

PROCEEDINGS OF SPIE

Optical System Contamination: Effects, Measurements, and Control 2012

**Sharon A. Straka
Nancy Carosso
Joanne Egges**
Editors

**13 August 2012
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 8492

Proceedings of SPIE 0277-786X, V.8492

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Optical System Contamination: Effects, Measurements, and Control 2012, edited by Sharon A. Straka,
Nancy Carosso, Joanne Egges, Proc. of SPIE Vol. 8492, 849201 · © 2012 SPIE
CCC code: 0277-786/12/\$18 · doi: 10.1117/12.2013717

Proc. of SPIE Vol. 8492 849201-1

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Optical System Contamination: Effects, Measurements, and Control 2012*, edited by Sharon A. Straka, Nancy Carosso, Joanne Egges, Proceedings of SPIE Vol. 8492 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN: 0277-786X

ISBN: 9780819492098

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

Copyright © 2012, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/12/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID Number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID Number.

Contents

- v *Conference Committee*
- vii *Introduction*

SESSION 1 CONTAMINATION, OPTICAL, AND THERMAL COATINGS DEVELOPMENT, TESTING, AND MEASUREMENTS

- 8492 02 **Chromate conversion coating: Iridite 14-2 thermal/optical characterization** [8492-1]
M. Rodriguez, NASA Goddard Space Flight Ctr. (United States)
- 8492 03 **Development and testing of molecular adsorber coatings** [8492-2]
N. S. Abraham, M. M. Hasegawa, S. A. Straka, NASA Goddard Space Flight Ctr. (United States)
- 8492 06 **Pre-launch testing and evaluation of typical mirror coatings for space optical instruments** [8492-5]
J. B. Heaney, L. R. Kauder, S. C. Freese, SGT, Inc. (United States); M. A. Quijada, NASA Goddard Space Flight Ctr. (United States)

SESSION 2 CONTAMINATION EFFECTS, MEASUREMENT, AND MITIGATION I

- 8492 07 **Measurement of the accumulation of water ice on optical components in cryogenic vacuum environments** [8492-6]
T. M. Moeller, L. M. Smith, F. G. Collins, J. M. Labello, J. P. Rogers, The Univ. of Tennessee Space Institute (United States); H. S. Lowry, D. H. Crider, Arnold Engineering Development Ctr. (United States)
- 8492 08 **Measurement of cryogenic ice sublimation using quartz crystal microbalances** [8492-7]
R. Perry, G. Meadows, L. Mosier, M. Woronowicz, SGT, Inc. (United States)
- 8492 09 **Application of ASTM E-1559 apparatus to study H₂O desorption** [8492-8]
M. Woronowicz, G. Meadows, SGT, Inc. (United States)
- 8492 0A **Evaluation of bakeout effectiveness by optical measurement of a contaminated surface** [8492-9]
H. Yokozawa, S. Baba, E. Miyazaki, Y. Kimoto, Japan Aerospace Exploration Agency (Japan)

SESSION 3 CONTAMINATION EFFECTS, MEASUREMENT, AND MITIGATION II

- 8492 0C **Volatile contaminant materials: relationship between condensate, effluent, and bulk composition** [8492-10]
N. J. Ianno, J. Pu, F. Zhou, Univ. of Nebraska-Lincoln (United States)

- 8492 0D **VUV modification of surfaces to induce film formation** [8492-11]
D. J. Coleman, K. T. Luey, The Aerospace Corp. (United States)
- 8492 0E **On small disturbance ascent vent behavior** [8492-13]
M. S. Woronowicz, SGT, Inc. (United States)
- 8492 0F **Assessment of particle deposition inside payload fairing from launch vehicle plume contribution** [8492-14]
D.-L. Liu, S. V. Didziulis, J. D. Fowler, The Aerospace Corp. (United States)

SESSION 4 CONTAMINATION CONTROL, MONITORING, AND VERIFICATION

- 8492 0H **Next generation nano-contamination monitoring** [8492-15]
S. Kochevar, T. Pietrykowski, D. Rodier, Particle Measuring Systems, Inc. (United States)
- 8492 0I **Comparison of particle sampling results from tape lifts and solvent rinses** [8492-16]
J. Egges, G. Devaud, C. M. Rockwell, B. A. Matheson, Ball Aerospace & Technologies Corp. (United States)
- 8492 0J **Micromachined reference samples for particle counting** [8492-17]
D. P. Taylor, W. W. Hansen, L. Steffeny, C.-T. Chu, The Aerospace Corp. (United States)
- 8492 0K **Investigation of various clean room gloves for cleanliness** [8492-18]
L. Lobmeyer, M. Pirkey, Ball Aerospace & Technologies Corp. (United States)
- 8492 0L **Operations of cleanrooms during a forest fire including protocols and monitoring results** [8492-19]
B. A. Matheson, J. Egges, M. S. Pirkey, L. D. Lobmeyer, Ball Aerospace & Technologies Corp. (United States)

POSTER SESSION

- 8492 0M **Optical throughput model** [8492-20]
L. M. Elasky, S. A. Smallwood, R. P. Galvin, ITT Exelis Inc. (United States)

Author Index

Conference Committee

Program Track Chairs

José Sasián, College of Optical Sciences, The University of Arizona
(United States)

R. John Koshel, Photon Engineering LLC (United States) and College
of Optical Sciences, The University of Arizona (United States)

Conference Chairs

Sharon A. Straka, NASA Goddard Space Flight Center (United States)

Nancy Carosso, NASA Goddard Space Flight Center (United States)

Joanne Egges, Ball Aerospace & Technologies Corporation
(United States)

Conference Program Committee

Mark T. Boies, Research Support Instruments, Inc. (United States)

H. Dewitt Burns, Jr., NASA Marshall Space Flight Center (United States)

Mark S. Crowder, Ball Aerospace & Technologies Corporation
(United States)

Jonathan P. Elders, Raytheon Space & Airborne Systems
(United States)

Carlos E. Soares, The Boeing Company (United States)

David P. Taylor, The Aerospace Corporation (United States)

O. Manuel Uy, The Johns Hopkins University Applied Physics
Laboratory (United States)

Session Chairs

- 1 Contamination, Optical, and Thermal Coatings Development, Testing,
and Measurements

Joanne Egges, Ball Aerospace & Technologies Corporation
(United States)

- 2 Contamination Effects, Measurement, and Mitigation I

Nancy Carosso, NASA Goddard Space Flight Center (United States)

- 3 Contamination Effects, Measurement, and Mitigation II

David P. Taylor, The Aerospace Corporation (United States)

- 4 Contamination Control, Monitoring, and Verification

Michael S. Woronowicz, SGT, Inc. (United States)

Introduction

We sincerely thank the authors, audience, and committee members for making the Optical System Contamination: Effects, Measurements, and Control 2012 Conference an outstanding success. This year, we hosted excellent presentations, papers, a panel discussion, and posters on a variety of interesting topics. The conference topics clearly continue to be of great interest to the community, as there was excellent participation from the audience with respect to the presentation question and answer discussions and the panel discussion.

This year, the conference had four strong sessions on contamination effects, measurements, and control. Some of the topics included: contamination mitigation coatings; testing and evaluation of coatings; contamination measurements in vacuum systems; photopolymerization effects, vent behavior and associated contamination effects, particulate deposition, clean room operations, contamination control monitoring, and material evaluations. Additionally, we had the opportunity to conduct a panel discussion on how to promote the contamination engineering field to better serve our projects, programs, and customers. An informal dinner was also assembled at a local restaurant to further discuss the latest developments in this specialized field in a casual setting.

We would like to thank again our program committee for continuing to promote the conference and soliciting interesting papers from industry. We would also like to thank the contamination engineering community for sharing their work and for active participation in making this conference a success again. Special appreciation goes to our colleagues abroad, who made the long trip to share their expertise in this field. These conference interactions are very beneficial advancing contamination engineering, coatings engineering, and industry collaborations.

The conference will continue in 2014. We highly encourage everyone interested in contamination effects and measurements, cleanliness verification, contamination mitigation, analytical modeling, clean room operations, as well as, coatings development, degradation, testing, and measurements to please submit their work and attend the sessions. It is our goal, in 2014, to expand this conference to multiple days to capture more of the important work being performed in contamination engineering throughout multiple industries. Please encourage your colleagues and industry peers to participate. Also, please feel

free to contact us or anyone on our program committee, if you have any questions, or suggestions to enhance our conference. We look forward to your participation in 2014.

**Sharon A. Straka
Nancy Carosso
Joanne Egges**