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EDUCATION

B.S. (Chemistry) North Dakota State University, 1988
Ph.D. (Chemistry) Northwestern University, 1993

PROFESSIONAL EXPERIENCE

North Dakota State University, Fargo, ND

PI, NSF EPSCoR FlexEM Program (10/08-Present)
Director, Center for Surface Protection – Hard Coatings (5/06-Present)
Adjunct Professor, Mechanical Engineering (5/05-Present)
Senior Research Scientist, Center for Nanoscale Science and Engineering (12/03-Present)

CeraMem Corporation, Waltham, MA

Group Leader/Senior Scientist (12/99-12/03)

National Renewable Energy Laboratory, Golden, CO

Scientist II (10/97-11/99)
Scientist I (4/95-10-97)
Post-Doc (4/93-4/95)

RESEARCH INTERESTS

- Precursor chemistries for electronic materials including liquid silanes for printed silicon.
- Atmospheric-pressure deposition processes for electronic materials including spray deposition, plasma-assisted deposition and direct-write (e.g., ink-jet, collimated aerosol beam, laser-induced forward transfer).

SELECTED PUBLICATIONS AND PATENTS

Schulz, D.L.; Sailer, R.A.; Payne, S.; Leach, J.; Molz, R.J. Thin Films by Metal-Organic Precursor Plasma Spray. *J. Vac. Sci. B*, (in revision).

Sailer, R.A.; Wagner, A.; Schmit, C.; Klaverkamp, N.; **Schulz, D.L.** Transparent Conductive Indium Oxide by Atmospheric-Pressure Plasma Deposition, *Surf. Coat. Tech.*, **2008**, *203*, 835-838.

Hoey, J.M.; Halvorsen, A.; Vaselaar, D.; Braaten, K.; Maassel, M.; Reich, M.T.; Akhatov, I.S.; Ghandour, O.; Drzaic, P.; **Schulz, D.L.** Rapid Prototyping of RFID Antennas using Direct-Write, *IEEE Trans. Adv. Packaging* (in revision).

- Halvorsen, A.D.; Vaidya, P.; Robinson, M.; **Schulz, D.L.** Transforming a Laser Micromachiner into a Direct-Write Tool for Electronic Materials, *J. Microelectron. Electronic Packaging*, **2008**, *5*, 116-121.
- Han, S.; Dai, X.; Loy, P.; Lovaasen, J.; Huether, J.; Hoey, J.M.; Wagner, A.; Sandstrom, J.; Bunzow, D.; Swenson, O.F.; Akhatov, I.S.; **Schulz, D.L.** Printed Silicon as Diode and FET Materials - Preliminary Results, *J. Non-Cryst. Solids*, **2008**, *354*, 2623-2626.
- Akhatov, I.S.; Hoey, J.M.; Swenson, O.F.; **Schulz, D.L.** Aerosol flow through a long micro-capillary: collimated aerosol beam, *Microfluid. Nanofluid.*, **2008**, *5*, 215-224.
- Jeppson, P.; Sailer, R.; Jarabek, E.; Sandstrom, J.; Anderson, B.; Bremer, M.; Grier, D.G.; **Schulz, D.L.**; Caruso, A.N. Payne, S.A.; Eames, P.; Tondra, M.; He, H.; Chrisey, D.B. Cobalt Ferrite Nanoparticles: Achieving the Superparamagnetic Limit by Chemical Reduction, *J. Appl. Phys.*, **2006**, 114324/1-114324/7.
- Mascaro, D.J.; Baxter, J.C.; Halvorsen, A.; White, K.; Scholz, B.; **Schulz, D.L.** ChemiBlock Transducers, *Sens. Act. B*, **2007**, *120*, 353-361.
- Curtis, C.J.; Wang, J.; **Schulz, D.L.** Preparation and Characterization of LiMn₂O₄ Spinel Nanoparticles as Cathode Materials in Secondary Li Batteries, *J. Electrochem. Soc.*, **2004**, *151*, A590-A598.
- Schulz, D.L.**; Curtis, C.J.; Ginley, D.S. Surface Chemistry of Copper Nanoparticles and Direct Spray Printing of Hybrid Particle/Metallorganic Inks, *Electrochem. Solid-State Lett.*, **2001**, *4*, C58-C61.
- Parilla, P.A.; Dillon, A.C.; Jones, K.M.; Riker, G.; **Schulz, D.L.**; Ginley, D.S.; Heben, M.J. The First True Inorganic Fullerenes? *Nature*, **1999**, *397*, 114.
- Schulz, D.L.**; Curtis, C.J.; Cram, A.; Alleman, J.L.; Mason, A.; Matson, R.J.; Perkins, J.D.; Ginley, D.S. CIGS Films Via Nanoparticle Spray Deposition: Attempts At Densifying a Porous Precursor, *IEEE Photovoltaic Specialists Conference Proceedings*, **1997**, *26*, 483-486.
- Schulz, D.L.**; Pehnt, M.; Rose, D.H.; Urgiles, E.; Cahill, A.F.; Niles, D.W.; Jones, K.M.; Ellingson, R.J.; Curtis, C.J.; Ginley, D.S. CdTe Thin Films from Nanoparticle Precursors by Spray Deposition, *Chem. Mater.*, **1997**, *9*, 889-900.
- Schulz, D.L.**; Neumayer, D.A.; Marks, T.J. Volatile b-Diketonate Complexes of Calcium (II), Strontium (II), and Barium (II), *Inorganic Syntheses*, **1997**, *31*, 1-7.
- Schulz, D.L.**; Marks, T.J. Superconducting Materials. In *CVD of Non-Metals*; Rees, Jr., W.S., Ed. VCH, Weinheim, 1996, pp 37-150.
- Schulz, D.L.**; Parilla, P.A.; Ginley, D.S.; Voigt, J.A.; Roth, E.P.; Venturini, E.L. Superconducting Tl-Pb-Ba-Sr-Ca-Cu-O(Ag) Thick Films (5-20 mm) Prepared Using a Commercial Spray Pyrolysis System and 2-Zone Furnace Annealing. *IEEE Trans. Appl. Supercond.*, **1995**, *5*, 1962-1965.
- Schulz, D.L.**; Hinds, B.J.; Neumayer, D.A.; Stern, C.L.; Marks, T.J. Barium b-Ketoimate Complexes Containing Appended Ether 'Lariats'. Synthesis, Characterization, and Implementation as Fluorine-Free Barium MOCVD Precursors, *Chem. Mater.*, **1993**, *5*, 1605-1617.

Webster, D.C.; Datta, S.; **Schulz, D.L.** Conductive Ink Compositions Containing Thermoplastics and Conductive Particles, *PCT Int. Appl.* 2007062131.

Schulz, D.L.; Curtis, C.J.; Ginley, D.S. Direct Printing of Thin-Film Conductors Using Metal-Chelate Inks. U.S. Patent 6,830,778, December 14, 2004.

Schulz, D.L.; Curtis, C.J.; Ginley, D.S. Passivating Etchants for Metallic Particles. U.S. Patent 6,436,305, August 20, 2002; World Intellectual Property Organization Patent WO0234435A1, May 2, 2002; European Patent EP1066416A4, January 16, 2002; Australia Patent AU0153780A5, May 6, 2002.

Schulz, D.L.; Curtis, C.J.; Ginley, D.S. Solution Synthesis of Mixed-Metal Chalcogenide Nanoparticles and Spray Deposition of Precursor Films. U.S. Patent 6,126,740, October 3, 2000; World Intellectual Property Organization Patent WO9937832A1, July 29, 1999; European Patent EP1066418A4, May 23, 2001.

Pehnt, M.; **Schulz, D.L.**; Curtis, C.J.; Ginley, D.S. Preparation of a Semiconductor Thin Film. U.S. Patent No. 5,711,803, January 27, 1998; World Intellectual Property Organization Patent WO9712082A1, April 3, 1997.

SELECTED PROFESSIONAL ACTIVITIES

Member, *American Chemical Society*, 1989 - present

Member, *Materials Research Society*, 1993 - present

Member, *Congressional Visits Day – Materials Research Society*, 2008 - present

Co-Editor, *IEEE Transactions on Advanced Packaging – FlexTech2009 special issue*, 2009

SELECTED RESEARCH PROJECTS

“Flexible Electronics and Materials (FlexEM) – a Statewide Research Initiative” NSF/ND EPSCoR, \$3,500,000, October 2009 – September 2014 (PI).

“Center of Excellence in Surface Protection” North Dakota Department of Commerce, \$4,000,000, May 2005 – April 2011 (Director and Co-PI).

“Center for Nanoscale Energy Related Materials” DoE-EERE, \$7,380,000, July 2008 – June 2011 (Co-PI).

“EPSCoR: Spintronics - Statewide Research Initiative” NSF-EPSCoR, \$1,000,000, 06/01/05-05/31/08 (Project Coordinator, Co-PI).

“Electronics and Materials for Flexible Sensors and Transponders” DoD-DMEA, \$2,799,386, March 2008 – September 2009 (Co-PI).

“Gun Barrel Coatings” DoD-ARL, \$1,000,000, March 2007 – June 2009 (Co-PI).

“Durable Hybrid Coatings for Aircraft Systems” DoD-AFRL, \$2,772,800, July 2004 – February 2009 (Co-PI)

“Center of Excellence for Microsensors Systems – Phases IV and V” DoD-DMEA, \$9,000,000, October 2005 – December 2007 (Co-PI).

“Development of Ferromagnetic and Ferroelectric Materials with Spintronic Applications – Phases III and IV” DoD-DMEA, \$1,780,000, July 2004 – June 2007 (Co-PI).