



TQ15-81  
E1  
1980/2

8464044

# EXTENDED ABSTRACTS

TQ15-53  
E96  
1980  
V.2

0646-53  
E96  
1980.10

## VOLUME 80-2

Battery  
Corrosion  
Dielectrics and Insulation  
Electrodeposition  
Electronics  
Electrothermics and Metallurgy  
Energy Technology  
Industrial Electrolytic  
Physical Electrochemistry



FALL MEETING

HOLLYWOOD, FLORIDA

OCTOBER 5-10, 1980

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Printed in the United States of America

8464044

# THE ELECTROCHEMICAL SOCIETY, INC.

Fall Meeting, Hollywood, Florida

October 5-10, 1980



## Extended Abstracts of BATTERY DIVISION

### Subjects:

Characteristics of Fuel Cell and Battery Electrodes

Lithium Battery

Rechargeable Alkaline Zinc Electrodes

General Session

\*Molten Carbopnate Fuel Cell Technology

\*\*Energy Storage for Solar Applications

\*Sponsored jointly with Battery/Corrosion/Electrothermics and Metallurgy/  
Energy Technology

\*\*Sponsored jointly with Battery/Corrosion/Energy Technology

# CONTENTS

Abstract  
Number

Page

## CHARACTERISTICS OF FUEL CELL AND BATTERY ELECTRODES

|    |                                                                                                                                                                           |    |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1  | Fuel Cell and Battery Electrodes<br>B. S. Baker.....                                                                                                                      | 15 |
| 2  | Low Cost Ni/H <sub>2</sub> -Cells for Terrestrial Applications<br>G. Gutmann.....                                                                                         | 17 |
| 3  | Polymer Reinforced Inorganic Separators for Nickel-Hydrogen and Nickel-Cadmium Spacecraft Batteries<br>H. S. Lim, S. A. Verzwylt, J. D. Margerum, and R. C. Knetchli..... | 20 |
| 4  | II. Charge-Discharge Characteristics of Lightweight Composite Nickel-Graphite Battery Electrodes<br>R. A. Sutula and W. A. Ferrando.....                                  | 22 |
| 5  | Lightweight Composite Cadmium Electrodes<br>R. A. Sutula and W. A. Ferrando.....                                                                                          | 23 |
| 6  | Zinc-Electrode Coulombic Efficiency in Zinc-Chloride Battery: Effect of Forced Convection on Chlorine Transport<br>J. Jorne and A. Kermani.....                           | 24 |
| 7  | Concentration Profiles under Natural Convection at the Zinc Cathode of a Zinc-Chloride Cell<br>C. M. Vest, S. Cha, S. Kodali, and S. Argade.....                          | 27 |
| 8  | Motion of Isolated Zinc Fragments by Electrochemical Displacement<br>T. Katan and S. Szpak.....                                                                           | 30 |
| 9  | Modes of Charge Acquisition and Utilization at Silver Oxide Electrodes<br>T. Katan and P. J. Bergeron.....                                                                | 32 |
| 10 | Performance of Advanced Chromium Electrodes for the NASA-Redox Energy Storage System<br>R. F. Gahn, J. Charleston, J. S. Ling, and M. A. Reid.....                        | 34 |
| 11 | Effect of Br <sup>-</sup> on H <sub>2</sub> Oxidation with Implications towards Gas Diffusion Electrodes<br>G. G. Barna, S. N. Frank, and T. H. Teherani.....             | 38 |
| 12 | Effect of Anode Alloy on Performance of Aluminum Anode Primary Batteries<br>D. Belitskus.....                                                                             | 41 |

**Abstract  
Number**

**Page**

|    |                                                                                                                                                                              |    |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 13 | Growth of Positive Electrodes in Automotive Batteries<br>J. R. Willhite, J. K. Eggers, and P. Rao.....                                                                       | 44 |
| 14 | Simulation of Dendrite Growth Patterns in Electro-<br>chemical Flow Reactors<br>J. R. Selman and J. Lee.....                                                                 | 46 |
| 15 | Capacity Limitation during Discharge of Porous Lead<br>Dioxide Electrodes<br>W. G. Sunu and B. W. Burrows.....                                                               | 49 |
| 16 | Determination of the Charge of a Lead Acid Battery<br>with Impedance Technique<br>D. Leuckx and J. Vereecken.....                                                            | 51 |
| 17 | Influence of Metal Ions on the O <sub>2</sub> Reduction on Noble<br>Metals in Alkaline Solutions<br>R. Amadelli, P. Bindra, and E. Yeager.....                               | 52 |
| 18 | Impedance of Sphere-Packed Electrodes<br>J. P. Candy, P. Fouilloux, M. Keddam, and<br>H. Takenouti.....                                                                      | 55 |
| 19 | Deterioration of Porous Carbon Oxygen Cathode<br>J. C. Huang, A. L. Barnes, T. M. Clere, and<br>L. J. Gestaut.....                                                           | 58 |
| 20 | Preparation of Dispersed Pt on Conductive SnO <sub>2</sub> and Its<br>Catalytic Activity for O <sub>2</sub> Reduction<br>M. Watanabe, S. Venkatesan, and H. A. Laitinen..... | 61 |
| 21 | Carbon Support Materials for Fuel Cell Electrodes<br>J. McBreen, H. Olender, K. V. Kordesch, and<br>S. Srinivasan.....                                                       | 63 |
| 22 | Development of Electrocatalysts and Conductive<br>Substrates for Cathodes in Phosphoric Acid Fuel Cells<br>P. Stonehart, J. MacDonald, and J. Baris.....                     | 66 |
| 23 | A Chromatographic Method for Determination of Platinum<br>Surface Area<br>L. S. Joyce, A. J. Coleman, and J. A. Joebstl.....                                                 | 68 |
| 24 | Anomalous Current Ratios in Teflon Bonded Electrodes in<br>Very Concentrated H <sub>3</sub> PO <sub>4</sub><br>P. N. Ross, Jr.....                                           | 70 |
| 25 | The Reduction of Oxygen on the Pt-Group IVb and Vb<br>Intermetallics in Acidic Electrolyte<br>P. N. Ross, Jr.....                                                            | 73 |

- 26 Impedance Characterization of the Solid Oxide  
Electrolyte Interface  
L. J. Olmer and H. S. Isaacs..... 76

LITHIUM BATTERY

- 27 Cyclic Voltammetry of  $\text{ICl}$ ,  $\text{ICl}_3$  and Thionyl Halide  
Systems  
R. W. Bennett..... 81
- 28 A Comparison of Accelerated and Real Time Discharge  
Characteristics of the Lithium/Iodine-Polyvinylpyridine  
Battery  
C. F. Holmes and R. C. Stinebring..... 83
- 29 Comparison of Accelerated Test Methods to Determine  
Capacity of Lithium/Silver Chromate Pacemaker Batteries  
R. J. Solar and R. Kafesjian..... 86
- 30 Characterization of Anode Surfaces of Lithium/Iodine  
Pacemaker Batteries with Varying Lengths of Service  
K. M. Black, R. J. Bennett, and P. A. Linfors..... 88
- 31 Mixed Bismuth - Metal Oxides as Cathodic Materials for  
Miniature Lithium Cells  
M. Broussely and Y. Jumel..... 90
- 32 Dimensional Stability of  $\text{Li-MnO}_2$  Cells  
R. Moses, A. H. Taylor, and M. J. Turchan..... 92
- 33 Thermally Induced Decomposition of Lithium Hexafluoro-  
arsenate-Based Electrolytes  
V. R. Koch, J. L. Goldman, J. T. Y. Maurand, and  
M. Mulvaney..... 94
- 34 Thermal Decomposition of  $\text{LiSCN}$ -Containing Lithium  
Battery Electrolyte  
B. M. L. Rao and G. E. Milliman..... 97
- 35 Chemical and Morphological Studies of Lithium Electrode  
Surfaces in a Nonaqueous Electrolyte  
S. P. S. Yen, D. Shen, and R. B. Somoano..... 99
- 36 Chemical Analysis for Impurities in Lithium Battery  
Electrolytes  
C. J. Johnson..... 101
- 37 Ellipsometric Studies of Surface Layers on Lithium  
F. Schwager, Y. Geronov, and R. H. Muller..... 102

Abstract  
Number

Page

- 38 On the Question of Apparent Lithium Reduction of  
Ethers - The Case for 1,3-Dioxolane  
L. P. Klemann and G. H. Newman..... 104
- 39 The Kinetic Stability of Potassium in Propylene  
Carbonate Electrolytes  
H. H. Law, R. Atanasoski, and C. W. Tobias..... 106
- 40 Conductance and Density Behavior of  $\text{LiAsF}_6$  Solutions in  
Mixed Solvents. I.  $\gamma$ -Butyrolactone-Propylene  
Carbonate Versus 1,2 Dimethoxyethane-Propylene  
Carbonate  
N. Margalit and H. J. Canning..... 109
- 41 Lithium Closoborane Electrolytes  
J. W. Johnson, A. H. Thompson, and J. F. Brody..... 111
- 42 New Organic Electrolytes for Li Batteries. II. Effect  
of Crown Size on Conductivity  
I. Angres..... 113
- 43 Conductivity Study of Iodine/Poly(2-Vinylpyridine)  
System  
A. Wolfert, J. Schoonman, and D. Untereker..... 115
- 44 The Effect of Cation Complexing Compounds on the  
Conductivity of Lithium Salts in 1,3-Dioxolane  
W. N. Olmstead..... 118
- 45 Properties and Structure of Nonaqueous Electrolyte  
Solutions for Lithium Batteries  
H. V. Venkatesetty, D. J. Saathoff, and B. K. Patel... 120
- 46 Anionic Transport in the Iodine/Poly(2-Vinylpyridine)  
System  
G. M. Phillips and D. F. Untereker..... 121
- 47 Investigations of Anion Structure in  $\text{LiBr}_4$  Salts -  
Steps toward the Design of an Organic Electrolyte  
L. P. Klemann, G. H. Newman, T. A. Whitney, E. L.  
Stogryn, and D. Farcasiu..... 124
- 48 Vanadium Oxides as Cathodes for Secondary Li Cells  
K. M. Abraham, J. L. Goldman, and G. L. Holleck..... 127
- 49 Cycle Life Performance of Organic Electrolyte Secondary  
Lithium Cells  
R. A. Rizzo..... 129

**Abstract  
Number**

**Page**

|    |                                                                                                                                                                                            |     |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 50 | Performance of Ambient Temperature Sulfospinel and $\text{TiS}_2$ -Lithium Secondary Cells<br>M. Eisenberg.....                                                                            | 133 |
| 51 | Molten Salt Electrolytes for Ambient Temperature Secondary Lithium Cells<br>G. H. Newman and L. P. Klemann.....                                                                            | 136 |
| 52 | Correlations between Cell Component Characteristics and Cell Performance in Secondary Lithium Cells<br>D. Shen, S. P. S. Yen, S. K. Khanna, and R. B. Somoano.....                         | 139 |
| 53 | Rechargeability Studies in Lithium Organic Electrolyte Batteries<br>B. Di Pietro, B. Scrosati, F. Bonino, M. Lazzari, L. P. Bicelli.....                                                   | 141 |
| 54 | Sources of Heat in High Rate Reserve $\text{Li/SOCl}_2$ Batteries<br>J. C. Hall, H. F. Gibbard, and L. W. Wiechmann.....                                                                   | 142 |
| 55 | Cathode-Limited $\text{Li/SOCl}_2$ Cells<br>K. A. Klinedinst.....                                                                                                                          | 145 |
| 56 | Exothermic Reactions among Components of Lithium-Sulfur Dioxide and Lithium-Thionyl Chloride Cells<br>S. Dallek, S. D. James, and W. P. Kilroy.....                                        | 149 |
| 57 | Cathode Additives for Lithium-Thionyl Chloride Batteries: Electrochemical and Chemical Behavior of Copper and Copper Chlorides<br>W. K. Behl.....                                          | 152 |
| 58 | Testing of Modified $\text{Li/SO}_2$ Cells<br>S. C. Levy, H. K. Street, and C. C. Crafts.....                                                                                              | 154 |
| 59 | Raman and ESR Spectroscopic Studies of the Electro-reduction of Sulfur Dioxide<br>D. T. Fouchard, C. L. Gardner, W. A. Adams, and F. C. Laman.....                                         | 156 |
| 60 | A Study of Lithium Reactivity in $\text{SOCl}_2$ Cells Using the Method of Galvanostatic Transients<br>R. G. Keil, P. S. Zaidain, T. N. Wittberg, J. R. Hoenigman, and R. C. McDonald..... | 159 |
| 61 | Theoretical Model for Double-Layer Lithium-Chloride Film Growth on Lithium Anodes in Thionyl-Chloride Batteries<br>A. M. Hermann.....                                                      | 161 |

- 62 Spectroscopic Studies of the Hazards of  $\text{Li}/\text{SOCl}_2$   
Batteries during Cell Reversal  
D. J. Salmon, M. E. Adamczyk, L. L. Studer,  
L. L. Abels, and J. C. Hall..... 163
- 63 Microcalorimetric and A.C. Impedance Measurements on  
Lithium-Thionyl Chloride Cells  
J. Phillips and H. F. Gibbard..... 165
- 64 Electrochemical and Spectroscopic Studies on Thionyl  
Chloride-Electrolyte Solutions  
H. V. Venkatesetty and K. Y. Kim..... 168
- 65 Investigation of the Lithium and Carbon Electrodes in  
Thionyl Chloride Solutions by A.C. Impedance and Pulse  
Techniques  
J. Phillips, J. C. Hall, and H. F. Gibbard..... 169
- 66 The  $\text{Li}/\text{Cl}_2$  in  $\text{SO}_2\text{Cl}_2$  Inorganic Battery System: II D Cell  
Discharge Characteristics  
C. C. Liang, M. E. Bolster, and R. M. Murphy..... 172
- 67 Electrode Processes in the  $\text{Li}/\text{SO}_2\text{Cl}_2$  Battery  
M. Lazzari, G. Razzini, B. Rivolta, and B. Scrosati... 175
- 68 The Anodic Oxidation Stability of Lithium Electrolytes  
H. H. Horowitz, J. I. Haberman, L. P. Klemann,  
G. H. Newman, E. L. Stogryn, and T. A. Whitney..... 177
- 69  $\text{LiB}(\text{C}_6\text{H}_5)_4$  - Solute for a Stable Organic Electrolyte for  
Secondary Lithium Cells  
G. H. Newman and L. P. Klemann..... 182
- 70 An Improved Secondary Lithium Electrode in a Dioxolane-  
Based Electrolyte Incorporating 2,6-t-Butyl-4-Methyl  
Phenol  
P. G. Glugla..... 185
- 71 Electrochemical Investigation of Charge Transport  
Processes in the Lithium- $\text{TiS}_2$  Intercalation Reaction  
A. J. Vaccaro, T. Palanisamy, R. L. Kerr, and  
J. T. Maloy..... 188
- 72 Effect of Sulfur Impurities on  $\text{Li}/\text{TiS}_2$  Cells  
B. M. L. Rao and J. A. Shropshire..... 191
- 73 Methods for Estimating the Solubility of Gases in  
Electrolytes Used in Lithium Batteries  
H. A. Frank and D. D. Lawson..... 193

|    |                                                                                                                                                             |     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 74 | A Simple One-Electron MO Model for the Intercalation of Lithium in $\text{TiO}_2$ and $\text{MnO}_2$<br>M. Voinov.....                                      | 197 |
| 75 | Evaluation of Nickel Positive Electrode Components in $\text{LiAl/FeS}$ Cells<br>J. A. Smaga and J. E. Battles.....                                         | 199 |
| 76 | Designing Stable Capacity for $\text{LiAl/FeS}$ Multiplate Cells<br>T. D. Kaun, W. E. Miller, and J. D. Arntzen.....                                        | 202 |
| 77 | Performance Characteristics of Iron Disulfide Electrodes<br>J. S. Dunning, R. N. Seefurth, and R. A. Murie.....                                             | 206 |
| 78 | Phase Relationships in Positive Electrodes of High Temperature Lithium-Aluminum/Iron Sulfide Cells<br>Z. Tomczuk, M. F. Roche, and D. R. Vissers.....       | 209 |
| 79 | Development of the Lithium/Metal Sulfide Battery for Electric Vehicle Applications<br>T. W. Olszanski, R. Borris, and B. A. Askew.....                      | 212 |
| 80 | Determination of Effective Conductivity of Porous Ceramic Separators of $\text{LiAl/LiCl-KCl/FeS}$ Cells<br>H. Ohno and H. Shimotake.....                   | 215 |
| 81 | Electrode Potential Relaxation in High Temperature $\text{LiAl/FeS}$ Engineering Cells<br>L. Redey, S. Higuchi, T. Kaun, F. Martino, and D. R. Vissers..... | 220 |
| 82 | Nitrate Molten Salt Electrolytes for Use in Intermediate Temperature Lithium Cells<br>I. D. Raistrick, J. Poris, and R. A. Huggins.....                     | 224 |
| 83 | Behavior of Lithium and Positive Electrode Materials in Molten Nitrate Electrolytes<br>J. Poris, I. D. Raistrick, and R. A. Huggins.....                    | 226 |
| 84 | Lithium Silicon Anodes in Molten Chloroaluminate Cells<br>R. L. Vaughn and L. A. King.....                                                                  | 228 |
| 85 | All-Solid Lithium Electrodes with Mixed-Conductor Matrix<br>B. A. Boukamp, G. C. Lesh, and R. A. Huggins.....                                               | 231 |
| 86 | Heat Generation in Lithium/Iron Sulfide Cells<br>M. M. Farahat, A. A. Chilenskaskas, and D. L. Barney.....                                                  | 234 |

**Abstract  
Number**

**Page**

|                                                     |                                                                                                                                                      |     |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 87                                                  | Capacity Retention in Iron Disulfide Electrodes<br>R. N. Seefurth and J. S. Dunning.....                                                             | 237 |
| 88                                                  | Agglomeration in Li-Al Alloy Electrodes<br>A. K. Fischer and D. R. Vissers.....                                                                      | 240 |
| 89                                                  | Thermal Management of LiAl/FeS Batteries<br>C. C. Chen and H. F. Gibbard.....                                                                        | 243 |
| <b><u>RECHARGEABLE ALKALINE ZINC ELECTRODES</u></b> |                                                                                                                                                      |     |
| 90                                                  | Effects of Various Binary Additives in Alkaline Zinc<br>Electrodes<br>A. Himy and R. Karcher.....                                                    | 246 |
| 91                                                  | Electrochemistry of Metal Oxide Additives in Zinc<br>Electrodes<br>J. McBreen, E. Gannon, and M. G. Chu.....                                         | 248 |
| 92                                                  | Vibrating Zinc Electrode in Alkaline Electrolyte<br>M. Knaster.....                                                                                  | 250 |
| 93                                                  | Current Distributions in Porous Zinc Electrodes. I.<br>Experimental<br>M.-B. Liu, Y. Yamazaki, G. M. Cook, and N. P. Yao.....                        | 253 |
| 94                                                  | Sealed Type Cylindrical Ni-Zn Secondary Batteries<br>M. Kanda, T. Shirogami, H. Niki, M. Ueno, K. Murata,<br>Y. Sato, and T. Takamura.....           | 256 |
| 95                                                  | Crosslinked Polyvinyl Alcohol Films as Alkaline Battery<br>Separators<br>D. W. Sheibley, L. C. Hsu, M. A. Manzo, and<br>O. D. Gonzalez-Sanabria..... | 258 |
| 96                                                  | Evaluation of Production Versions of the Inorganic-<br>Organic Separator<br>D. W. Sheibley, M. A. Manzo, and O. D. Gonzalez-<br>Sanabria.....        | 262 |
| 97                                                  | Transference Numbers of Zinc in Zinc-Chloride Battery<br>Electrolytes<br>J. Jorne and W.-T. Ho.....                                                  | 265 |
| 98                                                  | Short-Circuit Characteristics of Zinc-Chloride Cells<br>M. J. Hammond and M. S. Mashikian.....                                                       | 268 |

GENERAL SESSION

|     |                                                                                                                                                                       |     |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 99  | Evaluation of Calcium Alloy Grids Produced by the Cominco Drum Cast, Rotary Expansion Process<br>R. English.....                                                      | 271 |
| 100 | Accelerated Corrosion Testing of Wrought Lead-Calcium-Tin Battery Alloys<br>P. H. Abramowitz and R. F. Dvorak.....                                                    | 273 |
| 101 | Lead Acid Battery Expander. II. Efficacy of the Microelectrode Technique in Predicting the Expander Activity on the Pasted Electrode Performance<br>B. K. Mahato..... | 275 |
| 102 | Cycling Behavior of Lead-Acid Batteries for Electric Vehicles<br>G. L. Wierschem and W. H. Tiedemann.....                                                             | 278 |
| 103 | The Influence of Charge and Discharge Rates on the Accelerated Testing of Nickel Cadmium Batteries<br>P. P. McDermott and K. L. Vasanth.....                          | 281 |
| 104 | The Effect of "Memory" on Discharge Performance of Nickel-Cadmium Aircraft Batteries<br>J. J. Lander, J. W. Logsdon, and G. Hart.....                                 | 284 |
| 105 | Short Circuit Formation and Hydrogen Generation during Reversal of Nickel Cadmium Cells<br>A. H. Zimmerman, M. R. Martinelli, and C. C. Badcock.....                  | 285 |
| 106 | Electrochemically Impregnated Nickel Electrodes—Process Development, Electrode Characteristics and Cell Performance Results<br>T. R. Williamson III.....              | 288 |
| 107 | Some Characteristics of Nickel-Hydrogen Cells<br>R. L. Kerr, T. Palanisamy, H. N. Chuang, and D. F. Pickett.....                                                      | 290 |
| 108 | A Gasometric Method for Analyses of Silver Oxide Electrodes<br>T. Katan and R. R. Carlen.....                                                                         | 292 |
| 109 | Status Cells: A Demonstration of Li-Al/FeS Cell Performance Reproducibility, Energy Retention and Extended Lifetime<br>F. J. Martino, E. C. Gay, and W. E. Moore..... | 294 |

**Abstract  
Number**

**Page**

- 110 Cycle Life and Performance Evaluation of Positive Current Collectors in Li-Al/FeS Cells  
L. G. Bartholme, E. C. Gay, and H. Shimotake..... 298
- 111 Electrochemical Studies of Intercalation Compounds for Molten Salt Batteries  
G. Vassort, M. Gauthier, A. Belanger, and W. A. Adams..... 303
- 112 Development of Ceramic-Coated Positive Current Collectors for Li-Al/Molten LiCl-KCl/FeS<sub>2</sub> Batteries  
G. Bandyopadhyay and T. M. Galvin..... 305
- 113 Phthalocyanines as New Cathodes in Lithium Secondary Batteries  
A. Yamaji and J. Yamaki..... 307
- 114 Electrochemical Flue Gas Desulfurization  
D. Townley and J. Winnick..... 309
- 115 The Aluminum-Air Battery for Electric Vehicle Propulsion: Overview and Status  
J. F. Cooper, R. V. Homsy, and J. H. Landrum..... 310
- 116 Control of Electrolyte Composition of an Aluminum-Air Battery Through Precipitation of Aluminum Trihydroxide  
J. F. Cooper and J. H. Landrum..... 313
- 117 Aluminum-Air Power-Cell System Design: Mass and Enthalpy Balance  
R. V. Homsy..... 316
- 118 Estimates of the Cost and Energy Consumption of Aluminum-Air Electric Vehicles  
J. F. Cooper..... 319
- 119 Potential Distribution on Operating Bifunctional Air Electrodes  
B. G. Demczyk and C. T. Liu..... 322
- 120 Parasitic Current Elimination in Series Connected Electrochemical Cell Systems with Shared Electrolyte.  
I. Theory  
M. Zahn, P. Grimes, R. Bellows, and J. Shropshire..... 325
- 121 Parasitic Current Elimination in Series Connected Electrochemical Cell Systems with Shared Electrolyte.  
II. Experimental  
P. Grimes, R. Bellows, J. Shropshire, and M. Zahn..... 328

**Abstract  
Number**

**Page**

- 122 A Quasi-Chemical Failure Model for Secondary Electrochemical Cells  
R. F. Fedors, M. Cizmecioglu, S. D. Hong, A. Gupta, and J. Moacanin..... 331
- 123 Evaluation of the Analog Circuit Model for the Prediction of Leakage Currents in Bipolar Electrochemical Systems  
J. B. Riggs..... 333
- 124 Automatic Charging of Storage Batteries by Electrochemical Control  
E. I. Onstott..... 336
- 125 Ellipsometry of Supersaturation and Adsorption in Dissolution-Precipitation Reactions  
R. H. Muller and C. G. Smith..... 338
- 126 Test Methods of Separators for the Industrial Advanced Alkaline Electrolysis  
J. C. Bardin..... 341

FUEL CELL AND BATTERY ELECTRODES

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Battery and fuel cell electrode development has undergone intensive effort in the past two decades.

In the nickel cadmium area, we have seen a pursuit of high reliability result in more controlled structures and impregnation techniques and consequently higher cycle life. For the lead acid battery, studies of grid contouring and paste formation are leading to longer life, lighter weight structures.

More advanced, near-term secondary batteries stressing high energy densities such as nickel-zinc and nickel-iron have seen the development of entirely new forms of nickel electrodes wherein the conventional high cost sintered nickel plaque has been abandoned in favor of either polytetrafluoroethylene (PTFE)-graphite or nickel plated steel wire structures. Zinc and iron electrode technology have both seen substantial improvements.

Long-term, high energy secondary battery programs have led to whole new electrode technologies for such diverse battery systems as zinc-chlorine, lithium-iron sulfide and sodium-sulfur. These new approaches to batteries are at a rudimentary stage. In some cases the chemistry of side, reverse and overcharge electrode reactions are still not well understood. One can expect the battery cycling characteristics of the new systems to be affected by the chronic problems of structure rearrangement.

Fuel cell electrodes have undergone a virtual explosion of research and development in recent times. Beginning with the space program of the sixties and followed by the energy related problems of the seventies, we have seen a truly substantial improvement in fuel cell electrode technology.

From the pure platinum black structures of the sixties to the mixed precious metal catalysts of the early seventies to the carbon and graphite supported catalysts of the present, the yield of power per unit weight of catalyst has increased several fold. The PTFE-catalyst structure for producing a gas-liquid-solid interface has shown that electrochemical reaction rates may someday approach those of direct combustion.

Equally promising has been the recent progress made on electrodes for molten salt "second generation" fuel cells. In this case, nickel alloy electrodes have been shown to be stable for long periods of time and the G-L-S interface is maintained by cleverly balancing electrode-electrolyte matrix pore size distribution.

Hybrid fuel cell-battery electrochemical cells such as metal-air and metal oxide-hydrogen cells have also resulted in some unique electrode configurations in recent years.

In general, the progress made in electrochemical electrode technology could open doors to more efficient, energy saving, electric power generation and transportation systems. Further the experience gained in developing improved fuel cell and battery electrodes may have fall out in electro-organic synthesis and certain metal and chemical electrowinning industries.

Hybrid fuel cell-battery electrochemical cells such as metal-air and metal oxide-hydrogen cells have also resulted in some unique electrode configurations in recent years. In general, the progress made in electrochemical electrode technology could open doors to more efficient, energy saving, electric power generation and transportation systems. Further the experience gained in developing improved fuel cell and battery electrodes may have fall out in electro-organic synthesis and certain metal and chemical electrowinning industries. Long-term, high energy, rechargeable battery systems have led to whole new electrode technologies for such systems as zinc-chlorine, lithium-lithium sulfide and sodium-sulfur. Some new approaches to catalysts are of a redox nature. In some cases the catalysts are still not well understood. One can expect the battery celling characteristics of the new systems to be limited by the chronic problems of electrode reagentless. Fuel cell electrodes have undergone a rapid explosion of research and development in recent years. Beginning with the space program of the sixties and followed by the energy related projects of the seventies, we have seen a fairly substantial improvement in fuel cell electrode technology. From the pure platinum and iridium of the sixties to the mixed carbon metal catalysts of the early seventies to the carbon and graphite catalysts of the present, the yield of power per unit weight of catalyst has increased several fold. The thin-carbon structure for producing a glass-like solid electrolyte has allowed electrochemical reaction rates may someday approach those of direct combustion. Presently providing has been the recent progress made on electrodes for molten salt "second generation" fuel cells. In this case, nickel alloy electrodes have been shown to be stable for long periods of time and the G-I-C interface is maintained by electrically balancing electrode-electrolyte matrix pore size distribution.