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Special optical fibers – heart of thulium and holmium fiber lasers and amplifiers (I. Kašík)..... 4
Fiber lasers and amplifiers have been developed as magnificent alternative to traditional solid-state or gas lasers. They are effectively employed for low-power applications, e.g. in metrology or in medicine, as well as for high-power applications like industrial splicing, cutting, or welding. Special optical fibers based on silica or soft optical glasses are heart of the fiber lasers. This paper deals with special silica-based optical fibers doped with thulium and/or holmium ions for amplified spontaneous emission (ASE) sources operating around 2 μm . Pretty versatile method of fiber preparation was elaborated making ones possible fabrication of single-mode or double-clad fibers with core modified with Al_2O_3 or P_2O_5 up to 14 mol % and doped with rare-earth ions (Tm^{3+} , Ho^{3+} , Er^{3+} , Eu^{3+} , Dy^{3+} , Yb^{3+} , Sm^{3+}) in the range of 10^2 ppm – 10^4 ppm. This method is suitable also for doping the fiber core with nanoparticles. Such fibers can be employed for preparation of high-power fiber lasers and/or stable ASE sources in infrared region. This kind of sources was demonstrated in generator of extremely wide emission within 1540 nm – 2340 nm suitable for spectroscopy characterization of optical components.

Workshop on Applied Optics and Microscopy 2014 (J. Novák)..... 7

Iodine absorption cells spectral properties evaluation (J. Hrabina, M. Šarbort, M. Holá, O. Číp, J. Lazar) 8
Optical frequency references – absorption cells filled with ultra-pure gases – represent an unique tool for laser frequency stabilisation. The key properties of these cells are their spectral parameters, which define the achievable frequency stability of realised laser standard. Chemical impurities in absorption media cause undesirable frequency shifts of absorption spectra and degradation of frequency stability. Due to these reasons their level must be precisely controlled. We present a novel simple method for evaluation of iodine cells quality based on measurement of hyperfine transitions spectra profiles.

Combination of electron lithography with Gaussian and shaped beams (S. Krátký, M. Urbánek, J. Chlumská, M. Matějka, P. Meluzín, V. Kolařík, M. Horáček)..... 10
One of the main goals in e-beam lithography is to increase exposure speed to achieve higher throughput. There are basically two types of electron-beam writers, shaped beam lithography systems and Gaussian beam lithography systems. The exposure time of both e-beam writers consist in essence of beam-on time, deflection system stabilization time and stage movement time. Exposure time testing was carried out on two types of patterns. There were completely filled in areas, binary period gratings (ratio 1:1 between exposed and unexposed areas), and multileveled structures (computer generated holograms). Exposures data was prepared according to standard technology (PMMA resist, exposure dose, non-alcoholic based developer) for both systems. The result of experiment shows that variable shaped beam system has advantage in multileveled structures while the Gaussian beam system is more suitable for gratings type of pattern. It was proved that combination of both systems has its use to increase exposures throughput.

Keywords: e-beam writer, Gaussian beam, variable shaped beam

RNDr. Miroslav Císař's 90th jubilee (A. Mikš)..... 13

Advanced interferometry systems for dimensional measurement in nanometrology (J. Lazar, M. Holá, J. Hrabina, J. Oulehla, O. Číp, M. Vychodil, P. Sedlář, M. Provazník)..... 14

We report on the results of the common collaborative project of applied research where the Institute of Scientific Instruments (ISI) of the Academy of Sciences of the Czech Republic and a company Meopta – optika joined their effort in development of high-precision interferometric systems for dimensional metrology and nanometrology. This research exploits previous results in the field of laser standards of optical frequencies and the methodology of interferometric metrology of length together with detection systems of interference signals and their processing at the ISI and the production technology of precise optical components at Meopta – optika.

The main aim of the project is a design of a complex interferometric measuring system in a form of a prototype serving as a master for further production. It concept is a modular family of components configurable for various arrangements primarily for multi-axis measurements in nanotechnology and surface inspection. Within this project we developed a compact, solid-state frequency stabilized laser referenced to iodine transitions and technology of iodine cells for laser frequency stabilization. A fundamental setup of the laser interferometer has been arranged and tested. The company Meopta – optika contributes with development of new technology together with a design of a machine for processing and polishing of high-precision flat-surface optical components.

Week of Science and Technology 2014 in the Institute of Scientific Instruments of the Academy of Sciences of the Czech Republic, v. v. i. in Brno (M. Selingerová) 18

Deformable mirror for high-power laser applications (L. Mrňa, M. Šarbort, M. Holá) 19

The modern trend in high power laser applications such as welding, cutting and surface hardening lies in the use of solid-state lasers. The output beam of these lasers is characterized by a Gaussian intensity distribution. However, the laser beams with different intensity distributions, e.g. top-hat, are preferable in various applications. In this paper we present a new type of deformable mirror suitable for the corresponding laser beam shaping. The deformation of the mirror is achieved by an underlying array of actuators and a pressurized coolant that also provides the necessary cooling. We describe the results of the surface shape measurement using a 3D scanner for different settings of actuators. Further, we show the achieved intensity distributions measured by a beam profiler for a low power laser beam reflected from the mirror.

Keywords: deformable mirror, high-power lasers, adaptive optics

LED or laser for life sciences instrumentation? (M. Klečka)..... 22

A comprehensive analysis reveals that lasers provide both superior performance and lower total cost in comparison with LEDs for life sciences instrumentation.

Influence of points selection in the specified area on stability of correlation coefficient during image data processing

(P. Kulmon)..... 23

In this paper, the correlation between two functions which values are known in the discrete set of points is analyzed. Influence of number of points and their location in the specified area on stability of correlation coefficient is investigated. Furthermore, various methods for selection of these points are described.

Fluorescence detection of emulsion microdroplets with controlled chemical composition on a microfluidic chip

(Z. Pilát, J. Institoris, J. Ježek, J. Kaňka, P. Zemánek) 26

We demonstrate a microfluidic system that builds emulsion droplets of water in oil in one chip and provides continuous control of fluorescein concentration in the droplet and fluorescence detection by built in optical fiber. In this fluid flow chip water is mixed with an adjustable amount of fluorescein solution and injected into oil where emulsion droplets of uniform size are formed. Fluorescence from the droplets was detected directly on the chip using optical fibers. Such miniaturized chemical laboratory is useful for applications where chemical reactions or their products can be characterized by optical way.

Leading Czech experts reunited for fourth time in Třešť at LASER 54 conference (M. Selingerová)..... 29

Laser diode noise reduction using unbalanced fiber interferometer (M. Čížek, R. Šmíd, V. Hucl, M. T. Pham,

B. Mikel, J. Lazar, O. Číp)..... 30

Measuring length changes of optical resonators usually requires using lasers with a narrow spectral linewidth. For tracking the

whole interval of possible lengths a laser with a wide tunability is needed. Laser sources based on DFB laser diodes have required tunability range however their spectral linewidth is in the MHz order. An usual way of reducing the noise and hence the linewidth of a tunable laser is locking its optical frequency to an etalon cavity using f.e. a P-D-H setup. In this case, the tunability is reduced to a discrete set of frequency values corresponding to the modes of the etalon resonator. The method presented in this article uses the Michelson interferometer with heterodyne detection as an optical frequency discriminator. Using a fast servo loop controlling the optical frequency of a diode laser we are able to reduce the sideband noise of the laser by up to 60 dB and reduce its spectral linewidth.

Instrumental technique for control of optical parts in the company Meopta – optika, s.r.o. (S. Michal)..... 32

Light therapy (I. Gonová, O. Tůmová) 41

This paper summarizes possibilities of combination of medicine and light therapy. The paper deals with dynamic phototherapy designed to cancer treatment, light therapy intended for wound treatment, chromotherapy and phototherapy for mood disorders treatment.

Keywords: phototherapy, chromotherapy, light therapy