

# **CARTS USA 2005**

**Palm Springs, California, USA  
21-24 March 2005**

**ISBN: 978-1-62748-086-4**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2005) by the Electronic Components Industry Association (ECIA)  
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact the Electronic Components Industry Association (ECIA)  
at the address below.

Electronic Components Industry Association (ECIA)  
1111 Alderman Drive, Suite 400  
Alpharetta, GA 30005

Phone: (678) 393-9990  
Fax: (678) 393-9998

[rwillis@eciaonline.org](mailto:rwillis@eciaonline.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## SESSION 1: MATERIALS & PROCESSES

<b>1.1 Shrinkage Characteristics of MLCC Electrode Nickel Powders .....</b>	5
<i>D. Yuan, M. Ruscoe, M. Oehlers, H. Aminian, B. Sutherland</i>	
<b>1.2 The Optimization of Carbon and Silver Inks for Low ESR Tantalum Capacitors .....</b>	11
<i>M. Sica</i>	
<b>1.3 A New Feedthrough Filter Adhesive Which Produces Robust CTE Performance .....</b>	19
<i>A. Devoe, L. Devoe</i>	
<b>1.4 Electrical Properties of BaTiO<sub>3</sub> Co-Doped with Rare Earth and Mn .....</b>	24
<i>J. Jeong, E. J. Lee, Y. H. Han, J. H. Jeong, J. H. Hwang</i>	
<b>1.5 A New Neutral pH Electroplating Process for Acid Sensitive Electronic Components .....</b>	30
<i>G. Federman, G. Hradil</i>	
<b>1.6 Novel Copper Powders and Flakes for Electronic Applications .....</b>	38
<i>D. Andreeescu, C. Goia, D. Goia, K. Blakely, R. Donn, E. Groat</i>	

## SESSION 2: APPLICATION OF CAPACITORS

<b>2.1 Benchmark of Tantalum Versus Ceramic Capacitors.....</b>	47
<i>J. Pelcak, B. Vrana, T. Zednicek, P. Vasina, C. Kotrba</i>	
<b>2.2 Considerations for Capacitor Selection in FPGA Designs.....</b>	57
<i>S. Weir</i>	
<b>2.3 Aluminum Capacitors for Automotive High Temperature Applications.....</b>	65
<i>H. Post, W. Meinema, D. Rekers</i>	
<b>2.4 Film Technology to Replace Electrolytic Technology .....</b>	71
<i>G. Terzulli, B. Peace</i>	
<b>2.5 Benefits of Using Custom Components in Respect to Film Capacitors and Assemblies .....</b>	78
<i>J. Glazebrook, R. Anderson</i>	
<b>2.6 High Crystalline Segmented Polypropylene Capacitors Offer Increased Energy Density .....</b>	84
<i>R. Kerrigan</i>	
<b>2.7 Diamond-Like Carbon Capacitors for High Voltage High Energy Density Operations.....</b>	89
<i>R. Wu, H. Kosai, M. Carter, M. Rumler, S. Fries-Carr, J. Weimer, T. Furmaniak, E. Barshaw, S. Scozzie, R. Jow, R. Garrison, F. Warnock</i>	

## SESSION 3: LEAD-FREE IMPACT ON ELECTRONICS

<b>3.1 Effects of Lead-Free Solders on Flex Performance.....</b>	97
<i>B. Long, M. Prevallet, J. Prymak</i>	
<b>3.2 RoHS and Tin Whisker Issues for Resistive Components .....</b>	102
<i>D. Bolin, W. Bosze</i>	
<b>3.3 Pure Tin Electroplating Process for pH Sensitive Devices .....</b>	108
<i>N. Brown, M. Imanari, K. Suda, M. Shimazu</i>	
<b>3.4 Ta Capacitors with Conductive Polymer Robust to Leadfree Process .....</b>	112
<i>Z. Sita, M. Biler</i>	
<b>3.5 RoHS Compatible Products .....</b>	119
<i>G. Schulz</i>	

## SESSION 4: APPLICATIONS

<b>4.1 Discrete vs Thick Film Integrated Filter Performance.....</b>	129
<i>R. Demcko, B. Ward</i>	
<b>4.2 Frequency Response of Thin Film Chip Resistors .....</b>	136
<i>R. Johnson, C. Wakeman, W. Cuvillo</i>	

<b>4.3 Ceramic Capacitors for Extreme Environments.....</b>	142
<i>E. Alberta, W. Hackenberger</i>	

## **SESSION 5: RELIABILITY & TESTING**

<b>5.1 Accelerating Factors in Life Testing of High-Voltage Multi-Layer Ceramic Capacitors.....</b>	151
<i>D. Liu, H. Leidecker, T. Perry, F. Felt</i>	
<b>5.2 Measuring the Power Dissipation Capability of High-Voltage, Low-Capacitance Ceramic Chip Capacitors .....</b>	157
<i>E. Reed, J. Paulsen</i>	
<b>5.3 Reliability Effects with Proofing of Tantalum Capacitors .....</b>	167
<i>B. Long, M. Prevallet, J. Prymak</i>	
<b>5.4 The Quantitative Measurement of the Effectiveness of Decoupling Capacitors in Controlling Switching Transients from Microprocessors.....</b>	173
<i>D. Sanders, J. Muccioli, T. North, K. Slattery</i>	
<b>5.5 Reliability of Low-Voltage Tantalum Polymer Capacitors .....</b>	189
<i>E. Reed, J. Kelly, J. Paulsen</i>	
<b>5.6 Effect of Lead and Cadmium-Free Glasses on Reliability and Microstructural Development of Pb-Free Silver End Termination for MLCC Application .....</b>	199
<i>M. Akhtar, R. Anklekar</i>	
<b>5.7 MLC Discoidal Capacitors for EMI-RFI Filters Employing Non-Overlapping Electrodes Yield Substantial Performance Improvements .....</b>	208
<i>H. Trinh, D. Devoe, A. Devoe, M. Trinh, M. Petkova</i>	

## **SESSION 6: DESIGN & CONSTRUCTION**

<b>6.1 A Soft Termination MLCC Solution to Guard Against Capacitor Crack Failures .....</b>	219
<i>M. Stewart</i>	
<b>6.2 Strategies for Manufacturing Ultra Low ESR Ta Capacitors .....</b>	225
<i>R. Hahn, K. Pritchard</i>	
<b>6.3 Progress in High CV Ta Capacitors .....</b>	232
<i>Y. Pozdeev-Freeman</i>	
<b>6.4 High Dielectric Constant Terpolymers for Energy Storage Capacitors.....</b>	239
<i>W. Hackenberger, E. Alberta, P. Rehrig, D. Jeong, Q. Zhang</i>	
<b>6.5 Niobium Oxide and Tantalum Capacitors: M-I-S Model Parameters Comparison .....</b>	244
<i>J. Sikula, J. Hlavka, V. Sedlakova, P. Hoeschl, R. Grill, Z. Sita, T. Zednicek, M. Tacano</i>	
<b>6.6 Advanced Coating Technology for Film Capacitor Applications .....</b>	249
<i>P. Olbrich</i>	
<b>6.7 Dielectric Properties of a Newly Developed Very Low Fired COG Dielectric For High Q and High Voltage Applications.....</b>	261
<i>G. Maher, J. Wilson, S. Maher</i>	

## **SESSION 7: NEW TECHNOLOGY**

<b>7.1 Extended Range NbO Capacitors Through Technology and Materials Enhancements .....</b>	269
<i>S. Zednicek, I. Horacek, T. Zednicek, Z. Sita, C. McCracken, W. Millman</i>	
<b>7.2 Novel Ag and AgPd Nanoparticles for MLCC's with Ultrathin Electrodes: A Case for the Revival of PM MLC Technology.....</b>	275
<i>B. Farrell, D. Andreeșcu, C. Eastman, D. Goia</i>	
<b>7.3 MKP Capacitors for DC-Link Application in Modern Converters.....</b>	283
<i>O. Fernandez, F. Esteban</i>	
<b>7.4 Medialess High Efficiency Electroplating of SMT Discrete Device Terminations .....</b>	288
<i>G. Minogue, J. Lee, M. Hannon, T. Griego, R. Höppener</i>	
<b>Author Index</b>	