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Current Developments in Lens Design and Optical Engineering XI; and Advances in Thin Film Coatings VI

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Editors

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Introduction

This year, our conference on Current Developments in Lens Design and Optical Engineering also included Advances in Thin Film Coatings. The papers were presented in eight sessions, one of which was held jointly with the Imaging Spectroscopy Conference 7812. There was a strong session of poster papers as well. Some papers were withdrawn or cancelled due to visa problems of the overseas contributors. A total of 40 manuscripts appear in the Proceedings that include 30 oral and 10 poster papers, including the five oral papers from the joint session. A brief summary of each session is given below with the name and affiliation of the session chair given in parentheses.

Session 1: SSL Research at National Central University in Taiwan (C. C. Sun, National Central University)

National Central University is at the forefront of LED research. LEDs are regarded as one of the most important and promising light source in the 21st century. The advantages in energy saving, design freedom in color, and optics and human factor, all attract intense attention by researchers in various fields. Optical design is important for lighting concerns not only in lens or mirror optimization, but also in phosphor scattering and object diffusion, and not only in getting desired illumination uniformity, but also in how to extract light from a trapping cavity. SSL (solid state light) will continue to be a hot topic in optical design.

In this session, one invited and four contributed papers were presented. T. H. Yang in his invited paper reported the novel progress on colorimeter calibration, which enables accurate measurements of the chromatic property of LEDs under various practical correlate color temperatures (CCT). The second paper was presented by W. T. Chien, who reported a study of color mixing with a compact optical element. Through power adjustment and appropriate total internal reflection (TIR) lens design, the light emitted by red, green, and blue (RGB) LEDs can be color mixed to meet the CCT at 6500 K, 4500 K and 3000 K and be projected at an angle of 40° of FWHM. The third paper was presented by T. C Wei, who reported a design of color filter incorporated with phosphor to recycle light at large incident and scattering angles, and then increase not only the directionality of the integrating light source but also the system optical efficiency. In the fourth paper, X. H. Lee presented a design of a street light with TIR lens design incorporated with a specific diffuser. The advantage of the design is that the optical utilization factor exceeds 80%, which is much higher than the 40% value of a normal design. In the last and fifth paper of this session, C. C. Chen reported the results of an in-depth study on the phosphor particle number, which is regarded as the most important factor to determine the CCT as well as luminous efficacy of an LED package.

Session 2: Lens Design and Optical Engineering (R. B. Johnson, Consultant and Alabama A&M University)

Due to visa problems, two of the six papers planned in the program were not presented. The first paper was presented by L. N. Hazra on a new approach for synthesis of thin lens structures for zoom lenses using evolutionary programming based upon genetic algorithms. Although the work is in its early stages, it does show interesting promise for future zoom lens system design. The second paper by K. Liu et al., and presented by the session chair R. B. Johnson, discussed GPU (graphics processing unit)-based data parallel techniques to reduce the computational time in the design of diffractive optics. The method was successfully demonstrated by computation of a diffractive element and followed by fabrication and evaluation of the element. In the next paper, A. Brückner, et al. discussed their work in developing ultra-compact close-up microoptical imaging systems for application in machine vision and biological imaging. Their method utilizes an innovative method of using a multi-aperture approach to shorten the total track length and a stack of several two-dimensional arrays of refractive microlenses. They have achieved demonstration of a compact system having high resolution without scanning. The final paper was presented by Y. Takashima in which he discussed the design and implementation of a recording and readout system for micro-holographic optical data storage. A lens design was achieved for a multilayer micro holographic optical recording system having a NA = 0.4 and a recording depth range of 0.4 mm using their proposed power arrangement, as explained in the paper.

Session 3: Astronomical Optics (V. N. Mahajan, The Aerospace Corporation)

This year, we received some papers in the area of astronomical optics. However, only one paper is included in the Proceedings due to visa problems of some of the presenters. J. Lents et al. discuss perceptual image quality and performance ranking of telescopes used for imaging space launch vehicles.

Session 4: Developments in Materials and Techniques (M. Mandina, Optimax Systems, Inc.)

A new Ion milling system manufactured by Roth Rau was discussed by S. Kiontke. The system figures lenses up to 200 mm diameter and was designed for production of precision optics, most notably spheres and aspheres. Results presented demonstrated a 10x improvement in the peak-to-valley figure. The process parameters are adjustable so beam size can be optimized for fast removal, and then altered for more optimal surface correction. Analyses of micron-scale dielectric microspheres as lens elements was presented by A. Devilez et al. The focusing characteristics and the resulting photonic jet are discussed. Applications for molecular imaging and directional antenna are also considered. Flat-liquid crystal-diffractive lenses with variable focus and magnification were presented by P. Valley. Annular liquid crystal shutters are integrated with a multi-focused diffractive lens element that enables multi-stepped focal length capability. These tunable-focus flat liquid crystal diffractive lenses (LCDL) employ binary Fresnel zone electrodes and are fabricated on Indium-Tin-Oxide using conventional micro-photolithography.

Sample images taken through the lens at various magnifications were shown. A means of calculating color maps for rectangular tapered light pipes was presented by I. Mereno. The premise is that a tapered lightpipe behaves as a three-dimensional kaleidoscope. The method enables simulation of diode placement and light pipe dimension modification yielding both representative color pattern and color map.

Session 5: Thin Film Optical Coatings I (J. Turner-Valle, College of Optical Sciences, The University of Arizona)

The papers presented in this session illustrate the great depth and diversity of optical thin film applications in existence today. In this era of well-understood and repeatable deposition of optical coatings, it is rare to find an application, whether consumer- or aerospace-driven, where thin film coatings are not used to control the transmission, reflection, and absorption of light. Likewise, the authors in this conference covered a wide range of topics spanning the full range of applications.

C. T. Chu presented test results of accelerated atmospheric corrosion of electroplated gold-mirror coatings. They are relevant to infrared optics used in industrial, space, and military applications where gold-coated mirrors are exposed to atmosphere. The changes in optical properties of these mirrors were correlated with the morphology of corrosion features. A. Avsar presented results from the development of a rain erosion-resistant hard carbon coating for germanium substrates used as windows in airborne infrared optical systems. He showed improvement in the damage resistance of germanium substrates coated with a diamond like carbon coating and correlation of the observed damage to that predicted by modeling. M. Poirier presented spectroscopic ellipsometry of an amorphous silicon/silica coating for fabrication of the James Webb Space Telescope's Fine Guidance Sensor Tunable Filter Imager (JWST-FGS-TFI) etalon plates, which must perform well over a 1-5 μm wavelength range. He refines optical properties characterization for the deposited layers in the a-Si/SiO_2 stack based on a multiple-layer ellipsometric model. W. Y. Hsiao presented the design and deposition of anti-reflection coatings on an aluminum substrate for a solar and the deposition of anti-reflection and high-reflector coatings for an organic light-emitting diode (OLED) device. He gave results for the two cases and compared them with the theory. C. Buchholz presented the characterization of optical coating edge feathering for application in helmet mounted displays.

Session 6: Optical Design and Engineering of Hyperspectral Sensors (P. Mouroulis, Jet Propulsion Laboratory)

A session on the Optical Design and Engineering of Hyperspectral Sensors was held for the first time in conjunction with the long-standing Imaging Spectrometry conference. Five papers were presented, which will be indexed in the Imaging Spectrometry volume 7812, but are also reprinted here. Three of these presented designs based on the Dyson spectrometer form, for spectral ranges spanning the visible and thermal infrared, showing the flexibility of this design form. One paper presented a novel electro-optic

stacked filter concept that can be tailored to produce several bands centered at specific wavelengths of interest, while another dealt with the engineering and tolerancing aspects of imaging spectrometers that are necessary in order to achieve the tight calibration and stability specifications required of high-accuracy spectroscopy.

Session 7: Thin Film Optical Coatings II (A. Wood, Qioptic Ltd. and J. Turner-Valle, College of Optical Sciences, The University of Arizona)

In the first paper, P. Z. Chen et al. describe a post-annealing technique for improving the optical and electrical properties of fluorine doped tin oxide films. The experimental arrangement to assess the variation of properties with temperature and optimizing the annealing process is described. The next paper by S. H. Peng describes a technique for producing a Nb doped TiO_2 transparent conducting coating using a pulsed DC magnetron co-sputtering technique. The advantages of this film over alternatives are presented and experimental results form the films produced are discussed. The final paper by C. C. Chan describes an experiment to produce an electro-chromic device with GZO (gallium-doped zinc oxide) as a conductive layer and discusses the results. This technique is a potential alternative to ITO (indium tin oxide); a summary of applications is presented.

Session 8: System and Component Test (L. N. Hazra, University of Calcutta)

The four papers presented in this session cover a broad range of problems encountered in performance evaluation and testing of optical systems and components. The paper by L. Zhao et al deals with characterization of image stabilization systems for tackling vibrations in camera. A dynamic model for studying the effect of vibration on system performance is presented in the paper by A. Avsar et al. The paper by A. Anisimov and I. Konyakhin reports studies on the effects of tetrahedral reflector properties on the characteristics of autocollimating systems. A dedicated test set up for panoramic lenses is described in the paper by A-S. Poulin-Girard et al.

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