

# ENGINEERED CERAMICS

CURRENT STATUS AND  
FUTURE PROSPECTS

EDITED BY  
TATSUKI OHJI • MRITYUNJAY SINGH



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## Current Status and Future Prospects

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Published by John Wiley & Sons, Inc., Hoboken, New Jersey.  
Published simultaneously in Canada.

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***Library of Congress Cataloging-in-Publication Data is available.***

ISBN: 978-1-119-10040-9

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

# ENGINEERED CERAMICS





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# PREFACE

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Since the dawn of human civilization, the discovery of materials has been known to culminate in major turning points in human history. Materials innovations through the ages have transformed societal development and have opened unforeseen possibilities for economic growth and well-being of society. As an increasing global population strives to improve their standards of living, the demand for various products in energy, health care, housing, transportation, and environmental industries also grows rapidly. However, the higher demand and production in all these areas lead to a dramatic increase in the overall consumption of resources and rate of pollution. These factors have been leading to escalation in climate change and creating the risk of irreversible changes in the ecosystem. New technologies and innovative solutions are required to address these societal needs.

This book addresses the critical role of engineered ceramic materials and technologies in solving various societal challenges. It also commemorates the 40th Jubilee of the world premier International Conference on Advanced Ceramics and Composites (ICACC). Over the last four decades, the Engineering Ceramics Division (ECD) of The American Ceramic Society (ACerS) has organized this conference covering wide-ranging topics and identifying key challenges and opportunities for various ceramic technologies in creating sustainable development. The ICACC is the most preeminent international meeting in the area of advanced structural and functional ceramics, composites, and emerging ceramic materials and technologies. Since its first meeting in Cocoa Beach, Florida in 1977, it has experienced tremendous growth in interest and participation from the global ceramic community.

The evolution of the current ECD from the Enamel and Ceramic-Metal Systems (CMS) divisions has a very interesting history. In the 1960s, ACerS was evolving from an industry-based to a technology- and science-based membership organization. It led to the creation of the CMS Division from the Enamel Division in 1961. There was a growing need for high-performance ceramic and metal systems that exceeded the properties of traditional enamels. The CMS Division was formed to represent the society in all matters pertaining to combining ceramic compositions with metals to form coatings, seals, composites, and adhesives. However, during the 1960s and 70s, work on high-performance structural monolithic and composite materials was increasing and, as a result, new meetings to address these advancements emerged. According to records, the attendance at the CMS meetings was dropping and new engineers/scientists in the field were not relating to the traditional name.

The CMS Division, led by Jim Mueller, Jerry Persh, Sy Bortz, John Buckley, Jim McCauley, and many others, initiated the first “Cocoa Beach Conference” on Composite

and Advanced Ceramic Materials in January 1977, where 37 papers (all invited) were presented and approximately 90 people attended. On the waterfront by Frank Wolfe's Beach Side Hotel in Cocoa Beach, the attendees watched the first Titan missile launch from the NASA Kennedy Space Center.

In 1985, the CMS Division changed its name to Engineering Ceramics Division. This name change reflected the division's desire to meet the challenges of advanced material concepts and new engineering systems, including ceramics for energy conversion systems, fiber-reinforced composites, brittle materials design, structural reliabilities, high-temperature components, advanced coatings, tribological parts, ceramic cutting tools, nanocomposites and nanomaterials, biomaterials, porous materials, armor ceramics, geopolymers, ceramic sensors, and advanced processing technologies. With growing interests in these technological fields, the numbers of presented papers and attendees at the Cocoa Beach Conference have increased year by year, reaching approximately 700 papers and more than 900 attendees in 2005. In 2007, the Cocoa Beach Conference moved to its current venue in Daytona Beach, Florida, in order to better accommodate the growing number of attendees and exhibitors. In 2015, the 39th ICACC had more than 14 symposia and several focused sessions with more than 1000 presentations/1100 attendees where nearly half of the attendees were from outside the United States and represented more than 55 countries worldwide.

This conference also features a highly successful Global Young Investigator Forum, where the young investigators and future leaders are heavily involved. The aim of the forum is to bring together young researchers and scientists from around the globe to discuss new approaches in materials synthesis and address societal challenges, and to provide a platform for intensive exchange of ideas, knowledge, and network building. In addition, the international conference also started Engineering Ceramics Summits (Pacific Rim, European Union, and Summit of Americas).

To chronicle and celebrate the 40th anniversary of the conference, we thought that it was appropriate to publish a 40th Jubilee Commemorative Book Volume titled *Engineered Ceramics: Current Status and Future Prospects*. All the ECD Mueller and Bridge Building Award winners, and the past and current ECD Officers were invited to write book chapters. A key feature of this book is the focus on current status and future prospects of various technical topics related to advanced ceramics and composites, as evident from the book title. We hope that the book will offer a vision for future developments and stimulate fresh thinking in this field, as well as meet the needs of the global ceramics community.

We gratefully acknowledge the leadership and contributions of division award winners, ECD leaders, and numerous volunteers from all over the world. Our special thanks to Dr. Jim McCauley for providing historical perspective. We also thank the ACerS staff who have been very helpful and instrumental in organizing this event over the years. We are thankful to the publication and editorial staff of Wiley and ACerS for their excellent support during the preparation of the book. Finally, we would like to extend our warm

welcome to potential members and future attendees to join this exciting conference and become a part of the dynamic and vibrant ECD and ACerS ([www.ceramics.org](http://www.ceramics.org)).

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# CONTENTS

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Preface

ix

List of Contributors

xiii

## PART 1 MATERIALS DESIGN AND CHARACTERIZATION

- 1 AN INTRODUCTION TO MATERIALS BY DESIGN INCLUDING  
A DYNAMIC STRESS ENVIRONMENT** 3

*James W. McCauley*

- 2 CUSTOM MECHANICAL STRENGTH TEST SPECIMENS FOR  
BRITTLE MATERIALS AND THEIR COMPONENTS** 29

*Andrew A. Wereszczak*

- 3 APPLICABILITY OF PROBABILISTIC ANALYSES TO ASSESS  
THE STRUCTURAL RELIABILITY OF MATERIALS  
AND COMPONENTS FOR SOLID-OXIDE FUEL CELLS** 46

*Edgar Lara-Curzio, Miladin Radovic, and Claire R. Luttrell*

- 4 FAILURE OF ION-CONDUCTING MATERIALS BY INTERNAL  
PRECIPITATION UNDER ELECTROLYTIC CONDITIONS** 59

*Anil V. Virkar*

## PART 2 ADVANCED CERAMICS AND CERAMIC MATRIX COMPOSITES

- 5 SILICON NITRIDE CERAMICS** 79

*Stuart Hampshire*

- 6 MICROSTRUCTURAL EVOLUTION AND MECHANICAL/  
THERMAL PROPERTIES OF SILICON NITRIDE CERAMICS** 98

*Tatsuki Ohji and Kiyoshi Hirao*

<b>7</b>	<b>SILICON NITRIDE CERAMICS FOR TRIBOLOGICAL APPLICATIONS</b>	<b>124</b>
	<i>Junichi Tatami and Katsutoshi Komeya</i>	
<b>8</b>	<b>SiC-MATRIX COMPOSITES: TOUGH CERAMICS FOR THERMOSTRUCTURAL APPLICATION IN DIFFERENT FIELDS</b>	<b>142</b>
	<i>Roger R. Naslain</i>	
<b>9</b>	<b>LIFE-LIMITING BEHAVIOR AND LIFE MANAGEMENT OF SiC-BASED COMPOSITES</b>	<b>160</b>
	<i>Ronald J. Kerans</i>	
<b>10</b>	<b>ADVANCED ENVIRONMENTAL BARRIER COATINGS FOR SiC/SiC CERAMIC MATRIX COMPOSITE TURBINE COMPONENTS</b>	<b>187</b>
	<i>Dongming Zhu</i>	
<b>11</b>	<b>CARBON COMPOSITES WITH CONTROLLED MICROSTRUCTURES</b>	<b>203</b>
	<i>Lalit Mohan Manocha</i>	
<b>12</b>	<b>THERMAL PROTECTION MATERIALS AND SYSTEMS: AN OVERVIEW</b>	<b>224</b>
	<i>Sylvia M. Johnson</i>	
<b>PART 3 NOVEL CERAMIC PROCESSING AND INTEGRATION TECHNOLOGIES</b>		
<b>13</b>	<b>PROGRESS IN ADVANCED CERAMICS RESEARCH ENABLED BY NOVEL PROCESSING AND MATERIALS TECHNOLOGIES</b>	<b>247</b>
	<i>Yoshinari Miyamoto</i>	
<b>14</b>	<b>REACTION-FORMING OF CERAMIC COMPOSITES USING METALLIC ALUMINUM</b>	<b>261</b>
	<i>Rolf Janssen, Nahum Travitzky, Peter Greil, and Nils Claussen</i>	
<b>15</b>	<b>PROCESSING AND MORPHOLOGY CONTROL OF POROUS CERAMICS</b>	<b>276</b>
	<i>Manabu Fukushima, Paolo Colombo, and Yu-ichi Yoshizawa</i>	

<b>16</b>	<b>INTEGRATION CHALLENGES IN ALTERNATIVE AND RENEWABLE ENERGY SYSTEMS</b>	<b>291</b>
	<i>Mrityunjay Singh, Rajiv Asthana, and Kun-Lin Lin</i>	
<b>17</b>	<b>FREE FORM FABRICATION OF CERAMICS COMPONENTS BY THREE-DIMENSIONAL STEREOLITHOGRAPHY</b>	<b>330</b>
	<i>Soshu Kiriwara</i>	
<b>18</b>	<b>JOINING AND INTEGRATION OF SILICON CARBIDE-BASED CERAMICS AND COMPOSITES FOR HIGH-TEMPERATURE STRUCTURAL APPLICATIONS</b>	<b>352</b>
	<i>Michael C. Halbig and Mrityunjay Singh</i>	
<b>PART 4    MULTIFUNCTIONAL CERAMICS</b>		
<b>19</b>	<b>CURRENT TRENDS IN CERAMIC TECHNOLOGIES AND SYSTEMS</b>	<b>383</b>
	<i>Alexander Michaelis, Michael Stelter, Hagen Klemm, Ingolf Voigt, and Ralf Krieger</i>	
<b>20</b>	<b>OXIDE CERAMICS: THE ROLE OF SURFACE AND GRAIN BOUNDARIES FOR RELIABLE FUNCTIONAL APPLICATIONS</b>	<b>415</b>
	<i>Jose Arana Varela, Marcelo Ornaghi Orlandi, Eliana Navarro dos Santos Muccillo, and Reginaldo Muccillo</i>	
<b>21</b>	<b>INTEGRATED STRATEGY TO DISCOVER COMPLEX CERAMICS WITH EXTREMELY LOW THERMAL CONDUCTIVITY</b>	<b>427</b>
	<i>Jingyang Wang, Zhilin Tian, and Luchao Sun</i>	
<b>22</b>	<b>CHEMICALLY BONDED PHOSPHATE CERAMICS: STABILIZATION OF SECONDARY WASTES STREAMS</b>	<b>445</b>
	<i>Dileep Singh, Roopa Ganga, Jose Gaviria, and Yusuf Yusufoglu</i>	
<b>23</b>	<b>PERSPECTIVES OF NANOSTRUCTURED METAL OXIDES AND THEIR HETEROSTRUCTURES IN PHOTOELECTROCHEMICAL WATER SPLITTING FOR SOLAR HYDROGEN PRODUCTION</b>	<b>457</b>
	<i>Sanjay Mathur, Thomas Fischer, Yakup Gönüllü, Myeongwhun Pyeon, and Meng Wang</i>	
	<b>Index</b>	<b>497</b>



