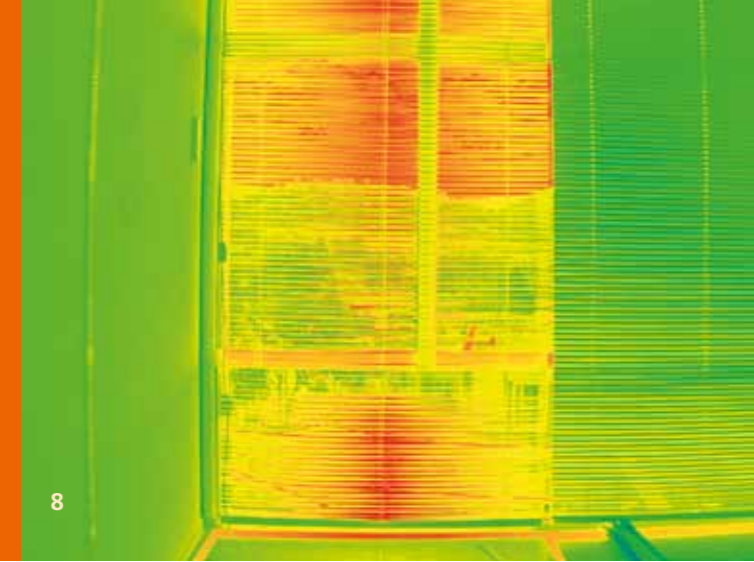


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7 Simulation of the luminance distribution at an office workplace.

8 Glare protection test carried out for a sunshading system with a luminance camera.

Lighting Technology

High-quality lighting with good illumination and color and without glare is a central element of workplace design for non-residential buildings. A good optical design as well as a goal-oriented control of façades and light sources provide for a visually pleasant atmosphere. At the same time, the requirements of workplace safety and ergonomics are placed in the focus just as much as the energy efficiency for buildings and off-grid applications. The evaluation of integral lighting concepts for buildings is essential for putting the Energy Conservation Ordinance EnEV into practice.

We offer surface and coating development for new optics, sophisticated expertise, characterization and testing facilities for daylighting and artificial lighting, and simulation tools and consultancy to support the development of your lighting technologies.

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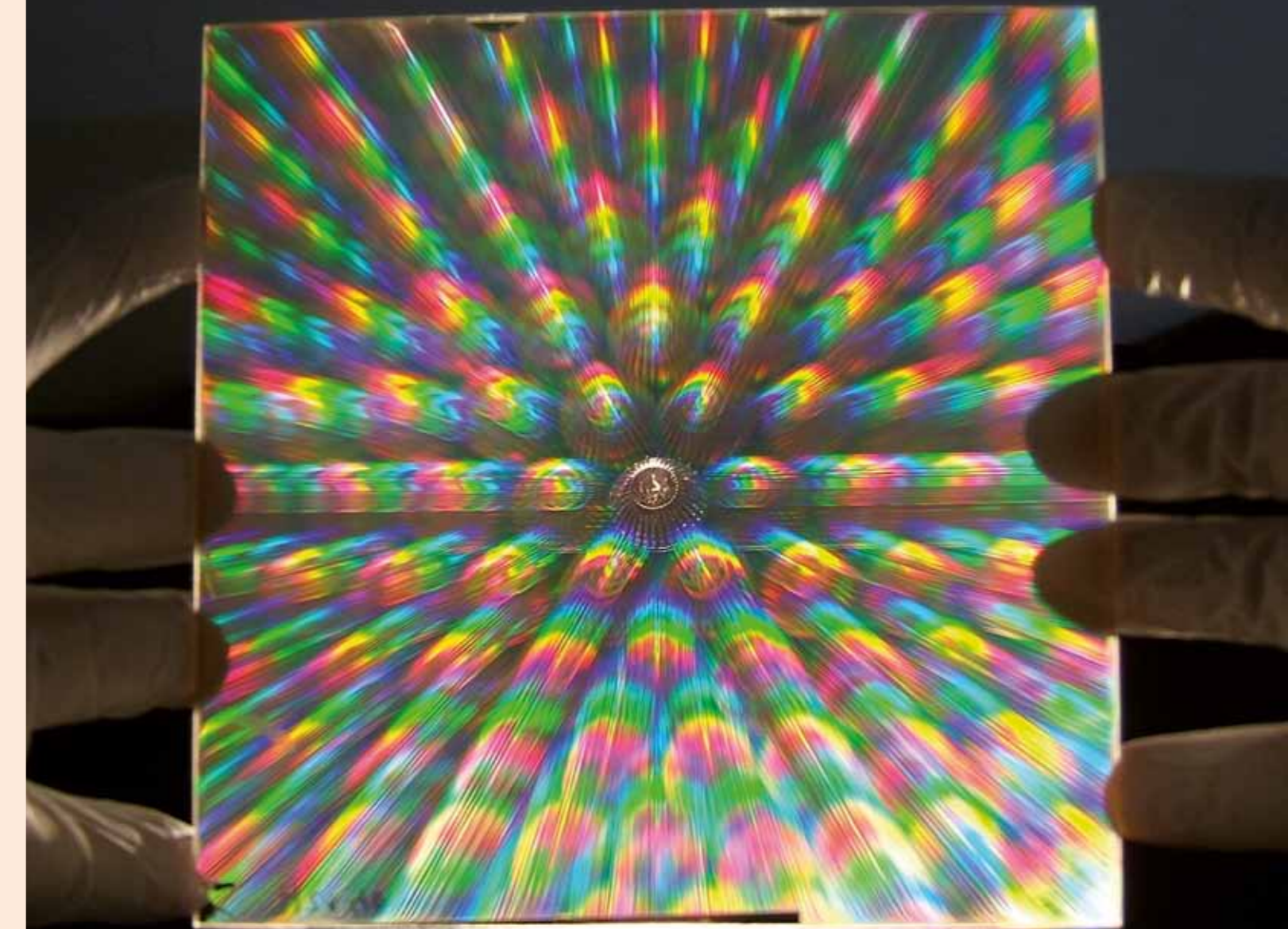
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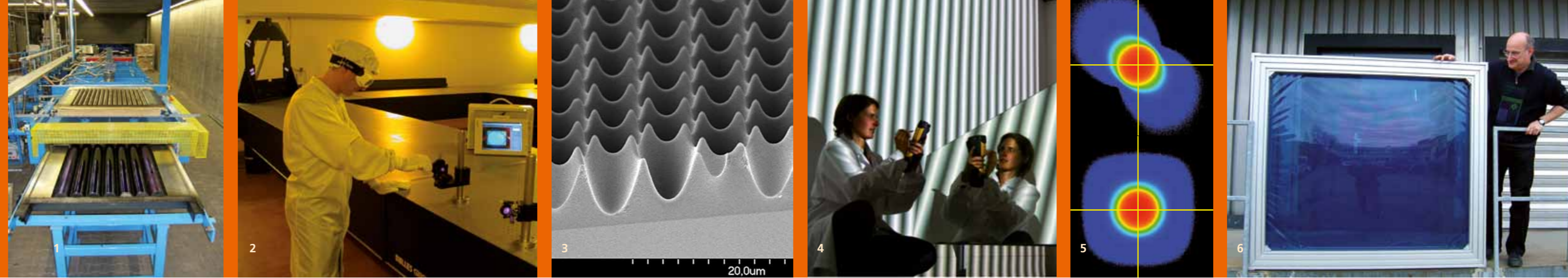
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APPLIED OPTICS AND FUNCTIONAL SURFACES



APPLIED OPTICS AND FUNCTIONAL SURFACES



- 1 Absorber pipe coating on industrial prototyping machine.
- 2 Laser lab for the generation of large area microstructures.
- 3 Honeycomb texture for light-trapping in solar cells.

- 4 Fringe reflection method for qualification of shape accuracy of e. g. CSP mirrors.
- 5 Fresnel lens arrays for CPV modules and radiance distribution in the focal spot, measured at our indoor test stand.
- 6 A gasochromic membrane cushion for applications as switchable sun protection in membrane architecture.

Applied Optics and Functional Surfaces at Fraunhofer ISE

R&D in optical methods is required in many market segments of solar technologies, e. g. in solar cells, windows and façades, solar thermal collectors and concentrator systems. Our expertise is similarly needed in non-solar applications such as lighting and display technology. Our emphasis is on optical simulations, surface characterization and analytics as well as the development of optimized coating systems using PVD and surface structuring with the help of laser interference lithography.

Important areas of work are:

- solar thermal absorbers and receivers
- surface mirrors
- low-e and vacuum glazings
- optically switchable systems e. g. gasochromic windows
- light scattering and light guiding
- photonic structures
- light trapping
- concentrator optics etc.

SERVICE AREAS

We offer customized services to

- industrial and medium size manufacturers
- machinery and plant manufactures

Our services:

- analysis and characterization of surfaces
- optical measurements and optical design
- technology development on the basis of thin film coatings
- surface structure development using interference lithography
- geometrical and wave-optical modeling: raytracing, scattering theories, scalar and rigorous diffraction theory, photonic band structure calculations

Special equipment

- vacuum deposition for industrial level production of large area complex coating systems (150 x 400 cm² up to a maximum thickness of 16 cm)
- interference lithography for the homogeneous production of micro and nanostructured surfaces up to 120 x 120 cm²
- optics lab: spectrometry, goniometry, luminosity measurement using imaging methods, fringe reflectometry, special tests for concentrator optics
- surface characterization: optical profilometer, raster electron microscopy, atomic free microscopy, Auger electron spectroscopy

Systems Employing High Tech Coatings

Many of today's products rely on high tech coatings to reach the desired performance. We develop for our customers system solutions employing such coatings. Typical applications are mirrors, absorbers, transparent electrodes, thermal insulation as well as optically switching devices. In addition to the optical properties e. g. the long-term stability and scalability are optimized to meet the specific application's requirements. We operate a variety of vapor and sputter deposition machines, equipped with state of the art technology. Coating substrates include glass panes, polymer foils, metal sheets and pipes up to an area of 1.5 x 4 m² and 16 cm thickness.

For the qualification of the electrical, optical, mechanical and chemical properties a wide variety of characterization tools is available.

Microstructured Surfaces

Micro- and nanostructured surfaces can fulfil a variety of different functions. The key application is radiation management. Structures with dimensions in the micro or nano scale lead to improved light trapping in solar cells, contribute to enhanced light outcoupling or light deflection in lighting technology, and are used for antireflection, polarization, light steering or diffusion in displays. In addition, microstructures play a role in the modification of non-optical properties, such as adhesion, wettability or the friction coefficient of surfaces.

For the origination of micro- and nanostructures on areas of up to 1.2 m x 1.2 m², we use interference lithography. Further fields of activity are wave optical modelling, replication and characterization of structured surfaces.

Concentrator Optics

We offer professional assistance in the design and characterization of concentrating optics for Concentrated Solar Thermal Power (CSP) and Concentrator Photovoltaic (CPV) applications using reflective or refractive optics.

Using sophisticated instrumentation and procedures, we characterize optical materials, optical surface properties, reflector panels, multistage optics (CSP/CPV) and entire CSP collectors. Thorough characterization of material properties and components uncovers potential for further optimization. Optical qualification allows for appropriate quality control of manufacturing processes.

Our simulation tools range from pure optical simulation to techno-economical optimization routines of e. g. entire Concentrated Solar Thermal power plants. We take cost and manufacturing aspects into account and allow for an overall optimization of a concentrator optical system.

Windows and Façades

The architectural glass and façade sector presents a large untapped potential for energy savings as well as for directly harvesting solar energy.

For our customers we provide innovative solutions for building integrated PV and solar heat systems. In the field of sun protection systems, we offer optically switchable elements based on electrochromic, gasochromic and photochromic layers. We have experience with the integration of switchable layers into glass and polymer façade elements.

Vacuum insulation glass is currently under development. Record low heat transfer coefficients of U~0.5 W/m²K can be reached with a window thickness as small as ~10 mm. Work focuses on the production of a durable vacuum-tight edge sealing.