OPTICAL COMPONENTS for Quantum Electronics, Fibre Optics and Electronic Instrumentation

Optical components - are elements manufactured of optical glass, semiconductors or metals coated with interference films. Optical components may change such important parameters of optical signal as: power, spectrum, polarization. Interference films are used to reduce power loss at optical interfaces (antireflection coatings), to achieve high reflection (reflective coatings or mirrors), to split or reduce power (splitting and absorbing coatings), to split wave range (spectral splitting coatings), to select narrow spectral intervals in optical range (band-pass filters), to change polarization state (polarizing coatings).

For 190-5000 nm spectral range IEM "KVARZ" offers the following components and coatings:

ANTIREFLECTION COATINGS for optical media with the refractive index N=1.44-4.00, which reduces the reflection coefficient to 0.1-0.5%:

- antireflection coatings for laser lines;
- achromatic coatings for visible range (leucosapphire intro-ocular lens, spectral lens, projecting optics, photographic and film equipment optics);
- antireflection coatings of laser crystals: Nd:YAG; Cr:Forsterite; Cr:YAG; Ho,Tm:YAG, Er:YAG; Cr,Er:YSGG etc.;
- antireflection coatings of non-linear optical crystals: LiNb03, KTP, BBO, LBO etc.;
- broadband antireflection coatings for the main ranges of fibre optics (antireflection coatings for quartz fibre ends);

microlens surfaces, including spherical sapphire lens and SELFOC lens; calcite prisms; Ferro-Yttrium Garnet polarization rotators; Integrated Optics elements; semiconductor materials Si, GaAs, In-GaAsP, Ge, for example, light sensor input windows and LED emitting surfaces).

MIRRORS with reflection coefficients up to 99.9%:

- cavity mirrors for different laser types (excimer, Ar, copper vapor, He-Ne, Ti:Sapphire and harmonics, Nd:YAG - 1.06 μm and harmonics, Nd:YAG - 1.44 μm, Cr:Forsterite, Cr:YAG, Ho, Tm:YAG, Er:YAG, Cr,Er:YSGG, laser diodes etc.);
- broadband cavity mirrors (high reflection and coupler) for femtosecond solid-state tunable lasers;
- dichromatic mirrors for diode pumping (Nd:YAG, Nd:YV04, Cr,Er:YSGG, Er:YAG) for optical parametric oscillators (LiNb03; KTP, GaSe, ZnGeP2, etc.) and up-conversion solutions for blue-green range;
- high reflection mirrors for intro-cavity laser spectroscopy (ranges: 2.6-3.1 μm; 3.0-3.6 μm etc.);
- deflecting mirrors (incidence angles 5-45 °) for different laser types;

POLARIZERS with polarization degree >95%:

- plate polarizers for laser lines, for example 1.06 μm-Nd:YAG laser, 0.81 or 0.98 μm -laser diodes;
- polarizers-cubes for broad-band ranges (visible, fibre optics ranges etc.).

Polarizers are used for light polarization, for optical beam splitting into two channels with different polarization states, for power coupling of two lasers. They are used in fibre optic sensors, laser interferometers, optical isolators, electronic instrumentation and so on.

OPTICAL POWER SPLITTERS for incidence angle 45:

- achromatic splitters with splitting ratio R:T=50:50 for visible range (semitransparent mirrors for visual inspection systems of different technological plants, projecting systems, film and photographic equipment, etc.);
- non-polarizing splitters for laser radiation of 630, 1300. 1550 nm wavelengths with polarization degree in transmitted beam less than 5% and splitting ratio R:T=50:50, 20:80, 10:90, 5:95;
- achromatic splitters of non-polarized radiation for different spectral ranges including ranges for main fibre intervals with splitting ratio R:T=50:50, 70:30, 75:25, 80:20, 90:10, 95:5.

Splitters are used for power splitting of lasers, LEDs and other radiation sources between different channels, in particular between optical fibres, in fibre optical channels for insertion loss measurements, for laser sources stabilization, in multi-beam laser interferometry and so on.

OPTICAL POWER ATTENUATORS based on absorbing coatings:

- fixed attenuators with 3, 5, 7, 10, 20, 30 dB attenuation;
- variable attenuators with 0-10 dB and 0-20 dB attenuation varying linearly depending on rotation angle.

Attenuators provide regulated attenuation of optical channels and light sensor linear operation mode. They are used for light sensors Ampere characteristic measurements and for tuning and adjustment of various optical measuring systems.

SPECTRUM SPLITTERS:

- optical multiplexers/demultiplexers of main fibre optical intervals (used to increase throughput of fibre optic systems);
- additive/subtractive color separation filter splitters transmitting visible range and reflecting laser lines in ultraviolet or infrared ranges (for visual inspection systems of technological plants).

NARROW-BAND FILTERS:

- narrow-band filters for ultraviolet spectrum with 1-30 nm HPBW and max transmission up to 20-70%;
- narrow-band filters for visible, near infrared and infrared ranges with 1.5-50 nm HPBW and max transmission up to 60-90%;
- rotary monochromator - narrow-band filters with 100-150 nm tuning range.

Narrow-band filters are used to select the required spectral lines from a broadband optical signal, for example for dense wave multiplexing/demultiplexing in fibre optics communications

A damage threshold of high power optics depends on wave length, energy density, pulse duration and repetition rate. For example, 0.308 μm HR mirror have a threshold energy density Et >0.4-0.5 J/cm^2 for 12-20 ns pulse duration and 4 Hz repetition rate; 1.064 μm AR coating have a threshold power density Pt >500 MW/cm^2 for a nanosecond pulse; 2.088 and 2.94 μm HR and coupler mirrors have Et >20-30 J/cm^2 for 100-300 us pulse duration and 10 Hz repetition rate; Ti:Sapphire HR and coupler mirrors and broadband polarizers operate in laser systems having 5-12 W CW pumping energy and pulse duration of <100 fs and energy >1 mJ.

STAGES of optical components production:

- Coating.

A coating structure is optimized using SINOP (synthesis) and OCA (analysis) computer programs to obtain the best approximation of the required spectral characteristic.

- Substrate manufacture.

By customer order substrates for optical components may be manufactured with the required finish quality.

- Substrate cleaning.

A substrate surface is thoroughly cleaned with organic solvents and then is processed in oxygen plasma.

- Vacuum evaporation.

Interference coatings are evaporated by an automatic plant. The vacuum pump system has a high efficient cryogenic pump providing oil-free vacuum. A layer thickness is controlled by a photometer or a quartz monitor calibrated by a laser ellipsometer or a profilometer.

- Control.

Spectral characteristic control of manufactured optical components is provided by UV-VIS-NIR spectrophotometers.

Besides the above mentioned components IEM "KVARZ" may develop and manufacture other optical components by customer order with the required parameters.

Price and optical component production time depend on a coating complexity, a substrate type and a quantity of components in a batch.

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