

Contents

Preface xiii

The Genesis of the First World Congress on Microwave
Processing: A Personal Viewpoint..... xxiii
B. Krieger

Microwave Processing—Status, Challenges, and Opportunities

Microwave Processing: Triumph of Applications Driven Science in
WC-Composites and Ferroic Titanates..... 3
Rustom Roy, D. Agrawal, J.P. Cheng, and M. Mathis

Dielectric Heating: EPRI's Perspective on the Market and the
Technology 27
Clark Gellings

Principles of Industrial Microwave and RF Heating 41
Robert F. Schiffman

Microwave Processing of Materials 61
D.E. Clark, W.H. Sutton, and D.A. Lewis

Microwave/Material Interactions and Non-Thermal Effects

What Form of Motion Gives Rise to Dielectric Response at
Microwave Frequencies?..... 99
L.A. Dissado and R.M. Hill

A Microwave Effect: Molecular Level Microwave Study of
Water Vapor..... 107
Martin Vala and Jan Szczepanski

Mixing Rules for the Dielectric Properties of Solvent Mixtures at
Microwave Frequencies 115
Janfeng Lou, T. Alan Hatton, and Paul E. Laibinis

Electrochemical Processes in Ceramics: Overview and Correlation with Microwave Effects	123
Joachim Maier and Janez Jamnik	
Electric Field Intensification in Spherical Neck Ceramic Microstructures During Microwave Sintering	135
J.P. Calame, K. Rybakov, Y. Carmel, and D. Gershon	
Thermal and Nonthermal Interactions Between Microwave Fields and Ceramics	143
John H. Booske, Reid F. Cooper, Samuel A. Freeman, Binshen Meng, Kirill I. Rybakov, and Vladimir E. Semenov	
A Microstructural Approach to the Origin of "Microwave Effects" in Sintering of Ceramics and Composites	153
M. Willert-Porada	
The Question of Non-Thermal Effects in the Rate Enhancement of Organic Reactions by Microwaves	165
R.N. Gedye	
Comparison of Microwave and Thermal Reaction Kinetics Via In-Situ FTIR Spectroscopy	173
William V. Corso and Jovan Mijovic	
Infrared Spectroscopic Analysis of Matrix Isolated Tetraethylorthosilicate (TEOS): Understanding the Effect of Microwave Irradiation on the Sol-Gel Process	185
Christine M. Wehlburg, Martin T. Vala, Jan Szczepanski, and J. Mark Moore	
Effects of Microwave Irradiation on the Osmotic Properties of Human Erythrocyte Membranes	193
Alina I. Hategan, Diana Martin, Alina S. Popescu, C. Oproiu, R. Cramariuc, A. Margaritescu, and Vasile V. Morariu	
Advances in the Modeling of Microwave and RF and Hot Air Drying of Materials	201
Nguyen Tran and Andrew Piotrowski	
 Processing and Control Equipment	
A New Applicator Design for Microwave Processing of Zeolites	217
Frank Demmerle, Werner Wiesbeck, and Christian Stenzel	
Analysis and Optimization of Microwave Heating Applicators Using Finite Difference Time Domain	225
J. Haala, F. Demmerle, and W. Wiesbeck	

Semi-Automated Design of Microwave Applicators for Sterilization of Packed Foods	233
Magnus Sundberg	

Control of Microwave Induced Thermal Run-Away Using Temperature Derivative Feedback	241
H. Senko and V.N. Tran	

Non-Invasive Temperature Control by Microwave Radiometry for Industrial Applications	251
V. Tessier, L. Dubois, J.P. Sozanski, L. Prevors, M. Chive	

Radio Frequency Processing

RF Heating, an Old Technology with a Future	261
Peter L. Jones	

Recent Developments in Radio Frequency Technology	269
A.C. Metaxas	

The Development of 503 RF Technology in Industry	277
Jean-Paul Bernard	

Millimeter-Wave Processing

Millimeter Wave Processing of Alumina Compacts	287
Ralph W. Bruce, Arne W. Fliflet, Richard P. Fischer, David Lewis, III, Barry A. Bender, Gan-Moog Chow, Roy J. Rayne, Lynn K. Kurihara and Paul E. Schoen	

Intense High-Frequency Gyrotron-Based Microwave Beams for Material Processing	295
Thomas W. Hardek, Wayne D. Cooke, Joel D. Katz, William L. Perry and Daniel E. Rees	

MM-Wave Processing of Ceramics	303
G. Link, W. Bauer, A. Weddigen, H-J. Ritzhaupt-Kleissl, and M. Thumm	

Study of Ceramic Heating and Sintering by High-Power Millimeter-Wave Radiation Within JWRI at Osaka University	313
S. Miyake, Y. Setushara, S. Kinoshita, S. Sano, M. Kamai, T. Ohmae, and N. Abe	

Sintering of Piezoceramics Using Millimeter-Wave Radiation	321
Yuri V. Bykov, Anatoli G. Eremeev, Vladislav V. Holoptsev, C. Odemer, Anatoli I. Rachkovskii, and Hans-J. Ritzhaupt-Kleissl	

Microwave Induced Chemical and Plasma Synthesis

- Microwave Induced Chemical Reactions in Synthesis and Catalysis** 331
Steven L. Suib, Elizabeth Vileo, Qihua Zhang, Carolina Marun
and L. Daniel Conde
- Determination of Plutonium in Urine Using Stopped Flow
Microwave Sample Preparation** 341
D. Greenop
- Microwave Assisted Chemical Vapor Infiltration for Ceramic
Matrix Composites** 349
Yan Yin, Jon Binner, and Tom Cross
- Microwave-Assisted Reactions Under Solvent-Free
“Dry” Conditions** 357
Rajender Varma
- The Transition from Capacitive to Inductive to Wave Sustained RF
Discharges.** 367
R.W. Boswell, A. Ellingboe, A.W. Degeling, M. Lieberman, and J. Derouard
- Microwave Plasma Processing of Diamond Coatings for Aerospace
Applications: Deposition, Characterization, and
Performance Evaluation** 375
Ward C. Roman, Willard H. Sutton, Denise A. Tucker, Barbara Walden,
Fred A. Otter, and Michael T. McClure
- Microwave Interaction with Emulsions and its Application to the
Synthesis of Nanostructured Powders and Composites.** 387
Ch. Gerk, C.-W. Schmidt, A. Niesenhaus, and M. Willert-Porada
- Heat Transfer Model of Microwave Enhanced Catalysis** 397
J.R. Thomas, Jr.

Microwave Processing of Polymers

- Selected Issues in the Microwave Processing of Polymers** 409
D. Acierno, L. diMaio, M.E. Frigione, L. Cappetta, M. Feo, V. Fiumara, D. Napoli,
V. Pierro, I.M. Pinto and M. Ricciardi
- Microwave Radiation in Polymerization: Its Effect on the
Molecular Weight of PMMA, PMA, and PS** 417
J. Jacob, F.Y.C. Boey, and L.H.L. Chia
- Polymerization Under Microwaves: Fifteen Years of Experience** 425
Albert J. Gourdenne

Preliminary Investigations into the Use of Microwave Energy for Fast Curing of Adhesively Bonded Joints Formed Using Engineering Thermoplastics	437
Elias Siores and Paul Groombridge	

Application of Microwave Curing for the Production of Structural Fiber Reinforced Composite Components Using a High Pressure Autoclave Process	445
Freddy Y. C. Boey	

Microwave Processing of Ceramics

Microwave Joining of SiC Ceramics and Composites	455
Ikhtar Ahmad, Richard Silbergliitt, Yong-Lai Tian, and Joel D. Katz	

Microwave Joining of Alumina Ceramics	465
Alex D. Cozzi, Mattison K. Ferber, and David E. Clark	

Microwave Welding of Alumina Ceramic Using a Ridge Waveguide	475
Prasad K.D.V. Yarlagadda, A. Ahmed, C.T. Soon, and E. Siores	

Conventional and Microwave Preparation of the Al_2O_3/Cr_2O_3 (SS) Pink Pigment	483
Frederica Bondioli, Anna Maria Ferrari, Cristina Leonelli, Cristina Siligardi and Tiziano Manfredini	

Pressureless Microwave Sintering of Metal-Ceramic Functionally Gradient Materials	491
R. Borchert and M. Willert-Porada	

Rapid Microwave Processing and Production of Carbon-Carbon Composites	499
J. Buckley, R. Bryant, M. Long, A. Buchman, and J.R. Gleason	

Applications of Microwave Processing in Ceramics and Waste Remediation	507
D.E. Clark, D.C. Folz, R.L. Schulz, A. Boonyapiwat, R.R. Di Fiore, G. Darby, K. Leiser, and R.M. Hutcheon	

Microwave Sintering of Silicon Nitride with Rare Earth Sesquioxide Additions	515
Masayuki Hirota, Manuel E. Brito, Kiyoshi Hirao, Koji Watari, Motohiro Toriyama, and Takaaki Nagaoka	

Microwave Processing of Zeolites	523
H. Kosslick, H-L. Zubowa, U. Lohse, H. Landmesser, R. Fricke, and J. Caro	

Microwave Binder Burn-Out for Batch Processing of Al_2O_3 , $\text{Al}_2\text{O}_3/\text{SiC}$ Platelet, and $\text{Al}_2\text{O}_3/\text{ZrO}_2$ Particle Powder Compacts	539
Ki-Yong Lee, Eldon D. Case, and Jes Asmussen, Jr.	

Microwave Firing of Heavy Clay Bodies	547
Garth V.A. Tayler, Michael Hamlyn, and Michael Anderson	

A Combined Microwave and Electric Radiant Heating System for Firing Ceramics	555
Michael G. Hamlyn, Neil A. Hart, and Nigel G. Evans	

Microwave Waste Remediation, Regeneration and Recovery

Plasma Treatment of Halocarbons—Diagnostic and Waste Destruction Applications	565
J. Amouroux, K. Coulibaly, M.F. Renou-Gonnord, and H. Lancelin	

Regeneration of Exhausted Absorbents by Microwaves	577
Dieter Bathen and Henner Schmidt-Traub	

The Benefits of Microwave Regeneration of CIP Granular Activated Carbon	585
S.M. Bradshaw, E.J. van Wyk, and J.B. de Swardt	

Ultrapyrolysis of Chlorodifluoromethane in a Fluidized Bed Reactor Heated by Microwave Energy	593
Hyung Chun Kim, Hee Young Kim, and Seong Ihl Woo	

Crude Oil Emulsion Separation Rate Enhancement with High Frequency Energy	601
Edward R. Peterson	

Microwave Treatment of Biomedical Waste Provides a Cost-Effective Alternative to Incineration	611
Terry Strack, Maura Ryan, Rodney Dobson, and Mark Taitz	

Overview of Microwave and High-Frequency Energy for Hazardous Waste Processing	619
W.-M. Van Loock	

Microwave Technology for Waste Management Applications: Treatment of Discarded Electronic Circuitry	627
G.G. Wicks, D.E. Clark, and R.L. Schulz	

Scale-up and Commercialization

Drying Pulped Coffee Cherry Beans by Means of Heated Air Assisted by Microwaves	641
M.L. Cunha, M.W. Canto, and A. Marsaioli, Jr.	
Microwave Processing of Continuous Wide Webs	651
David A. Lewis, Stanley J. Whitechair, William V. Corso, and Alfred Viehbeck	
Some Aspects of Microwave Application in the Forest Industry	659
Grigori Torgovnikov and Peter Vinden	
Microwave-Assisted Firing of Ceramics	671
Ruth Wroe	
Application of Microwave Energy in Processing of Fish and Marine Products	679
Alexander S. Zusmanovskiy and Vadim V. Yakovlev	
Microwave Clothes Dryer	687
Richard Dunham Smith and John P. Kesselring	
Technology Transfer of Dielectric Heating Technology in South African Industry	695
B.C. Langenegger, I.O. Coker, and G.V.A. Tayler	
Statistics of Microwave and HF Power Application in Japan	707
Chokichiro Shibata	

Panel Discussion

Microwave and RF Energy Utilization: An Experts and Audience Perspectives	715
Index	727