



FOCUS ISSUE

Nitrides and Oxynitride Materials



CAMBRIDGE UNIVERSITY PRESS

Journal of MATERIALS RESEARCH

JOURNAL OF MATERIALS RESEARCH (JMR) is an interdisciplinary journal serving the materials research community through publication of original research articles and invited reviews encompassing the synthesis, processing, characterization, properties, and theoretical description of materials

JMR publishes new research that demonstrates a significant impact or advance of scientific understanding of interest to the materials research community. Engineering studies and applications to commercial products are beyond the scope of **JMR** and should be submitted elsewhere. Manuscripts that report data without giving an analysis, interpretation, or discussion are only acceptable if the data are sufficiently important that publication is expected to lead to significant new studies or advancements in science or technology.

Manuscripts must be submitted to the *Journal of Materials Research* electronically via ScholarOne manuscripts, at the following website address: http://mc.manuscriptcentral.com/jmr. Electronic submission expedites the review process and also allows authors to track the status of their manuscripts at any time. Complete instructions are available on the ScholarOne site and authors will be prompted to provide all necessary information.

Manuscripts must be prepared in English, using a word processing program, formatted to fit $8\frac{1}{2} \times 11$ in. paper, and saved as .doc, .pdf, .rtf, or .ps files. Separate graphics files (.eps and .tif) must be uploaded for each figure. Authors may also upload .xls or .ppt supplemental files as part of the manuscript submission process. All of these files will be converted to .pdf format. Detailed instructions are available on the submission web site. During submission, authors must enter all coauthor names and e-mail addresses. Manuscripts will not be considered for peer review until this information is provided. Authors must also enter manuscript keywords using the JMR keyword list (located on the submission web site). Authors who are not fluent in English must have their manuscript edited for correct English grammar and sentence structure before submission.

Authors are expected to follow the conventional writing, notation, and illustration style prescribed in *Scientific Style and Format: the CSE Manual for Authors, Editors and Publishers, 7th edition, 2006.* Authors should also study the form and style of printed material in this journal. SI units should be used. Authors should use an identical format for their names in all publications to facilitate use of citations and author indexes.

Manuscripts are accepted with the understanding that they represent original research, except for review articles, and that they have not been copyrighted, published, or submitted for publication elsewhere. Authors submitting manuscripts to *JMR* who have related material under consideration or in press elsewhere should send a copy of the related material to *JMR* at the time of submission. While their manuscripts are under consideration at *JMR*, authors must disclose any such related material. To expedite the review process, authors may provide names and contact information for up to four possible reviewers.

Articles are original research reports that include complete, detailed, self-contained descriptions of research efforts. All articles must contain an abstract and section headings.

Commentaries and Reviews: Journal of Materials Research occasionally publishes commentaries on topics of current interest or reviews of the literature in a given area. If an author proposes a review, the title, abstract, and a brief outline should be submitted to the Editorial Office via e-mail for prior consultation on the appropriateness of the topic.

Color policy: It is not necessary for authors to indicate that a figure should be displayed in color online. *JMR* will assume that any author who submits figures in color wants and agrees to their being produced in color online. Figures may be printed in color at the author's request for an additional charge. Color figures must be submitted before the paper is accepted for publication, and cannot be received later in the process. Authors cannot submit two versions of the same figure, one for color and one for black and white; only one version can be submitted. Authors need to carefully consider the following when submitting figures in color that will

be published in color online only: 1) The colors chosen must reproduce effectively and the colors should be distinguishable when printed in black and white; 2) The descriptions of figures in text and captions must be sufficiently clear for both online and print copy. When submitting figures to be in color online only, authors should include the phrase <<color online>> in the figure captions. This is the author's responsibility. Authors will see these color figures when viewing their author page proofs on screen. Authors should always print their page proofs in black and white to see how they will appear in print. Authors will NOT be allowed to submit color figures to replace black and white figures in the page proof stage. To maximize the probability that figures will be published in color online and also print as good quality black and white or grayscale graphics, authors are encouraged to follow these figure submission guidelines: 1) Submit a color graphic in Tagged Image File Format (.tif); 2) Submit color graphics with a resolution of at least 300 dpi (600 dpi if there is text or line art in the figure); 3) Submit color graphics in CMYK format; 4) Submit figures sized to fit the actual column or page width of the journal so that reduction or enlargement is not necessary; 5) Submit multipart figures in one single electronic file.

Copyright © 2015, Materials Research Society. All rights reserved. No part of this publication may be reproduced, in any form or by any means, electronic, photocopying, or otherwise, without permission in writing from Cambridge University Press. Policies, request forms and contacts are available at: http://www.cambridge.org/rights/permissions/permission. htm. Permission to copy (for users in the USA) is available from Copyright Clearance Center http://www.copyright.com, email: info@copyright.com.

Journal of Materials Research Subscription Prices (2015) [includes on-line web access]			
[includes on-line web access]	USA and Poss.	Non-US	Online Only
MRS Regular and Student Members	\$260.00	\$334.00	\$100.00
Institutions	\$1863.00	\$1863.00	\$1681.00

Journal of Materials Research (ISSN: 0884-2914) is published twenty-four times a year by Cambridge University Press, 32 Avenue of the Americas, New York, NY 10013 – 2473 for the Materials Research Society. Periodical Postage Paid in New York, NY and additional mailing offices. POSTMASTER: Send address changes to Journal of Materials Research, c/o Journals Dept., Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10994-2113, USA.

Subscriptions, renewals, address changes, and single-copy orders should be addressed to Subscription Fulfillment, *Journal of Materials Research*, Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10994-2133, USA (for USA, Canada, and Mexico); or Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge, CB2 8RU, England (for UK and elsewhere). Allow at least six weeks advance notice. For address changes, please send both old and new addresses and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing journal issues will be honored without charge only if received within six months of the issue's actual date of publication; otherwise, the issue may be purchased at the single-copy price.

Reprints of individual articles in *Journal of Materials Research* may be ordered. For information on reprints, please contact Cambridge University Press. Reprints of complete back issues older than the prior volume year may be ordered on an individual basis via the Cambridge Journals Online website. To determine availability, visit the appropriate page for the *JMR* back issue desired (www.journals.cambridge.org/jmr).

Individual member subscriptions are for personal use only.

CODEN: JMREEE ISSN: 0884-2914

https://doi.org/10.1557/jmr.2015.301 Published online by Cambridge University Press

Journal of

MATERIALS RESEARCH

Editor-in-Chief: Gary L. Messing, Ceramic materials, The Pennsylvania State University, USA

Associate Editor, Adrian Mann, Biomaterials, Rutgers University, USA

Associate Editor, Jürgen Eckert, Metallic materials, IFW Dresden, Germany

Associate Editor, Linda S. Schadler, Polymeric materials, Rensselaer Polytechnic Institute, USA

Guest Editors for Focus Issue: Nitrides and Oxynitride Materials

Joan Redwing, The Pennsylvania State University, USA

Zoltan Lences, Institute of Inorganic Chemistry, Slovak Academy of Sciences, Slovakia

Rong-Jun Xie, National Institute for Materials Science, Tsukuba, Japan

Tania Paskova, North Carolina State University, USA

2015 Principal Editors:

Lennart Bergström, Materials processing, Colloidal science, Stockholm University, Sweden

Edwin A. Chandross, *Organic materials*, *Materials Chemistry LLC*, *USA*

Xiaobo Chen, Photocatalysis and batteries, University of Missouri-Kansas City, USA

Yang-T. Cheng, Mechanical behavior, Electrochemical energy storage, University of Kentucky, USA

Paolo Colombo, Preceramic polymers, Porous ceramics, University of Padova, Italy; The Pennsylvania State University, USA

Franz Faupel, Functional nanomaterials, VPD, Metallic glasses, University of Kiel, Germany

Amit Goyal, Superconductors, Photovoltaics, 2D materials, Self-assembly, UT-Battelle/Oak Ridge National Laboratory, USA

Andrea M. Hodge, Nanostructured metals, Nanomechanics, PVD, University of Southern California, USA

Himanshu Jain, Inorganic glass, Optical, Electrical properties, Lehigh University, USA

Suk-Joong L. Kang, Sintering, Ceramics, Microstructure, Korean Advanced Institute of Science and Technology, Republic of Korea

C. Robert Kao, Metallic materials, Diffusion and joining, National Taiwan University, Taiwan

Edson Roberto Leite, Materials chemistry, Nanocrystals, Synthesis, Universidade Federal de São Carlos, Brazil

Jörg Löffler, Metallic materials/synthesis and properties, ETH Zurich. Switzerland

Sanjay Mathur, Oxide nanomaterials, Coatings, Nanotoxicity, University of Cologne, Germany

Michael E. McHenry, Magnetic materials, Carnegie Mellon University, USA

Scott T. Misture, In-situ diffraction, Electrochemically active ceramics, Alfred University, USA

Paul Muralt, Thin films, Piezoelectric and ferroelectric materials, Ecole Polytechnique Federale de Lausanne, Switzerland Akira Nakajima, Photocatalysis, Surface wettability, Ceramic processing, Tokyo Institute of Technology, Japan

Cewen Nan, Ferroelectric, Multiferroic materials, Tsinghua University, China

George M. Pharr, Mechanical behavior, Nanoindentation, University of Tennessee, USA

Ian M. Reaney, Electroceramics, TEM, Thin films, The University of Sheffield, United Kingdom

Joan M. Redwing, Semiconductor thin films and nanowires, Processing, The Pennsylvania State University, USA

Edward M. Sabolsky, Electroceramics, Electrochemistry, Processing, West Virginia University, USA

Winston Schoenfeld, Optical materials, University of Central Florida, USA

Don W. Shaw, Epitaxy, Vapor deposition, Semiconductors, The University of Texas at Dallas, USA

Susan B. Sinnott, Computational materials science, University of Florida, USA

Eric A. Stach, Materials characterization, Nanostructure growth, Brookhaven National Laboratory, USA

Mauricio Terrones, Nanocarbon, Graphene, 2-D metal chalcogenides, The Pennsylvania State University, USA; Shinshu University, Japan

Terry M. Tritt, Thermoelectrics, Clemson University, USA

José Arana Varela, Functional ceramics, Synthesis, Electro-optical, University of Sao Paulo State, Brazil

William J. Weber, Radiation effects, Nuclear ceramics, University of Tennessee; Oak Ridge National Laboratory, USA

Tao Xie, Polymers, Functional soft materials, Zhejiang University, China

Sam Zhang, Thin films/coatings,

Nanyang Technological University, Singapore

Yanchun Zhou, Structural ceramics, Electronic structure, Aerospace Research Institute of Materials and Processing Technology, China

Editorial Office: Ellen W. Kracht, Publications Manager, Materials Research Society, Warrendale, PA Susan Seibel, JMR Editorial Assistant, Materials Research Society, Warrendale, PA

Kirby L. Morris, JMR Production Assistant, Materials Research Society, Warrendale, PA Eileen M. Kiley, Director of Communications, Materials Research Society, Warrendale, PA

https://doi.org/10.1557/jmr.2015.301 Published online by Cambridge University Press

Journal of MATERIALS RESEARCH

Volume 30, Number 19, October 14, 2015

2845	Introduction	Joan Redwing,	Zoltan	Lences,
		Rong-Jun Xie	Tania P	askova

INVITED FEATURE PAPER

2846-2858	Stress engineering with AIN/GaN superlattices for epitaxial GaN	Jie Su, Eric A. Armour,
	on 200 mm silicon substrates using a single wafer rotating disk	Balakrishnan Krishnan,
	MOCVD reactor	Soo Min Lee,
		George D. Papasouliotis

REVIEWS

2859–2870	A review of in situ surface functionalization of gallium nitride via beaker wet chemistry	Brady L. Pearce, Stewart J. Wilkins, Tania Paskova, Albena Ivanisevic
2871–2880	Structural and optical properties of PA MBE AlGaN quantum well heterostructures grown on <i>c</i> -Al ₂ O ₃ by using flux- and temperature-modulated techniques	Valentin N. Jmerik, Dmitrii V. Nechaev, Sergey Rouvimov, Valentin V. Ratnikov, Peter S. Kop'ev, Mikolai V. Rzheutski, Eugenii V. Lutsenko, Gennadii P. Yablonskii, Maher Aljohenii, Abdulaziz Aljerwii, Ahmed Alyamani,

Sergey V. Ivanov

Lan Zhou, Santosh K. Suram,

Natalie Becerra-Stasiewicz, Slobodan Mitrovic, Kevin Kan, Ryan J.R. Jones, John M. Gregoire

ARTICLES

2928-2933

2881–2892	Polarity of GaN with polar {0001} and semipolar { $10\bar{1}1$ }, { $20\bar{2}1$ }, { $11\bar{2}2$ } orientations by x-ray photoelectron diffraction	Oleksandr Romanyuk, Petr Jiříček, Tania Paskova, Igor Bartoš
2893–2899	Quantitative compositional analysis of $\ln_x \text{Ga}_{1-x}\text{N}/\text{GaN}$ multiquantum wells in light-emitting diodes	Youngji Cho, Jung Sik Park, Jun-Mo Yang, Kyung Jin Park, Yun Chang Park, Jiho Chang, Sang Geul Lee, Kwan-Young Han
2900–2909	In situ stress measurements during direct MOCVD growth of GaN on SiC	Zakaria Y. Al Balushi, Joan M. Redwing
2910–2918	In situ functionalization of gallium nitride powder with a porphyrin dye	Brady L. Pearce, Stewart J. Wilkins, Matthew S. Rahn, Albena Ivanisevic
2919–2927	Synthesis, composition optimization, and tunable red emission of CaAlSiN $_3$:Eu $^{2^+}$ phosphors for white light-emitting diodes	Shu-Xing Li, Xue-Jian Liu, Jia-Qing Liu, Huili Li, Ri-Hua Mao, Zheng-Ren Huang, Rong-Jun Xie

Combining reactive sputtering and rapid thermal processing for

synthesis and discovery of metal oxynitrides

Press	
ridge University	
/ Cambridge	
yed online by	
Publish	
mr.2015.301 Publish	
/10.1557/jmr.2015.301 Published online by Cambridge	
https://doi.org/10.1557/jmr.2015.301 Publish	

2934–2939	Quasiparticle theoretical characterization of electronic and optical properties of the photocatalytic material $Ti_{3-\delta}O_4N$	Mauro Ribeiro Jr.
2940–2948	Thio-oxynitride phosphate glass electrolytes prepared by mechanical milling	Nerea Mascaraque, José Luis G. Fierro, Francisco Muñoz, Alicia Durán, Yusuke Ito, Yoshiaki Hibi, Ryo Harada, Atsutaka Kato, Akitoshi Hayashi, Masahiro Tatsumisago
REVIEW		
2949–2957	Oxidation behavior of vacuum plasma-sprayed hafnium–tantalum nitrides	Bradford C. Schulz, Daniel Butts, Gregory B. Thompson
ARTICLES		
2958–2966	Ultramicroporous silicon nitride ceramics for CO ₂ capture	Cristina Schitco, Mahdi Seifollahi Bazarjani, Ralf Riedel, Aleksander Gurlo
2967–2976	"In situ" XPS studies of laser-induced surface nitridation and oxidation of tantalum	Ruth Lahoz, Juan Pedro Espinós, Francisco Yubero, Agustín Rodríguez González-Elipe, Germán Francisco de la Fuente