Guest Editorial

Conical Optical Element Metrology

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A conference on Conical Optical Element Metrology, Thomas R. Ferguson, Chairman; Marek J. Konopnicki, Co-chairman, was held in Albuquerque, New Mexico, on June 24-25, 1981. The purpose of the conference was to provide a forum for presentation and discussion of work on measurement of surface properties of conical optical elements. An underlying motivation for the conference was the need for developing new techniques for metrology used in the fabrication, polishing, coating, and final testing of the conical elements designed for current and future high energy laser cylindrical resonators. The conference was organized in May and June by personnel from the Advanced Resonator/Optics Branch of the Advanced Radiation Technology Office at the Air Force Weapons Laboratory (AFWL) and was announced mainly by a hastily assembled telephone and mailing list. As a consequence, most of the papers presenting results of testing of conical optical elements arose from current Air Force programs. However, the scope of the conference included current and potentially applicable measurement methods, and many authors discussed the problems associated with adapting conventional methods to highly curved surfaces.

The 29 papers presented at the conference were organized into four half-day sessions as follows:

First Session: Jim Mayo, Chairman—

"Conical Element Nomenclature, Use, and Metrology," T. R. Ferguson, L. M. Gutheinz, J. W. Mayo III, W. H. Lowrey, M. J. Konopnicki (AFWL);

(Invited Paper) "Unified Approach to Figure and Surface Roughness Measurement," H. J. Caulfield (Aerodyne Research, Inc.);

"Reflaxicons and Other Icons; An Optical Viewpoint," R. C. Yoder (Union Carbide Corp.);

"Mechanical Measurements of Conical Optical Elements," John Casstevens (Union Carbide Corp.);

"Design, Fabrication, and Metrology of Negative Branch Waxicons," J. K. Guha (Rocketdyne) and R. C. Yoder (Union Carbide Corp.);

"Finite Element Studies of Tangent Mounted Conical Optics," Jerry Stoneking, (Univ. of Tennessee), John Casstevens and Douglas Stillman (Union Carbide Corp.).

Second Session: Marek J. Konopnicki, Chairman—

(Invited Paper) "Surface Metrology of Conical Optical Elements—Problems and Possibilities," Jean M. Bennett (Naval Weapons Center);

"Roughness Measurements of Curved Surfaces with Light Scatter," John C. Stover (Univ. of Colorado);

"Laser Damage, Reflectance, and Scattered Light Characterization of Nonnormal Incidence Plane and Conical Surfaces," D. L. Decker and J. O. Porteus (Naval Weapons Center);

"Specifying Surface Finish and Scattering Tolerances of Conical Optical Elements," James E. Harvey (United Technology Research Center);

"A Comparison of Two Common Methods of Surface Topography Evaluation," Allen L. Gauler (Los Alamos National Laboratory);

"Ion Polishing of Optical Surfaces," Sid Zafran, Ken Kauffman, and Mike Silver (TRW);

"Infrared Ellipsometry Instrumentation," Thomas A. Leonard and J. Loomis (Univ. of Dayton Research Institute).

Third Session: Bill Lowrey, Chairman—

"Precision Infrared Reflectometer with Glower-Source and Filter Monochromator," Erik Anthon (Optical Coating Laboratory, Inc.);

"High Reflectance Measurements using the CAPS Method," J. M. Herblein, M. A. Kwok, G. I. Segal, and R. H. Ueunten (Aerospace Corp.);

"High-Precision, Tunable IR Reflectometer," C. Gokay, K. Harding, J. Loomis, and J. Marcheski (Univ. of Dayton Research Institute);

"An Overview of the Polishing, Testing, and Figuring of Conical Elements at the Optical Sciences Center," Steven R. Lange (Univ. of Arizona);

"Optical Phase-Measurement Microscope for Surface Profiling," Chris L. Koliopoulos, Scott Forbes, and James C. Wyant (Univ. of Arizona);

"Alignment and Testing of an Independent Element, Nonlinear Reflaxicon System," John Hayes, Ed Strittmatter, James C. Wyant, and Robert E. Parks (Univ. of Arizona);

"Reflaxicon Interferogram Analysis," C-J Kim and James C. Wyant (Univ. of Arizona);

"Heterodyne Interferometric Analysis System," Chris L. Koliopoulos, Jim Jonas, Scott Forbes, and James C. Wyant (Univ. of Arizona);

"Ray Trace Analysis of Reflaxicon on FALCON," Ker-Li Shu and Robert E. Parks (Univ. of Arizona).

Fourth Session: Pete Latham, Chairman—

"Axicon Interferometric Testing for Evaluation of Surface Thermal Distortion," J. S. Harris, J. Loomis, and R. E. Clark (Univ. of Dayton Research Institute);

"Null Testing Techniques for Non-linear Axicons," Malcolm J. Macfarlane (International Laser Systems);

"Geometric-Optical Properties of Convex Conic-Section Reflectors in Laser Systems," Walter E. Woehl (White Sands Missile Range);

"Alignment Procedures for Annular Resonators with Diamond-Turned Conical Elements," J. A. Bernard, S. B. Mason, and R. A. Chodzko (Aerospace Corp.);

"An Alternative Way for Non-Contacting Measurements of Long Radii," Robert Cutler (Los Alamos National Laboratory);

"A New Absolute Reflectometer," K. Al-Marzouk, M. Jacobson, Robert E. Parks, and M. Rodgers (Univ. of Arizona);

"Laboratory Ellipsometry of Annular Mirrors," John D. German, W. P. Latham, and T. R. Ferguson (AFWL).

After the conference, John Caulfield offered to publish some of the papers in *Optical Engineering*. After the usual review process, twelve papers were accepted for publication in this issue. While they are reasonably representative of the topical areas of the conference, a disproportionate number of them deal with conical optics casually, if at all, and two are not metrology papers. Changes in titles, authors, and affiliations may be noted for some of the papers.

The conference proved to be useful in several ways. It brought together 113 scientists from government agencies, universities, and industry for an interdisciplinary meeting covering most of the metrology topics pertinent to conical elements of current interest in high energy laser programs. A variety of ideas have grown out of the conference, particularly in the area of figure testing of the individual conical surfaces in a waxicon or reflaxicon. As a result of the conference summary report that appeared in the SPIE Reports Forum section of *Optical Engineering* [Opt. Eng. 20(5), SR-140 (1981)], requests for copies of the abstracts came from several institutions not known to be interested in conical elements. These elements are used in a variety of applications, and we expect to hear from a wider group as a result of this publication.

Attendees indicated a preference for the conference to be repeated biannually and to remain under Air Force organization for the present. They mostly desired one interdisciplinary session and preferred limiting the papers to direct theory or application to conical elements or other uniquely curved surfaces. These wishes will be respected in the next conference. A date has not been set as of this writing. Those wishing to be specifically notified should send the appropriate name, address, and telephone number to Marek J. Konopnicki, AFWL/ARAO, Kirtland AFB, NM 87117.

The success of the conference was due to the efforts of many people. In particular, Jim Mayo contributed a plethora of names and telephone numbers for our invitation list, helped keep our switchboard jammed for days, and opened the first session with his hangman's knot and other useful devices for remaining on schedule. Most of our group, from scientists to secretaries to students, shared in the more mundane tasks. Our thanks go to these people, to the referees for the papers in this issue, and to all of the authors and attendees. We look forward to the next round.