTA has more than 30 years of experience in the design and production of filters for fluorescence measuring systems. Typical products are filter sets for single fluorochrome fluorescence (FITC) and double band filters for double fluorochrome fluorescence (DAPI/FITC). In order to manufacture band pass filters with high quality characteristics, one must manage the deposition of large numbers of sub-layers with distinct and varying thickness. DELTA was among the first to realize the necessity of using optical monitoring techniques to accomplish this. The proprietary optical monitoring and steering technique developed by DELTA makes it possible to deposit box shaped band pass filters with steep edges and a high transmission. Although used in sets, it is possible to buy single filters and beam-splitters from DELTA, and to use these beam-splitters with different combinations of excitation and emission-filters. DELTA's colour beam-splitters are designed to allow this.

Multi-line laser beam-splitters

Colour beam-splitters are presently produced for the excitation at as many as 5 different wavelengths. In a fluorescence microscope a typical function of such a beam-splitter would be to reflect the different excitation wavelengths on to an object and to transmit the emission light as efficiently as possible in the intervening wavelength ranges. A standard colour beam-splitter performs a polarization splitting in a 10 – 20 nm broad spectral range at the edge. This is acceptable in most systems. However, it is possible to minimize the polarization splitting by optimization of the design, if this is an important issue for the application of the beam-splitter.

X, Y, Z tristimulus filters

According to the CIE colour standard from 1931 it is possible to measure the colour coordinates with a set of X, Y, Z filters. In contrast to the standard RGB filters, which are simply band-pass filters and non-overlapping, the X, Y, Z filters are characterized by three overlapping and smoothly varying transmission curves that must be reproduced carefully to fulfil the requirements. DELTA was among the first to manufacture high tech filters for this purpose. X, Y, Z filters are incorporated in several instruments produced by DELTA including a color-analyzing camera named ICAM. The colour analyzer is capable of distinguishing between colours so closely matched that they may fool even the human eye. The Y-filter is often used to obtain a photopic eye response.

Cubes

Cubes are used in different image-transferring systems for two reasons. Firstly, they have a strong tendency to act as polarization splitters, and this is desired in some laser systems. Secondly, cubic splitters are especially easy to incorporate in existing image-transferring systems because they do not offset the optical axis. DELTA has comprehensive experience in designing cubic splitters according to customer specifications. Typical products are wide band polarizing beam-splitters and non-polarizing colour beam-splitting cubes. The cubes are produced routinely in sizes from 5x5x5 mm and up.

SMART coatings

It is a common market trend to try to integrate the functioning of different devices into a single device. This in order to reduce the physical dimensions of the total product and to limit the handling procedures required to assemble and adjust the final system. DELTA's SMART coatings, combining the function of two or more traditional coatings, typically consist of sub-layers with different thickness. DELTA uses proprietary synthesis techniques and advanced plasma sources like the APS and the Mark II ion gun to deposit dense and shift free SMART coatings with stable characteristics.

Filters for image-transferring systems

DELTA is an experienced manufacturer of filters for image-transferring systems. Filters with a wedge of less than 10 Arc Seconds are produced routinely. Such filters are said to be "pixel exact" and suitable for application in filter-wheels placed in front of CCD cameras. Even more parallel filters are available on request. Filters are available both as an un-mounted OEM product and mounted in a black aluminum ring labelled with laser lettering.

Steep edge filters

Steep edged long wave pass filters with a high transmission are used in laser based fluorescence microscopy. A typical application for short wave pass filters is as a NIR blocking filter for CCD cameras and silicon photo diodes. The steepness of the edge and the blocking depend on the number of layers in the coating. The flatness and the sharpness of the top "corners" of the transmission-band depend on the ability to deposit optimized multi-layers consisting of non-quarter-wave layer-thicknesses. The proprietary optical monitoring and steering system GIMP, developed by DELTA, is specifically designed to handle this task.



Design and production capabilities

The functioning of optical coatings becomes ever more complex. Not only a specific transmission or reflection is required, but also extra features such as a high laser damage threshold or a specific phase-retardation. In addition to this, the desired functioning may be different in distinct spectral ranges. Such coatings typically consist of a mixture of both relatively thick and thin layers. Advanced software and process systems are needed for the synthesis and production of this type of coatings. DELTA was among the first to implement optical monitoring techniques to control the deposition more than 30 years ago. The introduction of the computer based monitoring system GIMP in 1994 offered a better reproducibility and permitted coatings with a more complex composition and hence improved functionality.

When DELTA recently expanded its coating facilities Leybold Optics agreed to establish a software interface between the latest version of GIMP and the brand new generation of coating machines equipped with Leybold Optics Advanced Plasma Source (APS). The first commercial coatings produced by this machine were displayed at LASER 2003 - World of Photonics.

Trends in the market

Now more than ever complex coatings are required for several reasons. First, the construction of complex coatings is difficult to reverse engineer and copy by competitors, and the application of a coating with an advanced function increases the lifetime of the product in the market. These are major benefits as the cost of the coating is limited compared to the price of the final product. Secondly, there is a trend to integrate the functioning of different devices into a single device in order to reduce the physical dimensions of the total product and the number of handlings required to assemble and adjust it. Finally, there is a need for smaller dimensions of the optical components used in laser based systems. Today's optical filters are often made by glueing a number of coated glass-substrates together. However, it is possible to reduce the physical dimensions of the filter by combining the functioning of several of the coatings into a single advanced coating: a SMART coating.

About DELTA

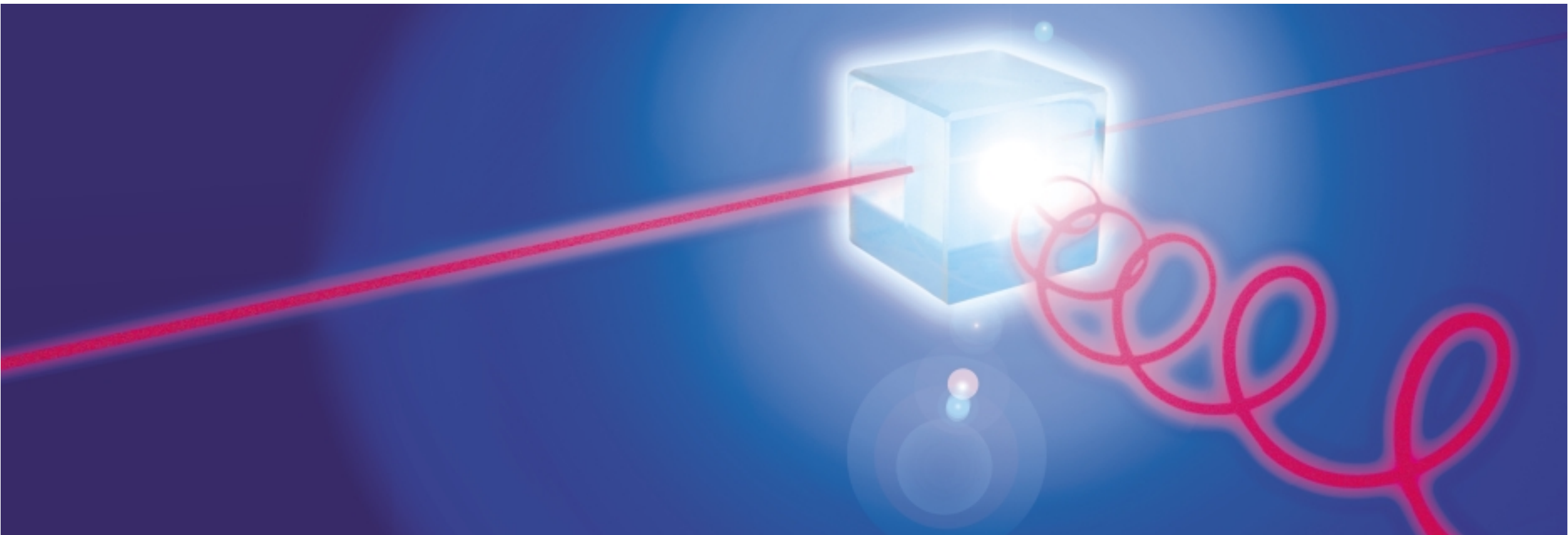
DELTA is among Europe's leading test, design, service, and consulting organisations in the field of electronics, software technology, optics and acoustics. DELTA's staff of 270 employees – of which more than one half holds academic degrees – service customers in more than 20 countries from offices in Denmark, Norway, Sweden, and Wales.

The Light & Optics division of DELTA was originally the Danish Institute for Technical Optics founded in 1956, and merged with the Danish Illuminating Engineering Laboratory in 1990 to form Light & Optics. DELTA was formed in 1993 by a merger between Light & Optics and other institutes.

Today at DELTA “we help ideas meet the real world” – we work together with the industry, as partners, to overcome the challenges of designing new products for a complex world.



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Optical thin-film components

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