

Victor Koch, PhD
Founder and President
Covalent Associates, Inc.
Bellingham, WA 98229
USA

Over the past thirty years, Dr. Koch has directed R&D in the field of non-aqueous electrolytes for high energy density portable power sources and room temperature ionic liquids. Dr. Koch's publications, review articles and patents in this field have led to a number of invited presentations at the Ionic Liquids Summit, Miami, the New Materials for Electrochemical Devices Conferences, Rome, and the International Conference on Advanced Capacitors, Kyoto. He concluded patent license agreements under the company's ionic liquid technology with industrial partners in North America, Europe and Asia. He received the Battery Innovator Award presented at the 32nd International Battery Seminar and Exhibit. From 2018 through 2020 he designed and prepared ultra-high rate lithium ion battery electrolytes under a U.S. Department of Energy program led by Stanford University.

Education:

Ph.D., Organic Electrochemistry, Colorado State University, 1973
B.S., Chemistry, University of Illinois, 1966

Experience:

Founder and President, Covalent Associates, Inc., Woburn, MA, Corvallis, OR and Bellingham, WA, 1981 - present.

Research Professor, Department of Chemistry and Materials Science, Oregon State University, Corvallis, OR, 1995 - 1999 and 2007 - 2012.

Visiting Professor, University of Rome, "La Sapienza", Rome, Italy, 2004, 2006 and 2008.

Group Leader, EIC Laboratories, Inc., Newton, MA, 1975 - 1981.

Post-doctoral fellow in the field of room temperature molten salts, Colorado State University, 1973 - 1975.

Selected Publications:

"Phase Behaviour, Transport Properties and Interactions in Li-doped Ionic Liquids", *Faraday Disc.*, **154**, 71 (2012).

"Evaluation of Vapor Pressure and Ultra-High Vacuum Tribological Properties of Ionic Liquids", *Tribol. Trans.*, **54**, 911 (2011).

"Thermal Properties and Ionic Conductivity of Imidazolium Bis(trifluoromethanesulfonyl)imide Dicationic Ionic Liquids", *J. Chem. Phys. B*, **113**, 10607 (2009).

"Inorganic-Organic Composite Solid Polymer Electrolytes," *J. Electrochem. Soc.*, **147**, 1251 (2000).

"Differential Capacitance Measurements in Solvent-Free Ionic Liquids at Hg and C Interfaces," *J. Electrochem. Soc.*, **144**, 3392 (1997).

"Chemical Oxidation - A Route to Enhanced Capacity in Li-ion Graphite Anodes," *J. Electrochem. Soc.*, **144**, 2968 (1997).

"The Role of SO₂ as an Additive in Li-ion Organic Electrolyte Systems," *J. Electrochem. Soc.*, **144**, 1159 (1997).

"Li-ion Battery Electrolyte Formulated for Low Temperature Application," *J. Electrochem. Soc.*, **144**, 823 (1997).

"Nonaqueous Electrolyte for Electrochemical Capacitors Comprising Imidazolium Cation and Inorganic Fluorides with Organic Carbonate Solvents," *J. Electrochem. Soc.*, **144**, L84 (1997).

"Intercalation Chemistry of Cobalt and Nickel Dioxides: A Facile Route to New Compounds Containing Organocations", *Material Research Bulletin*, **31**, 767 (1996).

"Ethylmethyl Carbonate: A Promising Solvent for Li-ion Rechargeable Batteries," *J. Electrochem. Soc.*, **143**, L273 (1996).

"Conductance of Solutions of Lithium tris(trifluoromethylsulfonyl) Methide in Water, Acetonitrile, Propylene Carbonate, N,N-Dimethylformamide and Nitromethane at 25°C", *J. Electrochem. Soc.*, **143**, 155 (1996).

"The Intrinsic Anodic Stability of Several Anions Comprising Solvent-Free Ionic Liquids," *J. Electrochem. Soc.*, **143**, 798 (1996).

"New Electrolyte System for Li-ion Battery," *J. Electrochem. Soc.*, **143**, L195 (1996).

"Intercalation Chemistry of Cobalt and Nickel Dioxides: A Facile Route to New Compounds Containing Organocations," *Materials Research Bulletin*, **31**, 7 (1996).

"The Intrinsic Anodic Stability of Several Anions Comprising Solvent-Free Ionic Liquids," *J. Electrochem. Soc.*, **143**, 798 (1996).

"The Interfacial Stability of Li with Two New Solvent-Free Ionic Liquids: 1,2-Dimethyl-3-Propylimidazolium Imide and Methide," *J. Electrochem. Soc.*, **142**, L116 (1995).

"The Stabilization of LiAsF₆/1,3-Dioxolane for Use in Rechargeable Lithium Batteries", *J. Power Sources*, **26**, 519 (1989).

"Electrochemical Stability of LiMF₆ (M = P, As, Sb) in Tetrahydrofuran and Sulfolane", *J. Electrochem. Soc.*, **135**, 2914 (1988).

"New Anions as Supporting Electrolytes for Rechargeable Lithium Batteries", *J. Power Sources*, **20**, 287 (1987)

"The Reactivity of Organic Electrolytes with Lithium: Mechanistic Aspects", *J. Power Sources*, **9**, 247 (1983).

"Specular Lithium Deposits from Lithium Hexafluoroarsenate/Diethyl Ether Electrolytes", *J. Electrochem. Soc.*, **129**, 1 (1982)

"Status of the Secondary Lithium Electrode", *J. Power Sources*, **6**, 357 (1981).

"Structure-Reactivity Relationships of Methylated Tetrahydrofurans with Lithium", *J. Electrochem. Soc.*, **127**, 1461 (1980).

"2-Methyltetrahydrofuran-Lithium Hexafluoroarsenate: A Superior Electrolyte for the Secondary Lithium Electrode", *Science*, **204**, 499 (1979).

"Reactions of Tetrahydrofuran and Lithium Hexafluoroarsenate with Lithium", *J. Electrochem. Soc.*, **126**, 181 (1979).

"The Stability of the Secondary Lithium Electrode in Tetrahydrofuran-Based Electrolytes, *J. Electrochem. Soc.*, **125**, 1371 (1978).

"Electroinitiated Friedel-Crafts Transalkylations in a Room Temperature Molten Salt Medium", *J. Am. Chem. Soc.*, **98**, 5277 (1976).

"Electrochemical Scrutiny of Organometallic Iron Complexes and Hexamethylbenzene in a Room Temperature Molten Salt", *J. Am. Chem. Soc.*, **97**, 3264 (1975).

"Anodic Acetamidation of Adamantane and 1-Haloadamantanes", *Tetrahedron Letters*, **9**, 693 (1973).

"Electrooxidative Fragmentation of Benzylic Aldehydes and Ketones", *Tetrahedron Letters*, **18**, 1389 (1971).

Selected Patents:

"Hydrophobic Ionic Liquids", Japanese Patent 4,693,010 (2011).

"A One-Step Process for the Preparation of Halide-Free Hydrophobic Salts", U.S. Patent 7,189,860 (2007).

"Hydrophobic Ionic Liquids", European Patent 0 839 139 (2003).

"Hydrophobic Ionic Liquids", U.S. Patent 5,827,602 (1998).

"Aprotic Solvent Electrolytes and Batteries Using Same", U.S. Patent 4,118,550 (1978)

Principal Investigator on Various Research Contracts & Grants:

An Improved rechargeable Lithium Electrode	NSF	10/01/81 03/31/82
Modification of Lithium Electrode Reaction Kinetics	NSF	05/01/84-10/31/86
Dilithium Squarate: A Novel Supporting Electrolyte for Lithium Batteries	ARO	07/15/84-09/14/84
Thermally Stable Supporting Electrolytes for Rechargeable Lithium Batteries	NASA	11/02/84-08/01/85
Thermally Stable Supporting Electrolytes for Rechargeable Lithium Batteries—Phase II	NASA	03/01/86 08/31/88
Novel, Stable, Non Complexing Anions for Rechargeable Lithium Batteries	NSF	03/01/87-08/31/87
Microcrystallite TiS ₂ Cathodes for Pulse Power	ONR	07/01/87- 12/31/87
Cycle Life Sensor for Rechargeable Lithium Batteries	NSF	02/01/88-07/31/88
Novel, Stable, Non Complexing Anions for Rechargeable Lithium Batteries--Phase II	NSF	05/01/88 10/31/90
Microcrystallite TiS ₂ Cathodes for Pulse Power--Phase II	ONR	12/01/88 11/30/90
Advanced Implantable Rechargeable Batteries For VAS	NIH	08/01/89-01/31/90
High Rate Polymer Electrolyte Based Rechargeable Lithium Batteries	DOE	08/16/89-02/28/90
High Rate Polymer Electrolyte Based Rechargeable Lithium Batteries—Phase II	DOE	06/15/90 06/14/92
Overcharge Protection Additives for Rechargeable Lithium Batteries	NASA	02/20/91 09/19/91
Advanced Implantable Rechargeable Batteries For VAS—Phase II	NIH	09/01/91 08/31/94
Overcharge Protection Additives for Rechargeable Lithium Batteries—Phase II	NASA	07/10/92 07/09/94
High Cation Mobility Li Polymer Batteries	DOE	07/27/92 02/17/93

High Rate, Solid Inorganic Polymer Electrolyte-Based Bipolar Lithium Batteries	DOD	01/02/93-07/31/93
New Turbostratic Mesocarbon Microbeads and Low Temperature Electrolytes for $\text{Li}_x\text{C}_6/\text{Li}_x\text{CoO}_2$ Cells	DOD	07/02/93-12/31/93
High Cation Mobility Lithium Polymer Batteries	DOE	06/07/93-08/31/95
High Rate, Solid Inorganic Polymer Electrolyte-Based Bipolar Lithium Batteries—Phase II	DOD	04/01/94-09/30/96
Lithium Manganese Oxides as Cathode Materials for Rechargeable Lithium Ion Batteries	DOD	07/07/94-02/06/95
Stabilized Li_xCoO_2 Cathode Material for Use in Rechargeable Li/ LiCoO_2 Batteries	DOD	08/08/94-03/07/95
Lithium Polymer Rechargeable Batteries with Lithium Manganese Oxide Cathodes	DOE	02/20/95-02/28/97
Advanced Materials for Lithium-ion Batteries	DOD	06/27/95-02/28/98
Highly Conductive Polymer Electrolytes for Rechargeable Li Batteries	DOD	07/25/95-03/29/96
Modified LiMn_2O_4 Cathode Materials for Rechargeable Lithium-ion Batteries	ARPA	09/13/95-12/31/98
A Five Volt Lithium-ion Battery	ARO	11/05/96-04/30/97
Rechargeable Li-Ion Cells for VAS Application	NIH	05/01/98-4/30/01
Halogenated Solvents for Non-Flammable Lithium Ion Battery Electrolytes	ARO	09/23/99-09/22/00
Chemically Stable 5V Cathode Materials for Lithium and Lithium-ion Batteries	NASA	12/10/99-06/09/00
Lithium-Ion Polymer Batteries for Implantable Devices	NIH	09/01/00–02/28/01
Advanced Polymer Electrolytes for Lithium-ion Batteries	NASA	05/01/01- 04/30/02
Lithium Ion Batteries for Implantable Medical Devices	NIH	04/01/02–09/30/02

Lithium Ion Batteries for Implantable Medical Devices—Phase II	NIH	04/05/03-03/31/05
Non-Flammable Lithium-ion Battery Electrolytes Capable of Extended Operational Temperatures	WPAFB	06/24/03-03/24/04
Thermal Batteries with Low Internal Operating Temperatures for Missile Applications	WPAFB	04/14/04-01/14/05
Lithium-ion Battery Electrolytes Capable Of Extended Operational Temperature Ranges—Phase II	WPAFB	06/08/04-12/31/06
Novel Electrolyte for -100°C Lithium Battery Application	NASA	01/23/06-07/24/07
New Non-aqueous Electrolyte Components Salts and Solvents	ARO	11/13/06-05/11/07
New and Improved Non-aqueous Electrolyte Components: Solvents and Salts—Phase II	ARO	12/12/08-11/30/10