Curriculum Vitae
Frank M. Delnick

Staff Scientist

Electrochemistry

Physical Chemistry of Materials Group, Materials Science and Technology Division

delnickfm@ornl.gov

865-576-8352

Area of Research:

Electrochemical energy conversion and energy storage in: thermal batteries, primary lithium batteries, lithium-ion batteries, supercapacitors, ultracapacitors and redox flow batteries. Charge transfer processes in molten salts, ionic liquids and aprotic solvents. Passivation reactions, mediated reactions, porous electrodes and complex impedance analysis.

Bio:

2014-present :	Staff Scientist, Oak Ridge National Laboratory, Oak Ridge, TN
2003-2014:	Distinguished member of the Technical Staff, Power Sources Technology Group, Sandia National Laboratories, Albuquerque, NM
1998-2003	Program Scientist, Duracell Inc., Bethel, CT
1994-1998	Principal Investigator and Group Leader, Electrochemical Capacitor Group, IMRA America Inc., (Research Branch of Aisin Seiki, Karia, Japan) Ann Arbor, MI
1976-1994	Senior Member of the Technical Staff, Exploratory Batteries Dept., Sandia National Laboratories, Albuquerque, NM
1975-1976	Post Doctoral Fellow, Rice University, Houston, TX
1975	PhD, Electrochemistry, Rice University, Houston, TX
1971	BS, Chemistry, New Mexico Institute of Mining and Technology, Socorro, NM

Projects:

- Ambient temperature electrochemical fixation of nitrogen.
- High temperature polymeric binders for thermal batteries.
- Radical anion mediators for redox flow batteries.
- Polymeric membranes for nonaqueous redox flow batteries
- High voltage electrolytes for ultracapacitors.
- Multivalent cathodes for advanced lithium-ion batteries.

Publications and Patents:

1. Che-Nan Sun, Frank M. Delnick, Douglas S. Aaron, Alexander B. Papandrew, Matthew M. Mench and Tom Zawodzinski, "Resolving Losses at the Negative Electrode in All-Vanadium Redox Flow Batteries Using Electrochemical Impedance Spectroscopy", **J. Electrochem. Soc., 161(6)** A981 (2014)

2. Frank M. Delnick, "Electrochemical Components Employing Polysiloxane-Derived Binders", **US Patent 8,460,823 June 11, 2013**

3. Che-Nan Sun, Frank M. Delnick, Loic Baggetto, Gabriel M. Vieth and Tom Zawodzinski, "Hydrogen Evolution at the negative electrode of the all-vanadium redox flow batteries", **J. Power Sources 248** (2014) 560-564

4. Che-Nan Sun, F.M. Delnick, D.S. Aaron, A.B. Papandrew, M.M. Mench and T.A. Zawodzinski, "Probing Electrode Losses in All-Vanadium Redox Flow Batteries with Impedance Spectroscopy", **ECS Electrochem. Lett. Vol 2**, Issue 5 (2013) A43-A45

5. C. Boczer, F.M. Delnick, R.D. Rosario, M. Kang, L.M. Pawlowska, M. Pozin, D. Rana, M. Stevanovic and J.J. Weckesser, "Flexible Cathodes", **US Patent 8,142,918 March 27, 2012**

6. C. Boczer, F.M. Delnick, R.D. Rosario, M. Kang, L.M. Pawlowska, M. Pozin, D. Rana, M. Stevanovic and J.J. Weckesser, "Flexible Cathodes", **US Patent 7,967,875 June 28, 2011**

7. Frank M. Delnick, F.W. Reinhardt and J. Odinek, "Battery Components Employing a Silicate Binder", **US Patent 7,947,397 May 24, 2011**

8. C. Boczer, F.M. Delnick, R.D. Rosario, M. Kang, L.M. Pawlowska, M. Pozin, D. Rana, M. Stevanovic and J.J. Weckesser, "Flexible Cathodes", **US Patent 7,753,968 July 13, 2010**

9. C. Boczer, F.M. Delnick, R.D. Rosario, M. Kang, L.M. Pawlowska, M. Pozin, D. Rana, M. Stevanovic and J.J. Weckesser, "Flexible Cathodes", **US Patent 7,527,895 May 5, 2009**

10. C. Boczer, F.M. Delnick, R.D. Rosario, M. Kang, L.M. Pawlowska, M. Pozin, D. Rana, M. Stevanovic and J.J. Weckesser, "Flexible Cathodes", **US Patent 7,033,698 April 25, 2006**

11. Paul Butler, Frank Delnick, Frank Peterkin, Robert Ripple, "Assessment of Rechargeable Batteries for High Power Applications", 2004 International Power Modulator Conference: 26th International Power Modulator Symposium and 2004 High Voltage Workshop, (2004) pp102-105

12. Frank M. Delnick, Sathya Motupally and Yuemin Zhang, "Finite Diffusion Capacitance", Proceedings of the 14th International Seminar on Double Layer Capacitors and Hybrid Energy Storage Devices, Dec. 6-8, 2004, Deerfield Beach, FL, Redox Engineering, LLC, 215 Dolphin Cove Court, Bonita Springs, FL (2004)

13. Frank M. Delnick, Alan Iwamoto, Zhendong Hu, Liya Wang, "Electrode Containing a Polymeric Binder Material, Method of Formation thereof and Electrochemical cell", **US Patent 6,316,142 November 13, 2001**

14. Frank M. Delnick, "Process of Manufacturing Porous Separator for Electrochemical Power Supply", **US Patent 6,148,503 November 21, 2000**

15. Frank M. Delnick, "Process of Manufacturing Porous Separator for Electrochemical Power Supply"**, US Patent 5,948,464 Sept. 7, 1999**

16. Frank M. Delnick, "Process of Manufacturing Porous Separator for Electrochemical Power Supply", **US Patent 5,882,721 March 16, 1999**.

17. Frank M. Delnick, "Process for Filling Electrochemical Cells with Electrolyte", **US Patent 5,865,860 February 2, 1999.**

18. F.M. Delnick, Z. Hu, L. Wang, S. Doi, and S. Denzumi, "The IMRA Electrochemical Capacitor", **Proc. of the 8th International Seminar on Double Layer Capacitors and Similar Energy Storage Devices, S.P.** Wolsky and N. Marincic eds., Dec. 7-9, 1998, Deerfield Beach, FL

19. Frank M. Delnick, D. Ingersoll, X. Andrieu and K. Naoi eds., **Electrochemical Capacitors II. Proc. Vol 95-25**, The Electrochemical Society, NJ (1997)

20. Frank M. Delnick et al. "Thin Film Polymeric Gel Electrolytes" **US Patent 5,589,295** Dec 31, 1996

21. Frank M. Delnick and M. Tomkiewicz eds**., Electrochemical Capacitors. Proc. Vol 95-29,** The Electrochemical Society, NJ (1996)

22. Frank M. Delnick, N. Doddapaneni, R. Lagasse, R. Simandl, D.G. Glasgow and A. Sylwester, "Structural Microporous Carbon Anode for Rechargeable Lithium Ion Batteries", **US Patent 5,510,212** April 23, 1996

23. Frank M. Delnick, W.R. Even, A.P. Sylwester, J.C. F. Wang and T. Zifer, “Structural Microporous Carbon Anode for Rechargeable Lithium-Ion Batteries” **US Patent 5,426,006 June 20, 1995**

24. R.R. Lagasse and F.M. Delnick, "Tailoring Poly(Acrylonitrile) Derived Porous Carbons for Electrochemical Applications", **SAND 94-0373 (1994)**

25. F.M. Delnick, "Carbon Supercapacitors", **Proc. of the Symposium on the Science of Advanced Batteries**, D. Scherson ed., Nov. 8-9, 1993, Cleveland, OH Publication date Spring 1994.

26. F.M. Delnick, D. Ingersoll and D. Firsich, "Double Layer Capacitance of Carbon Foam Electrodes", **Proc. of the Third International Seminar on Double Layer Capacitors and Similar Energy Storage Devices,** S.P. Wolsky and N. Marincic eds., Dec 6-9, 1993, Deerfield Beach, FL

27. F.M. Delnick, "Chloromethyl Chlorosulfate as a Voltage Delay Inhibitor in Lithium Cells, **US PATENT 5,202,203,** April 13, 1993

28. F.M. Delnick and A.R. Baldwin, "Voltage Delay in Li/$SOCl_2$ Cells for Artillery Applications at -35˚C", **Proc 34th Intl Power Sources Symp, Cherry Hill, NJ, June (1990) p215**

29. A.R. Baldwin, F.M. Delnick and D.L. Miller, "Active Primary Lithium Thionyl Chloride Battery for Artillery Applications", **Proc. 34th Intl Power Sources Symp., Cherry Hill, NJ, (1990) p275**

30. F.M. Delnick and R.A. Guidotti, "Ionic Conduction in Porous Media", **J. Electrochem. Soc., 137 (1990) p11, SAND 88-0561J**

31. F.M. Delnick, "The Kinetics of Charge Transfer Reactions on Passive Lithium Electrodes", **J. Power Sources, 26 (1989) p129**

32. F.M. Delnick, T.R. Guilinger and J.O. Stevenson, "Polarization of Li/$SOCl_2$ Cells", **SAND 89-0875 (1989)**

33. F.M. Delnick, "Impedance of Passive Lithium Anodes Under Low Field Polarization" in **Primary and Secondary Ambient Temperature Lithium Batteries, J.P. Gabano, Z. Takehara and P. Bro eds.,** Electrochem. Soc. Proc. Vol 88-6 (1988) p212

34. F.M. Delnick, W.R. Cieslak, D.E. Peebles and J.W. Rogers Jr., "Cathodic Passivation of Mo in 1.5M $LiAlCl_4$ - $SOCl_2$" in **Lithium Batteries**, A.N. Dey ed., Electrochem Soc. Proc. Vol 87-1 (1987) p1981

35. W.R. Cieslak and F.M. Delnick, "The Fabrication and Performance of a Ag/AgCl Reference Electrode in Thionyl Chloride Electrolyte", **J. Electrochem. Soc., 134 (1987) p132**

36. D.E. Peebles, J.W. Rogers, W.R. Cieslak and F.M. Delnick, "Passivity of Metals in Thionyl Chloride Electrolyte", **J. Vac. Sci. Tech., A5(4) (1987) p1172**

37. W.R. Cieslak, F.M. Delnick, D.E. Peebles and J.W. Rogers Jr., "Passive Film Formation on Metals in Thionyl Chloride Electrolytes" in **Surface Inhibition and Passivation**, E. McCafferty and R.J. Brodd eds., Electrochem. Soc. Proc. Vol 86-7 (1986) p368

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39. F.M. Delnick, C.D. Jaeger, and S.C. Levy, "AC Impedance Study of Porous Carbon Collectors for Li/$SOCl_2$ Primary Cells", **Chem. Eng. Commun., 35 (1985) p23**

40. F.M. Delnick and W.R. Cieslak, "The Oxidation of $SOCl_2$ Electrolyte on Mo, Ta, W, and Pt Electrodes", **SAND 85-0015 (1985)**

41. F.M. Delnick R.A. Guidotti and D.K. McCarthy, "Chromium (v) Compounds as Cathode Material in Electrochemical Power Supplies" **US PATENT 4,508,796 April 2, 1985**

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44. F.M. Delnick and W.R. Cieslak, "Anodic Behavior of Selected Metals in Neutral $LiAlCl_4$-$SOCl_2$ Electrolyte: Pt, Mo, W, V, Cr, Co, Ni, 316L Stainless Steel", **The Electrochemical Society Fall Meeting, New Orleans, Oct. 1984, Extended Abstracts Vol 84-2 (1984) , Abs. No. 145**

45. F.M. Delnick and D.K. McCarthy, "Electrochemical Reduction of Calcium Chromate" **J. Electrochem. Soc., 130 (1983) p1875**

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47. 83-1 (1983) p17

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49. R.A. Guidotti and F.M. Delnick "Complex Impedance of Ca/$CaCrO_4$/Fe Thermal Battery", **SAND 83-1523 (1983)**

50. F.M. Delnick, "Interpretation of Battery Response to Pulse Loads", **SAND 81-0772 (1982)**

51. S.C. Levy, N.H. Hall, F.M. Delnick and C.D. Jaeger, "Predicting Battery Reliability" **SAND 82-1938 (1982)**

52. R,A. Guidotti, D.K. McCarthy and F.M. Delnick, "Formation of Cr(V) Compounds in Ca/$CaCrO_4$/Fe Thermal Batteries", **The Electrochemical Society Fall Meeting, Detroit, Oct. 1982, Extended Abstracts Vol 82-2 (1982), Abs. No. 340, p547, SAND 82-1077A**

53. F.M. Delnick and R.A. Guidotti, "Diffusion of Nickel in Immobilized LiCl-KCl Eutectic", **The Electrochemical Society Fall Meeting, Detroit, Oct. 1982, Extended Abstracts Vol 82-2 (1982) , Abs. No. 338, p543, SAND 82-1075A**

54. S.C. Levy, C.D. Jaeger and F.M. Delnick, "AC Impedance Characterization of Porous Carbon Electrodes", **In Situ Methods for Characterizing Electrodes and Electrochemical Processes,** J.R. Selman and R. Varma eds., American Institute of Chemical Engineers, Annual Meeting, Los Angeles, 1982, No. 34d, **SAND 82-1508A**

55. C.D. Jaeger, F.M. Delnick and S.C. Levy, "Characterization of Li/SO_2 Battery Electrodes", **11th Conference on Surface Studies and 6th SUBWOG-12B Technical Exchange,** Los Alamos, 1982, **SAND 82-1857A**

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58. F.M. Delnick and N. Hackerman, "Passive Iron: A Semiconductor Model for the Oxide Film" in **Passivity of Metals**, R.P. Frankenthal and J. Kruger eds., Proc. 4th Intl. Symp. on Passivity, The Electrochemical Society Inc., (1978) p116

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