ISSN 1044-677X

March–April 1999 Volume 104, Number 2

## Journal of Research of the

# National Institute of Standards and Technology



United States Department of Commerce Technology Administration National Institute of Standards and Technology



The National Institute of Standards and Technology was established in 1988 by Congress to "assist industry in the development of technology . . . needed to improve product quality, to modernize manufacturing processes, to ensure product reliability . . . and to facilitate rapid commercialization . . . of products based on new scientific discoveries."

NIST, originally founded as the National Bureau of Standards in 1901, works to strengthen U.S. industry's competitiveness; advance science and engineering; and improve public health, safety, and the environment. One of the agency's basic functions is to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for comparing standards used in science, engineering, manufacturing, commerce, industry, and education with the standards adopted or recognized by the Federal Government.

As an agency of the U.S. Commerce Department's Technology Administration, NIST conducts basic and applied research in the physical sciences and engineering, and develops measurement techniques, test methods, standards, and related services. The Institute does generic and precompetitive work on new and advanced technologies. NIST's research facilities are located at Gaithersburg, MD 20899, and at Boulder, CO 80303. Major technical operating units and their principal activities are listed below. For more information contact the Publications and Program Inquiries Desk, 301-975-3058.

#### **Office of the Director**

- National Quality Program
- International and Academic Affairs

#### **Technology Services**

- Standards Services
- Technology Partnerships
- Measurement Services
- Technology Innovation
- Information Services

#### **Advanced Technology Program**

- · Economic Assessment
- Information Technology and Applications
- Chemical and Biomedical Technology
- · Materials and Manufacturing Technology
- Electronics and Photonics Technology

#### Manufacturing Extension Partnership Program

- Regional Programs
- National Programs
- Program Development

#### **Electronics and Electrical Engineering Laboratory**

- Microelectronics
- Law Enforcement Standards
- Electricity
- Semiconductor Electronics
- Electromagnetic Fields<sup>1</sup>
- Electromagnetic Technology<sup>1</sup>
- Optoelectronics<sup>1</sup>

#### Chemical Science and Technology Laboratory

- Biotechnology
- Physical and Chemical Properties<sup>2</sup>
- Analytical Chemistry
- Process Measurements
- Surface and Microanalysis Science

#### **Physics Laboratory**

- Electron and Optical Physics
- Atomic Physics
- Optical Technology
- Ionizing Radiation
- Time and Frequency<sup>1</sup>
- Quantum Physics<sup>1</sup>

### Materials Science and Engineering Laboratory

- · Intelligent Processing of Materials
- Ceramics
- Materials Reliability<sup>1</sup>
- Polymers
- Metallurgy
- NIST Center for Neutron Research

### Manufacturing Engineering Laboratory

- Precision Engineering
- Automated Production Technology
- Intelligent Systems
- Fabrication Technology
- · Manufacturing Systems Integration

#### **Building and Fire Research** Laboratory

- Structures
- Building Materials
- Building Environment
- · Fire Safety Engineering
- Fire Science

#### Information Technology Laboratory

- Mathematical and Computational Sciences<sup>2</sup>
- · Advanced Network Technologies
- Computer Security
- Information Access and User Interfaces
- High Performance Systems and Services
- Distributed Computing and Information Services
- Software Diagnostics and Conformance Testing

<sup>&</sup>lt;sup>2</sup>Some elements at Boulder, CO.

## Journal of Research of the National Institute of Standards and Technology

Volume 104

Number 2

**Board of Editors** 

Barry N. Taylor Chief Editor

Nancy M. Trahey, Technology Services
Loucas G. Christophorou, Electronics and Electrical Engineering Laboratory
Theodore V. Vorburger, Manufacturing Engineering Laboratory
Cynthia J. Zeissler, Chemical Science and Technology Laboratory
Ronald Collé, Physics Laboratory
Cynthia K. Montgomery, Materials Science and Engineering Laboratory
Nicos S. Martys, Building and Fire Research Laboratory
Alan H. Goldfine, Information Technology Laboratory
Daniel W. Lozier, Information Technology Laboratory
Matt Young, Boulder Laboratories

Julian M. Ives Managing Editor, and Technical Production Editor

**Ilse E. Putman, Nancy L. Gogniat, Karen J. Wick** Electronic Composition



U.S. Department of Commerce—William M. Daley, Secretary Technology Administration—Gary R. Bachula, Acting Under Secretary for Technology National Institute of Standards and Technology—Raymond G. Kammer, Director Available online

March-April 1999

http://www.nist.gov/jres

The *Journal of Research of the National Institute of Standards and Technology*, the flagship periodic publication of the national metrology institute of the United States, features advances in metrology and related fields of physical science, engineering, applied mathematics, statistics, and information technology that reflect the scientific and technical programs of the Institute. The *Journal* publishes papers on instrumentation for making accurate measurements, mathematical models of physical phenomena, including computational models, critical data, calibration techniques, well-characterized reference materials, and quality assurance programs that report the results of current NIST work in these areas. Occasionally, a Special Issue of the *Journal* is devoted to papers on a single topic. Also appearing on occasion are review articles and reports on conferences and workshops sponsored in whole or in part by NIST.

ISSN 1044-677X	Coden: JRITEF	Library of Congress Catalog Card No.: 89-656121
----------------	---------------	---

United States Government Printing Office, Washington: 1999

# Contents

Articles

Available online http://www.nist.gov/jres

Comparison of the NIST and BIPM Air-Kerma Standards for Measurements in the Low-Energy X-Ray Range	D. T. Burns, P. Lamperti, and M. O'Brien	135
Validation of New Instrumentation for Isotope Dilution Mass Spectrometric Determination of Organic Serum Analytes	P. Ellerbe, C. S. Phinney, L. T. Sniegoski, and M. J. Welch	141
Crystal Structures and Reference Powder Patterns of BaR <sub>2</sub> ZnO <sub>5</sub> (R = La, Nd, Sm, Eu, Gd, Dy, Ho, Y, Er, and Tm)	J. A. Kaduk, W. Wong-Ng, W. Greenwood, J. Dillingham, and B. H. Toby	147
Estimation of Concentration and Bonding Environment of Water Dissolved in Common Solvents Using Near Infrared Absorptivity	Brian Dickens and Sabine H. Dickens	173
Near Infrared 45°/0° Reflectance Factor of Pressed Polytetrafluoroethylene (PTFE) Powder	Maria E. Nadal and P. Yvonne Barnes	185
A Fast Method of Transforming Relaxation Functions Into the Frequency Domain	Frederick I. Mopsik	189
Manufacturer's CORBA Interface Testing Toolkit: Overview	David Flater	193

## News Briefs

GENERAL DEVELOPMENTS	
Guide to Calibration Service for Capacitance Standards Available New Directory Lists Federal Certification and Related Programs Solidification Sensor for Turbine Blade Castings Developed	
NIST's Rumble Elected President of CODATA New Apparatus Measures Thermal-Barrier Coatings Better A Novel Wear Tester for Biomaterials Evaluation	202
NIST-Developed Validation System for Triple Data Encryption Standard Algorithm Approved as American National Standards Institute (ANSI) Guideline Patent Awarded to NIST Scientist Prefixes for Binary Multiples	203

Medical Physicists Publish Recommendations on Radiochromic Film Dosimetry Nondestructive Radioassay Technique Developed by NIST for Fluid-Filled Balloon Catheters	204
NIST Develops Glow-Discharge Resonance Ionization Mass Spectrometry for Measurement of Environmental Radioactivity Real-Time Characterization of Lithium Transport in Thin-Films	205
NIST Commences Accreditation/Oversight of Commercial Proficiency Testing Study Providers for EPA/States Water Programs New Method Developed for Acquiring Interface Vibrational Spectra	206
Irreversible Magnetic Field Dependence of the Magnetic Structure in GMR Co/Cu Multilayers Experiments Show Feasibility of New Scanning-Probe Microscope Type for High-Resolution Imaging of Fields Encountered in Magnetic Recording NIST Works with Industry to Roadmap Information Technology Needs for the Electronics Industry	207
Standards in Trade Workshops Hosted for Latin America CRADA Signed to Evaluate NIST Ultrasonic Transducer	208
Better Boxes May Mean Reduced Fire Losses Collins Elected ILAC Chair Y2K Help Center Is Open for Business Conference Goal: Making the Web a Lot Less Tangled	209
New Transfer Standard Improves Calibrations for Optical Meters NIST Scientists Demonstrate Highly Directional Atom Laser Doors Opened to New Chemistry Building and NIST's Future	210
1999 National Information Systems Security Conference NIST Proposes Triple DES NIST Facilitates Development of Electronic Books	211
Industry Successfully Evaluating Firewall Products Based on Profiles Developed by NIST and the National Security Agency (NSA) NIST's Interaction Automation Software Used at the South Pole Computer Model Predictions Aid in Decision to Ignite Ship A New Lubricant Concentration Measurement Technique for Pool Boiling	212
Analyzing Neutron Polarization With Polarized <sup>3</sup> He Analyzing Images from Near-Field Optical Microscopy	213
NIST Advanced Radiometer Selected for NASAs Triana Mission High Precision and Sensitivity Achieved Using Midinfrared Cavity Ring Down Spectroscopy First Accurate Vacuum UV Refractive Index Measurements of Calcium Fluoride	214
A Free-Fall Determination of <i>G</i> , the Newtonian Constant of Gravitation Hexapod Kinematic Errors Reduced NIST Researchers Develop Advanced Micromachining Process That Allows Companies Without On-Site Fabrication Facilities to Manufacture MEMS	215

NIST Researchers Develop Standard Reference Data for Important Plasma Processing Gas Databases Now on the Job to Help Keep Gas Flowing	220
	220
New Infrared Spectral Database Introduced to Support Remote Sensing Applications	220
STANDARD REFERENCE DATA	
NIST Standard Reference Material (SRM) Used by the International Atomic Energy Agency Training Programs	
STANDARD REFERENCE MATERIALS	219
Proceedings of the NATO- and NIST-Sponsored Meeting on DNA Damage and Repair Published	219
Optical Spectroscopic Method Found Useful in Determining Phase Separation in Indium Gallium Nitride Films	210
Neutron Scattering Reveals the Mechanism Behind Thermal Contraction	218
Internet-Based Test Service Enables Customers to Interact With NIST Staff While Calibrations Are Performed Refractive Index Profiling of Optical Fibers and Planar Waveguides With Unprecedented Resolution	217
Experimental Results Demonstrate that Power Electronic Interconnect Parasitics Can Be Accurately Characterized With Time Domain Reflectometry Iterative IR Approach for Extracting Values of Intrinsic Optical Constants of Silicon Reduces Uncertainty by a Factor of 10	216