Optical Radiation News

Published by the COUNCIL for OPTICAL RADIATION MEASUREMENTS (www.cormusa.org) to report items of interest in optical radiation measurements. Inquiries may be directed to the Editor, John D. Bullough, Light and Health Research Center, Icahn School of Medicine at Mount Sinai, Suite 560, Albany, NY 12205. Tel: 518-242-4620, e-mail: John.Bullough@mountsinai.org.

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Joint Biennial CNC-CIE, CIE-USNC & CORM Conference 2023
November 6-8, 2023

The Joint Biennial CNC-CIE, CIE-USNC & CORM Conference was held November 6-8, 2023 virtually. A list of sessions and presentations has been posted, and conference materials will be forthcoming. The conference program included the following sessions:

- Conference Welcome and Introduction
- Optical Properties of Materials
- UV Radiometry
- Current Research at NMIs
- Educational Session on Glare Metrics, Models and Standards
- Metrology of Indoor and Outdoor Lighting
- Further Studies in Metrology of Indoor and Outdoor Lighting
- Cone Fundamental Photometry and Colorimetry
- Human Vision
- CIE Division Reports

We appreciate the active participation of all conference attendees and organizers! For more details, visit: https://cormusa.org/corm-2023-presentations.

NEWS FROM THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Extremely Broadband Calibrated Bolometers and Microbolometer Arrays for Earth Radiation Budget Measurements

The Earth radiation budget, a 40-year data record of the balance between solar radiation reaching the Earth and the amount absorbed, reflected, and emitted from the Earth, is a key climate record for determining whether the Earth is warming or cooling. The need for accurate and cost-effective space-based measurements is driving the technology development of broadband bolometers and linear microbolometer arrays. We describe the fabrication and performance of microfabricated bolometers and 1 x 32 linear microbolometer arrays developed for this purpose. To accurately measure the total outgoing radiation from 0.3 to over 100 μm, consisting of reflected shortwave solar radiation and emitted longwave thermal radiation, a vertically aligned carbon nanotube thermal absorber is incorporated with an electrical substitution heater that provides on-board calibration capabilities. A membrane heat link is used to maximize response time while minimizing noise and the inequivalence between thermal and optical heating. The devices operate at room temperature with noise floors at the nW/√Hz or lower at the measurement frequency of 7 Hz. Response times below 10 ms have been demonstrated in closed-loop operation using the electrical heater. Thin film Pt thermistors measure the change in microbolometer temperature. The deposition process of the thin film thermistors has been optimized to maximize the temperature coefficient of resistance, which is key to meeting the demanding signal-to-noise requirement of this application. For more information: https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=935259. Contact: Michelle Stevens, michelle.stephens@nist.gov.

Measuring Up: NIST's Missile Defense Transfer Radiometer

If you're undergoing a missile attack and that missile is above the atmosphere, the best place to destroy it is while it's still in space. To do that, you need to be confident that the missile interceptors that you launch from Earth are going to hit their target – a very difficult task. "They say it's like hitting a bullet with a bullet," said NIST's Simon Kaplan. "The missile is this little dot which is very far away against the cold background of space, and the military is trying to find it and hit it at very high speed – many kilometers per second." Key parts of this interception equipment are infrared sensors, extremely sensitive heat-detecting devices, in the form of telescopes, that are capable of locating the incoming missile. However, since it's complicated and expensive to conduct all the necessary tests using real rockets, Kaplan said, contractors test their sensors using special chambers in ground-based laboratories. For more information: https://www.nist.gov/news-events/news/2023/09/measuring-nists-missile-defense-transfer-radiometer. Contact: Eric L. Shirley, eric.shirley@nist.gov.

Solved: The Mystery of the Cloudy Filters

There's a mystery happening in some satellites facing the Sun, and scientists from the National Institute of Standards and Technology (NIST) and the Laboratory for Atmospheric and Space

Physics (LASP) are on the case. The team has been trying to figure out what is clouding up and compromising the performance of tiny, thin metal membranes that filter sunlight as it enters detectors that monitor the Sun's ultraviolet (UV) rays. These detectors can warn us about impending solar storms — bursts of radiation from the surface of the Sun — that could reach Earth and temporarily disrupt communications or interfere with GPS readings. Last year, the team disproved the prevailing theory: that this clouding was a buildup of carbon on the surface of the filters from organic sources stowing away on the satellite. For more information: https://www.nist.gov/news-events/news/2023/03/solved-mystery-cloudy-filters. Contact: Charles S. Tarrio, charles.tarrio@nist.gov.

Ocean Color System Gets a 'Refresh,' Allowing for More Precise and Accurate Measurements

We typically think of the ocean's color as blue, but in some places, it looks blue-green. That's because those areas are teeming with single-cell plants called phytoplankton, which contain chlorophyll and reflect the green in sunlight. Though tiny, phytoplankton collectively absorb almost as much carbon dioxide as all the trees and land plants on Earth. They have an enormous impact on our climate, and scientists study that impact by measuring the color of the ocean with satellites and sea-based sensors. To ensure satellite measurements are accurate, researchers in the U.S. and many other nations rely on an ocean-color sensor called the Marine Optical Buoy (MOBY). Now, the National Oceanic and Atmospheric Administration (NOAA), Moss Landing Marine Laboratories (MLML), the University of Miami and the National Institute of Standards and Technology (NIST) have collaborated on an upgrade to the sensor, known as MOBY-Refresh, that will enable more precise and accurate measurements of sunlight's colors or wavelengths. "MOBY measures how much light over a range of wavelengths is being scattered out of the water at a single location in the Pacific Ocean. The ocean-color satellite sensors observe the oceans, including the MOBY site. The MOBY data then are delivered to the satellite teams, which use the data to adjust the satellite sensors' calibration, thus improving the accuracy of the global data products such as the concentration of chlorophyll," explained NIST researcher Carol Johnson. For more information: https://www.nist.gov/news-events/news/2023/01/ocean-color-system-gets-refresh-allowing-more-precise-and-accurate. Contact: Alexandra Boss, alexandra.boss@nist.gov.

Star Light, Star Bright … But Exactly How Bright?

A picture may be worth a thousand words, but for astronomers, simply recording images of stars and galaxies isn't enough. To measure the true size and absolute brightness (luminosity) of heavenly bodies, astronomers need to accurately gauge the distance to these objects. To do so, the researchers rely on "standard candles"-- stars whose luminosities are so well known that they act like light bulbs of known wattage. One way to determine a star's distance from Earth is to compare how bright the star appears in the sky to its luminosity. But even standard candles need to be calibrated. For more than a decade, scientists at the National Institute of Standards and Technology (NIST) have been working to improve the methods for calibrating standard stars. They observed two nearby bright stars, Vega and Sirius, in order to calibrate their luminosity over a range of visible-light wavelengths. The researchers are now completing their analysis and plan to release the calibration data to astronomers within the next 12 months. The calibration data could aid astronomers who use more distant standard candles--exploded stars known as type Ia supernovas--to determine the age and expansion rate of the universe. (Comparing the brightness of remote type Ia supernovas to nearby ones led to the Nobel-prize winning discovery

that the expansion of the universe is not slowing down, as expected, but is actually speeding up.) For more information: https://www.nist.gov/news-events/news/2022/09/star-light-star-bright-exactly-how-bright. Contact: Susana Deustua, susana.deustua@nist.gov or John T. Woodward, john.woodward@nist.gov.

Single Photon Detectors and Metrology

For quantum applications, it is important to generate quantum states of light and detect them with extremely high efficiency. For future applications, it also important to do this at scale. This presents many engineering and metrology challenges. This paper discusses some of the open challenges and opportunities in single photon detector efficiency measurements, including the challenges of metrology for waveguide-integrated detectors on photonic circuits. For more information: https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=935203. Contact: Sonia Buckley, sonia.buckley@nist.gov.

NATIONAL RESEARCH COUNCIL OF CANADA

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RECENT ACTIVITIES FROM NRC CANADA

Autocollimators: Plane Angle Measurand Ambiguities and the Impact of Surface Form

The low-uncertainty measurement of plane angles is fundamental to practical angle metrology. Industry and most national metrology institutes (NMIs) use autocollimators as low-uncertainty but range-limited plane angle sensors. Autocollimators are used in combination with repeatable large-angle standards such as indexing tables, optical polygons, and angle encoders to realize the radian by subdivision of a full revolution or 2π rad. Autocollimators are meant to detect the orientation or normal vector of a plane reflecting surface. Real surfaces are never perfectly planar, and do not have a unique normal vector. In reducing a real surfaces's distribution of local normal vectors to a single angle reading the autocollimator is implicitly defining a measurand, and the relationship between measurands realized by different autocollimators is poorly understood. This measurand ambiguity can be a significant contributor to the uncertainty. The difficulty of estimating the uncertainty contribution due to imperfect surface form, which remains unresolved in the published literature, is a symptom of the same underlying problem. For more information: https://nrc-publications.canada.ca/eng/view/object/?id=b156144a-d8cf-4be3-b2d5-8cbb242c8a85. Contact: Brian Eves, brian.eves@nrc-cnrc.gc.ca.

Direct and Indirect Evolution of Photoluminescent Semiconductor CdS Magic-Size Clusters through Their Precursor Compounds

Colloidal semiconductor II–VI metal chalcogenide (ME) magic-size clusters (MSCs) exhibit either an optical absorption singlet or doublet. In the latter case, a sharp photoluminescence (PL) signal is observed. Whether the PL-inactive MSCs transform to the PL-active ones is unknown. We show that PL-inactive CdS MSC-322 transforms to PL-active CdS MSC-328 and MSC-373 in the presence of acetic acid (HOAc). MSC-322 displays a sharp absorption at ≈322 nm, whereas MSC-328 and MSC-373 both have broad absorptions respectively around 328 and 373 nm. In a reaction of cadmium myristate and S powder in 1-octadecene, MSC-322 develops; with HOAc, MSC-328 and MSC-373 are present. We propose that the MSCs evolve from their relatively transparent precursor compounds (PCs). The PC-322 to PC-328 quasi-isomerization involves monomer substitution, while monomer addition occurs for the PC-328 to PC-373 transformation. Our findings suggest that S dominates the precursor self-assembly quantitatively, and ligand-bonded Cd mainly controls MSC optical properties. For more information: https://nrc-publications.canada.ca/eng/view/object/?id=f344600c-989e-4d35-8dc6-d803a1484200. Contact: Nelson Rowell, nelson.rowell@nrc-cnrc.gc.ca.

2022 Optical Interference Coatings Conference: Manufacturing Problem Contest

Participants in the 2022 Manufacturing Problem Contest were challenged to fabricate an optical filter with a specified stepped transmittance spanning three orders of magnitude from 400 to 1100 nm. The problem required that contestants be versed in the design, deposition, and measurement of optical filters to achieve good results. Nine samples from five institutions were submitted with total thicknesses between 5.9 and 53.5 µm with between 68 and 1743 layers. The filter spectra were measured by three independent laboratories. The results were presented in

June 2022 at the Optical Interference Coatings Conference in Whistler, B.C., Canada. For more information: https://nrc-publications.canada.ca/eng/view/object/?id=9d04614d-7921-4903-a33d-f2f81a10f7d3. Contact: Daniel Poitras, daniel.poitras@nrc-cnrc.gc.ca.

INTEGRATION OF A CONSTRUCTED LAMP-BASED SPECTRAL CALIBRATION STATION INTO A RADIOMETRY COURSE

CORM member Leanne Robinson, a recent graduate of the Rochester Institute of Technology in Motion Picture Sciences, recently co-authored a paper presented at the 17th Conference on Education and Training in Optics and Photonics, which was published by SPIE. It is an excellent example of how to integrate student learning experiences into university laboratory measurement capabilities. The paper can be found online at: https://doi.org/10.1117/12.2670796. The abstract is below:

Radiometric calibration is the process of assigning engineering units and uncertainties to digital counts such that an instrument reading (or image format) conforms to a recognized standard such as radiance. One way to implement spectral radiometric calibration is through the use of an integrating sphere or FEL Lamp/Lambertian plaque setup. Calibrated integrating spheres can be expensive thus in this paper, we (i.e., student and faculty advisor) set out to design, construct, test, and evaluate a NIST-traceable FEL Lamp/plaque setup (as a senior project) for in-house spectral calibration as well as integration into the undergraduate and graduate curriculum at the Center for Imaging Science at the Rochester Institute of Technology. We compared FEL Lamp/plaque spectral radiance measurements to that of a NIST-traceable 20-inch integrating sphere with an uncertainty of 1%. Results showed our set up (with a 1% uncertainty 1000-watt FEL lamp) was on-par with the integrating sphere. As mentioned, this calibration station will be integrated into the lab section of RIT's radiometry course to educate students on how to conduct spectral radiometric calibration, independent of an integrating sphere. There is much to convey to students from classroom lecture-based radiometric concepts on calibration to the actual use of such a station in the lab. This includes, setting up the source, alignment, operation and usage, measurements, etc. Our take-away is to illustrate how others can replicate our station so as to teach students about hands-on spectral radiometric calibration. We will also discuss our success and failures related to the project. As someone now in the "radiometry" industry, thanks to this project, I would like to like to share our project with the educating community.

UPCOMING IES MEETINGS CALENDAR

The Illuminating Engineering Society (IES) is sponsoring the following meetings and conferences in the coming months (specific details are subject to change; please check the links for the latest information):

Modern Outdoor Lighting in the Court of Public Opinion
Zoom Online Webinar
November 28, 2023
https://www.ies.org/event/modern-outdoor-lighting-in-the-court-of-public-opinion/

Lighting in Hospitality
Zoom Online Webinar
December 14, 2023
https://www.ies.org/event/lighting-in-hospitality/

IES Standards Process
Zoom Online Webinar
January 18, 2024
https://www.ies.org/event/ies-standards-process/

IES 2024 Annual Conference
New York City, NY
August 15-17, 2024
https://www.ies.org/events/annual-conference/

International Commission on Illumination
Commission Internationale de l'Eclairage
Internationale Beleuchtungskommission

Upcoming Events

CIE Australia Lighting Research Conference 2024
University of Melbourne, Carlton, Australia
January 20, 2024
http://www.cie.org.au/calreco2024.html

Other CIE News

CIE Gold Pins are the highest honour awarded by the CIE. Established in 2007, the awards are granted once every four years at the time of the CIE Session. The 2023 awardees are Luc Schlangen (Wyszecki Gold Pin Award: exceptional outstanding contributions in fundamental research), Naomi Miller (Waldram Gold Pin Award: exceptional outstanding contribution in applied illuminating engineering) and Tony Bergen (de Boer Gold Pin Award: distinguished services award for organization/administration). The awards were handed over during an award ceremony at the 30th Quadrennial Session of CIE in Ljubljana in September, 2023. CIE congratulates and thanks the 2023 Gold Pin Awardees.

CIE has issued the following publications in 2023:

- CIE 251:2023 LED Reference Spectrum for Photometer Calibration
- CIE DIS 017-SP2:2023 ILV: International Lighting Vocabulary –Supplement 2: Terms and Definitions for Horticultural Lighting
- CIE TN 014:2023 Example Luminance Measurement Setup for UGR
- CIE TN 015:2023 Second International Workshop on Circadian and Neurophysiological Photoreception
- ISO/CIE 11664-5:2023 Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram
- ISO/CIE 23539:2023 Photometry — The CIE system of physical photometry
- ISO/CIE DIS 23603.2(E):2023 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour
- ISO/CIE DIS 28077(E):2023 Photocarcinogenesis action spectrum (non-melanoma skin cancers)
- ISO/CIE DIS 8995-1:2023 Light and lighting — Lighting of work places —Part 1: Indoor

Visit http://www.cie.co.at for additional information.

OTHER NEWS…

The following events related to lighting are coming up:

Disruptia
Mexico City, Mexico
November 30, 2023
https://lightcollective.net/light/ing/disruptia

Lightapalooza 2024
Phoenix, AZ
February 26-29, 2024
https://lightapalooza.com/

LEDucation 2024
New York, NY
March 19-20, 2024
https://leducation.org/

LightSPEC West
Anaheim, CA
April 17-18, 2024
https://www.lightspecwest.com/

Purpose of the Council for Optical Radiation Measurements (CORM)

The Council for Optical Radiation Measurements is a non-profit organization with the following aims:

1. To establish and publish consensus among interested parties on national, industrial and academic requirements for physical standards, calibration services, and inter-laboratory collaboration programs in the fields of optical radiation measurement, including measurement of the transmittance and reflectance properties of materials, measurement of radiant sources, and characterization of optical detectors used for the measurement of these properties.
2. To establish national consensus on the priorities for these requirements.
3. To maintain liaison with the National Institute of Standards and Technology (NIST) and The National Research Council Canada (NRC) and to advise the Institute(s) of requirements and priorities.
4. To cooperate with other organizations, both public and private, to accomplish these objectives for the direct and indirect benefit of the public at large.
5. To assure that information on existing or proposed standards, calibration services, collaboration programs, and its own activities is widely disseminated to interested parties.
6. To answer inquiries about such standards activities or to forward such inquiries to the appropriate agencies.

Optical Radiation News Editorial Policy

Optical Radiation News (ORN) is published semi-annually each year. ORN reports upcoming technical meetings and news from NIST and other national metrology laboratories. News relating to the status and progress in optical radiation metrology from affiliated organizations, including, but not limited to, the *Commission International De Éclairage* (International Commission on Illumination, CIE), Inter-Society Color Council (ISCC), Lamp Testing Engineers Conference (LTEC), etc., is welcome. No commercial advertising, endorsements, or contributions with commercial content are included in ORN. Unsolicited contributions are subject to review and approval by the editor, CORM publications committee, and /or executive board prior to publication. Anonymous contributions will not be accepted. Contact information for a submission is required and will be published. ORN is included free with CORM membership.

Instructions for Contributing Authors

ORN is published in English. Deadlines for submission of News items and announcements concerning optical radiation metrology are 1 March and 1 September. Items may be submitted to the editor in via fax or e-mail attachments in plain ASCII text or common electronic word processing file formats, preferably Microsoft Word® or Corel WordPerfect®. Contributions should be in 12 point Times New Roman font with simple formatting, e.g., the "Normal" style and template in Word. *Use of complex style templates and formatting is strongly discouraged.* Submissions with high quality pertinent electronic graphics are welcome, however digital photographs and graphics will be reproduced in black-and-white or grayscale. Graphics included in hardcopy submissions via fax will not be reproduced. Submissions are credited to organizations, rather than individuals.

Policy on Commercial Activities at CORM Conferences

The Council for Optical Radiation Measurements (CORM) does not permit commercial activities in conjunction with technical sessions of CORM conferences and CORM workshops. Commercial activities include, but are not limited to, product exhibition and dissemination or display of advertising in any format. Speakers at CORM conferences and workshops may not use talks for overt commercialization of products. Commercial activities as defined above are permitted for a fee for defined periods prior to social activities associated with the conference or workshop at the discretion of the CORM Board of Directors. Registration requirements, details of the structure of the allowed activities and fees are (event and site) specific.

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