

---

# Rechargeable Lithium and Lithium Ion Batteries

---

## Editors:

**M. K. Sunkara**

University of Louisville  
Louisville, Kentucky, USA

**K. M. Abraham**

E-Kem Sciences  
Needham, Massachusetts, USA

**M. C. Smart**

Jet Propulsion Laboratory  
Pasadena, California, USA

**R. Brodd**

Broddarp of Nevada, Inc.  
Henderson, Nevada, USA

**R. V. Bugga**

Jet Propulsion Laboratory  
Pasadena, California, USA

## Sponsoring Division:



Battery



Published by

**The Electrochemical Society**

65 South Main Street, Building D  
Pennington, NJ 08534-2839, USA

tel 609 737 1902

fax 609 737 2743

[www.electrochem.org](http://www.electrochem.org)

**ecs**transactions™

**Vol. 41, No. 41**

---

Copyright 2012 by The Electrochemical Society.  
All rights reserved.

This book has been registered with Copyright Clearance Center.  
For further information, please contact the Copyright Clearance Center,  
Salem, Massachusetts.

Published by:

The Electrochemical Society  
65 South Main Street  
Pennington, New Jersey 08534-2839, USA

Telephone 609.737.1902  
Fax 609.737.2743  
e-mail: [ecs@electrochem.org](mailto:ecs@electrochem.org)  
Web: [www.electrochem.org](http://www.electrochem.org)

ISSN 1938-6737 (online)  
ISSN 1938-5862 (print)  
ISSN 2151-2051 (cd-rom)

ISBN 978-1-56677-983-8 (PDF)  
ISBN 978-1-60768-342-1 (Softcover)

Printed in the United States of America.

---

**ECS Transactions, Volume 41, Issue 41**  
Rechargeable Lithium and Lithium Ion Batteries

**Table of Contents**

<i>Preface</i>	<i>iii</i>
----------------	------------

**Chapter 1  
Electrolytes**

Morphological Variation of Electrodeposited Li in Ionic Liquid <i>K. Nishikawa, H. Naito, M. Kawase, and T. Nishida</i>	3
A "Looking Glass" into Electrolyte Properties: Cyclic Carbonate and Ester-LiClO <sub>4</sub> Mixtures <i>D. M. Seo, T. Afroz, Q. D. Ly, M. O'Connell, P. D. Boyle, and W. A. Henderson</i>	11
Phosphate-Based Compounds as Additives for 5-Volt Lithium-Ion Electrolytes <i>A. von Cresce and K. Xu</i>	17
Ionic Liquids: Potential Electrolytes for Lithium-Ion Batteries <i>H. M. Srour, N. Giroud, H. Rouault, and C. C. Santini</i>	23
Fluoroethylene Carbonate as an Electrolyte Additive for Improving the Performance of Mesocarbon Microbead Electrode <i>Z. Wang, J. Xu, W. Yao, Y. Yao, and Y. Yang</i>	29
Solvent-LiBF <sub>4</sub> Phase Diagrams, Ionic Association and Solubility - Cyclic Carbonates and Lactones <i>J. L. Allen, D. M. Seo, Q. D. Ly, P. D. Boyle, and W. A. Henderson</i>	41
Delving into the Properties and Solution Structure of Nitrile-Lithium Difluoro(Oxalato)Borate (LiDFOB) Electrolytes for Li-Ion Batteries <i>S. Han, J. L. Allen, P. D. Boyle, and W. A. Henderson</i>	47

**Chapter 2  
Electrodes**

Genetically Programming Interfaces between Active Materials, Conductive Pathway and Current Collector in Li-Ion Batteries <i>K. Xu, D. Oh, H. Yi, J. Qi, A. Xu, J. Snyder, and A. Belcher</i>	55
--	----

Prevention of the Micro Cracks Generation in LiNiCoAlO <sub>2</sub> Cathode by the Restriction of ΔDOD	65
<i>S. Watanabe, T. Hosokawa, K. Morigaki, M. Kinoshita, and K. Nakura</i>	
First Principles Study of Multicomponent Silicate Materials for Rechargeable Li-Ion Batteries	75
<i>R. C. Longo, K. Xiong, and K. Cho</i>	
Achieving High Capacity by Vanadium Substitution into Li <sub>2</sub> FeSiO <sub>4</sub> for Li-Ion Battery	87
<i>Y. Li, X. Cheng, and Y. Zhang</i>	
A Study of Cobalt and Manganese Fluorides as Cathode Materials for Rechargeable Lithium Cells	97
<i>W. K. Behl and J. A. Read</i>	
Effects of Doping and C <sub>60</sub> Coating on the Electrochemical Characteristics of Silicon Film Anodes for Lithium Secondary Batteries	107
<i>A. Arie and J. Lee</i>	
First-Principles Study of Charge Compensation in Olivine Positive	115
<i>Y. Asari, Y. Suwa, T. Hamada, V. Dinh, J. Nara, and T. Ohno</i>	
C/Li <sub>2</sub> MnSiO <sub>4</sub> as a Composite Cathode Material for Li-Ion Batteries	129
<i>M. Świętosławski, M. Molenda, M. M. Zaitz, and R. Dziembaj</i>	
Deflagration Synthesis of Nanocrystalline LiNi <sub>1/3</sub> Co <sub>1/3</sub> Mn <sub>1/3</sub> O <sub>2</sub> Cathode Material	139
<i>J. Li, Y. Xu, X. Du, and L. Xiong</i>	

### **Chapter 3 Fundamental Studies**

Discharge Performance Dependence on Electrode Thickness for Li <sub>4</sub> Ti <sub>5</sub> O <sub>12</sub> /LiMn <sub>2</sub> O <sub>4</sub> Cells for Application in Wafer-Integrated Microbatteries	147
<i>M. Thunman, K. Marquardt, R. Hahn, D. Kober, O. Goerke, and H. Schubert</i>	
Tailoring a Desired Interphase on Graphitic Anode	159
<i>J. Ho and K. Xu</i>	
Mixed Metal Oxide Catalysts for Rechargeable Lithium-Air Batteries	167
<i>V. Anandan, R. Kudla, A. Drews, J. Adams, and M. Karulkar</i>	
Composite Multifunctional Lithium-Ion Batteries	175
<i>J. Mullenax, P. Browning, W. Huebsch, M. Gautam, and E. M. Sabolsky</i>	

Li <sup>+</sup> -Solvation Structure Directs Interphasial Processes on Graphitic Anodes <i>K. Xu and A. von Cresce</i>	187
On the Mechanism of Lithium Insertion into A <sub>2</sub> Ti <sub>6</sub> O <sub>13</sub> (A = Na, Li) <i>J. Pérez Flores, M. Hoelzel, A. Kuhn, and F. García Alvarado</i>	195
Solid State Multinuclear Magnetic Resonance Investigation of Electrolyte Decomposition Products on Lithium-Ion Electrodes <i>J. DeSilva, V. Udinwe, P. J. Sideris, M. C. Smart, F. Krause, C. Hwang, K. Smith, and S. G. Greenbaum</i>	207
Author Index	215