Dennis S. Grimard

Home

411 Burr Oak Drive
Ann Arbor, MI 48103
(734) 913-8065

Office

1246D EECS Building
1301 Beal Avenue
Ann Arbor, MI 48109-2122
(734) 936-1413

Objective

To complement my technical skill-base by accepting managerial challenges that require project leadership, technical vision, augmented people skills and pragmatic budget control with an emphasis on budget discipline.

Education

University of Michigan-Department of EECS **Ann Arbor, MI**
Ph.D., Electrical Engineering, September, 1990
Major: Solid-State Physics, Minor: Circuits

Thesis title: *Utilizing Diffraction for Real-Time In Situ Wafer Monitoring*, directed by Professor F. L. Terry, Jr. and Dr. M. E. Elta. Research utilized scalar diffraction and a high-speed image processor to extract topographical data from the surface of a semiconductor wafer *in situ* and in real-time. Thesis is referenced by authors of several Texas Instruments patents. Development of original thesis has been extended by Professor Terry to include advanced simulation and applications which includes time-evolved 2-D topography maps.

University of Michigan-Department of EECS **Ann Arbor, MI**
M.S., Electrical Engineering, May 1984

Worcester Polytechnic Institute **Worcester, MA**
B.S., Electrical Engineering, May 1982

Vermont Technical College **Randolph Center, VT**
Associates, Mechanical Engineering, May 1977

Experience

University of Michigan-MNF **Ann Arbor, MI**
Managing Director (August 2005 – Present)

Title change from Laboratory Manager to Managing Director of the Michigan Nanofabrication Facility (MNF).

University of Michigan-SSEL **Ann Arbor, MI**
Laboratory Manager (June 2002 – August 2005)

Title change; from Assistant Research Scientist to Laboratory Manager.

University of Michigan-SSEL **Ann Arbor, MI**
Laboratory Manager/Assistant Research Scientist (June 1998 – June 2002)

Plan and manage the operations of a 6500 square foot clean-room research facility as well as provide technical assistance for the primary research faculty. Responsibilities include providing for long-range objectives, policies and procedures for the facility; managing and coordinating the efforts of 15 full-time technicians and engineers; coordinating safety activities to meet university, state and federal regulations; and involving myself in the research activities of the faculty by providing intellectual content into their research.

Dennis S. Grimard

Experience **APVC**, LLC **Ann Arbor, MI**

Member (August 1995 – Present)

Provide consulting services for clients (Applied Materials, Novellus, KLA-Tencor, Pivotal Systems, Intevac) in the semiconductor manufacturing sector. Expertise includes electrostatic chuck design (application issues, electrodynamics, rf design, and materials selection), RIE, and HDP CVD process development (device design considerations, plasma physics, plasma chemistry and vacuum design). Additional services include expert witness consulting (literature research, patent litigation, and on-site technical support for legal teams).

University of Michigan-Center for DTM at the EML **Ann Arbor, MI**

Assistant Research Scientist (August 1995-June 1998)

Provided technical support for primary research faculty in the areas of dry-etch process control, TFT process development (wet and dry), TFT lithography and rf metrology. Responsibilities include process and hardware de-bugging, hardware design and hardware installation.

International Business Machines **Burlington, VT**

Advisory Engineer (October 1991 - August 1995)

Provided worldwide hardware, software and process solutions in support of IBM's 0.35 and 0.5 μM CMOS technologies. Typical challenges ranged from development projects, such as the mono-polar polyimide electrostatic chuck, to the re-engineering of astable RIE plasma processes. In addition to assigned technical challenges, project management tasks required completion of budgets (in most cases one to five million dollars), supplier negotiations and the formation of protocols to guarantee supplier compliance to contracts (which included both technical and financial requirements). Long-range challenges included advanced planning for such projects as the PowerPC and the dry etching of Cu as well as determining "Best-of-Breed" RIE tools for advanced chip-sets.

Techware Systems **Richmond, BC**

Service Engineer (February 1991 - October 1991)

Provided customer assistance with regard to the installation of Techware's real-time process controllers. Job requirements included detailed knowledge of circuits; grounding; vacuum systems; RIE, PECVD and PVD processes; plasma physics and computer systems.

University of Michigan-Department of EECS **Ann Arbor, MI**

Research Fellow (September 1990 - January 1991)

Conducted post-doctoral research into the utilization of diffraction as a practical wafer monitor.

Ford Motor Company-Product Research & Development **Dearborn, MI**

Research Staff Member (September 1990 - January 1991)

Developed reflective NIR optical coatings to reduce a vehicle's thermal load (interior heating) which results from solar radiation incident on the windshield. Research centered on the development of non-stoichiometric PECVD metal oxides which would simultaneously reflect the NIR and transmit the visible. Developed hardware and process to meet project goals.

University of Michigan-Department of EECS **Ann Arbor, MI**

Graduate Student Research Assistant (May 1984 - September 1990)

Conducted thesis-oriented research that required the utilization and detailed knowledge of optics, opto-mechanical components, lasers, the C language, image processors, CCDs, image intensifiers,

Experience plasma systems and the fabrication of two- and three-terminal semiconductor devices in a cleanroom. Additional responsibilities included managing a $220K budget for the SSEL's new RIE dry etcher as well as facilitating the installation of the RIE tool and all the necessary facility hook-ups (vacuum, process gasses, water and electrical).

University of Michigan-Department of EECS **Ann Arbor, MI**
Graduate Student Teaching Assistant (September 1982 - May 1984)

Taught and assisted in the development of solid-state electronics courses. Course titles included: Circuit Analysis, Introduction to Semiconductor Device Theory, Solid-State Device Laboratory and Electronic Properties of Semiconductor Materials.

General Motors Corporation-General Motors Research Laboratories **Warren, MI**
Summer Intern (May 1983 - September 1983)

Developed and tested an optical system to determine the quantity of hydrogen present in PECVD amorphous silicon thin films. Fabrication of silicon thin films and subsequent post-deposition processing of the films in a cleanroom was required.

Cincinnati Milacron-Heald Division **Worcester, MA**
Mechanical Engineer (June 1977 - September 1979)

Designed, assembled and tested subsystems for high-precision internal grinding tools. Additional experience included installation and set-up of Heald systems at customer sites (both overseas and stateside) as well as customer training.

Patents Over ten pending patent disclosures describing the preferred embodiments of processes and structures that improve electrostatic chuck or tool performance in semiconductor manufacturing applications. Actual titles still considered confidential.

Patent describing the preferred embodiment of an improved method for temperature control of process kits. Title of patent: "**Apparatus for Regulating Temperature of a Process Kit in a Semiconductor Wafer-Processing Chamber**," patent number: **6,795,292** issuing date: 21 September, 2004.

Patent describing the preferred embodiment of an improved high voltage and high temperature electrical connector for electrostatic chuck applications. Title of patent: "**High Temperature Connector**," patent number: **6,736,668** issuing date: 18 May, 2004.

Patent describing the preferred embodiment of an improved dielectric insulator for electrostatic chuck applications. Title of patent: "**Electrostatic Chuck Having Composite Dielectric Layer and Method for Manufacture**," patent number: **6,721,162** issuing date: 13 April, 2004.

Patent describing the preferred embodiment of an improved method of gas abetment. Title of patent: "**Method and Apparatus for Improving Exhaust Gas Consumption in an Exhaust Conduit**," patent number: **6,642,489** issuing date: 4 November, 2003.

Patent describing the preferred embodiment of an improved gas conduit for electrostatic chuck applications. Title of patent: "**Fabricating an Electrostatic Chuck Having Plasma Resistant Gas Conduits**," patent number: **6, 581,275** issuing date: 24 June, 2003

Patent describing the preferred embodiment of an improved heater for electrostatic chuck applications. Title of patent: "**Electrostatic Chuck Having Heater and Method**," patent number: **6,538,872** issuing date: 25 March, 2003.

Patents

Patent describing the preferred embodiment of an improved method of electrical coupling for electrostatic chuck applications. Title of patent: "**Plasma Chamber Support with Coupled Electrode**," patent number: **6,494,958** issuing date: 17 December, 2002.

Patent describing the preferred embodiment of an improved bonding material for electrostatic chuck applications. Title of patent: "**Electrostatic Chuck Bonded to Base with a Bond Layer and Method**," patent number: **6,490,146** issuing date: 3 December, 2002.

Patent describing the preferred embodiment of an improved bonding material for electrostatic chuck applications. Title of patent: "**Support for Supporting a Substrate in a Process Chamber**," patent number: **6,490,144** issuing date: 3 December, 2002.

Patent describing the preferred embodiment of an improved high-voltage connector for electrostatic chuck applications. Title of patent: "**Plasma Chamber Support Having Dual Electrodes**," patent number: **6,478,924** issuing date: 12 November, 2002.

Patent describing the preferred embodiment of an improved high-voltage connector for electrostatic chuck applications. Title of patent: "**Electrostatic Chuck Having Improved Electrical Connector and Method**," patent number: **6,462,928** issuing date: 8 October, 2002.

Patent describing the preferred embodiment of an improved RIE chamber. Title of patent: "**Inductively Coupled RF Plasma Reactor Having an Overhead Solenoidal Antenna and Modular Confinement Magnet Liners**," patent number: **6,454,898** issuing date: 24 September, 2002.

Patent describing the preferred embodiment of an improved dielectric material for electrostatic chuck applications. Title of patent: "**Dielectric Covered Electrostatic Chuck**," patent number: **6,414,834** issuing date: 2 July, 2002.

Patent describing the preferred embodiment of an improved heat transfer surface for electrostatic chuck applications. Title of patent: "**Chuck Having Pressurized Zones of Heat Transfer Gas**," patent number: **6,320,736** issuing date: 20 November, 2001.

Patent describing the preferred embodiment of an improved heat transfer cathode for electrostatic chuck applications. Title of patent: "**Electrostatic Chuck Having Gas Cavity and Method**," patent number: **6,310,755** issuing date: 30 October, 2001.

Patent describing the preferred embodiment of an improved rf and dc gas conduit for electrostatic chuck applications. Title of patent: "**Substrate Support for Plasma Processing**," patent number: **6,273,958** issuing date: 14 August, 2001.

Patent describing the preferred embodiment of an improved rf and dc connector for electrostatic chuck applications. Title of patent: "**Connectors for an Electrostatic Chuck and Combination Thereof**," patent number: **6,151,203** issuing date: 21 November, 2000.

Patent describing the preferred embodiment of an improved electrostatic chuck with He gas conduits that are less likely to experience plasma breakdown. Title of patent: "**Electrostatic Chuck Having Improved Gas Conduits**," patent number: **6,108,189** issuing date: 22 August, 2000.

Patent describing the preferred embodiment of a high-density plasma chamber. Title of patent: "**High Density Plasma Chamber**," patent number: **6,095,084** issuing date: 1 August, 2000.

Patent describing the preferred embodiment of an electrostatic chuck that minimizes tilting of the etch profiles at the edge of the wafer. Title of patent: "**Inductively Coupled RF Plasma Reactor Having an Overhead Solenoidal Antenna and Modular Confinement Magnet Liners**," patent number: **6,074,512** issuing date: 13 June, 2000.

Patents

Patent describing the preferred embodiment of an electrostatic chuck that minimizes tilting of the etch profiles at the edge of the wafer. Title of patent: "**Plasma Chamber Support having an Electrically Coupled Collar Ring**," patent number: **6,074,488** issuing date: 13 June, 2000.

Patent describing the preferred embodiment of a low-current and low-voltage electrostatic chuck that reduces the need to control the dc resistivity of the monolithic material. Title of patent: "**Hybrid Johnsen-Rahbek Electrostatic Chuck Having Highly Resistive Mesas Separating the Chuck From the Wafer Support Thereupon and Method of Fabricating Same**," patent number: **5,903,428** issuing date: 11 May, 1999.

Patent describing the preferred embodiment of a process that improves polysilicon RIE uniformity and selectivity to silicon nitride. Title of patent: "**Uniform Gas Flow Arrangements**," patent number: **5,789,324** issuing date: 4 August, 1998.

Patent describing the preferred embodiment of a device that improves polysilicon RIE uniformity and selectivity to silicon nitride. Title of patent: "**Uniform Gas Flow Arrangements**," patent number: **5,639,334**, issuing date: 17 June, 1997.

Patent describing the preferred embodiment of a device that improves the lifetime of a polyimide electrostatic chuck exposed to a high-selectivity silicon dioxide etch. Title of patent: "**Barrier Seal for Electrostatic Chuck**," patent number: **5,636,098**, issuing date: 3 June, 1997.

Patent describing the preferred embodiment of a process that improves mono-silicon RIE deep-trench uniformity, profile and etch rate. Title of patent: "**Deep Trench Process**," patent number: **5,605,603**, issuing date: 25 February, 1997.

Publications

O. D. Paterson, X. Dong, P.P. Khargonekar, V. N. Nair, and **D. S. Grimard,** "Methodology for Feedback Variable Selection for Control of Semiconductor Manufacturing Processes – Part 2: Application to Reactive Ion Etching," *IEEE Transactions on Semiconductor Manufacturing*, Vol 16, No. 4, pp. 588-597, Nov 2003.

H. M. Park, **D. S. Grimard,** and J. W. Grizzle, "Sensor Fault Detection in Etch Based on Broadband rf Signal Observation," *J. Vac. Sci. and Technol., **A**,* Vol. 21, No. 3, May/Jun 2003, pp. 804-824.

H. M. Park, **D. S. Grimard,** J. W. Grizzle, and Fred L. Terry, Jr, "Etch Profile Control of High-Aspect Ratio, Deep Submicron α-Si Gate Etch," *IEEE Transactions on Semiconductor Manufacturing*, Vol 14, No. 3, pp. 242-254, Aug 2001.

S. Ruegsegger, A. Wagner, Jim Freudenberg, and **D. S. Grimard** "Feedforward Control for Reduced Run-to-Run Variation in Microelectronics Manufacturing," *IEEE Transactions on Semiconductor Manufacturing*, Vol. 12, No. 4, pp. 493-502, Nov. 1999.

A. Wagner, S. Ruegsegger, J. Freudenberg, and **D. S. Grimard**, "Interprocess Run-to-Run Feedforward Control for Wafer Patterning," *Proceedings of the 1999 IEEE Conference on Control Applications,* Vol. 1, Kohala Coast, HI, pp. 789-795, Aug. 1999.

C. Garvin, **D. S. Grimard,** and J. W. Grizzle, "Advances in Broad Band RF Sensing for Real-Time Control of Plasma-Based Semiconductor Processing," *J. Vac. Sci. and Technol, **A**,* Vol. 17, No. 4, Jul/Aug 1999, pp. 1377-1383.

H. M. Park, C. Garvin, **D. S. Grimard,** and J. W. Grizzle, "Control of Ion Energy in a Capacitively Coupled Reactive Ion Etcher," *Journal of the Electrochemical Society*, Vol. 145, No. 12, Dec 1998, pp. 4247-4252.

Dennis S. Grimard

Publications S. Ruegsegger, A. Wagner, Jim Freudenberg, and **D. S. Grimard**, "Feedforword Recipe Selection control Design Software," *Proc. SPIE,* Vol. 3507, p. 69-80*, Process, Equipment, and Materials Control in Integrated Circuit Manufacturing, Santa Clara, CA, Sept 1998***.**

C. Garvin, **D. S. Grimard** and J. W. Grizzle, and B. E. Gilchrist,, "Measurement and Error Evaluation of Electrical Parameters at Plasma Relevant Frequencies and Impedance's," *J. Vac. Sci. and Technol.,* ***A****,* Vol. 16, No. 2, Mar/Apr 1998, pp. 595-606.

S. Ruegsegger, A. Wagner, J. Freudenberg, and **D. S. Grimard**, "Improved Fluorine Actinometry in a CF4/Ar Plasma by Estimating Argon Dilution," *Proc. Of the Symposium on Process Control, Diagnostics and Modeling in Semiconductor Manufacturing II, The 191st Meeting of the Electrochemical Society*, Montreal, CA, May 1997.

O. D. Paterson, P. P. Khargonekar, **D. S. Grimard**, X. Dong, and V. N. Nair, "Empirical Modeling of Reactive Ion Etching for Reduction of Variance via Robust, Real-Time Feedback and Run-to-Run Control," *Proc. Of the Symposium on Process Control, Diagnostics and Modeling in Semiconductor Manufacturing II, The 191st Meeting of the Electrochemical Society,* Montreal, CA, May 1997.

T. A. Morris, **D. S. Grimard**, C. F. Shu, F. L. Terry, Jr., M. E. Elta and R. C. Jain, "Utilizing Diffraction Imaging for Non-Destructive Wafer Topography Measurements," *Proc. SPIE Vol. 1926, p. 27-32, Integrated Circuit Metrology, Inspection and Process ControlVII, Michael T. Postek; Ed.*, August 1993**.**

D. S. Grimard, F. L. Terry, Jr. and M. E. Elta, "Theoretical and Practical Aspects of Real-Time Fourier Imaging," *Proc. SPIE Vol. 1392, p. 535-542, Advanced Techniques for Integrated Circuit Processing, James A. Bondur; Terry R. Turner; Eds., March 1991***.**

D. S. Grimard, F. L. Terry, Jr. and M. E. Elta, "*In Situ* Wafer Monitoring for Plasma Etching," *Proc. SPIE, Vol. 1185, p. 234-247, Dry Processing for Sub-micron Lithography, James A. Bondur; Alan R. Reinberg; Eds., January 1990***.**

D. S. Grimard, J. R. Troxell and C. E. Bleil, "Interference-Free Absorption Edge Measurements of Silicon Thin Films," *General Motors Research Publication, GMR-4964***,** *General Motors Research Laboratories*, February 1985**.**

Conferences S. Shannon, A. Patterson, T. Panagopoulos, D. Hoffman, J. Holland and **D. S. Grimard** "Multi-Frequency Sheath Dynamics," *57nd Gaseous Electronics Conference*, Oct 2004.

S. Ruegsegger, A. Wagner, Jim Freudenberg and **D. S. Grimard** "Metrology Feedforward Recipe Selection Control for the Reduction of Run-to-Run Control Variance," *42nd International Conference on Electron, Ion and Photon Beam Technology and Nano-Fabrication*, May 1998.

C. Garvin, **D. S. Grimard** and J. W. Grizzle**,** "RF Sensing and Calibration for Real-Time Control of Plasma-Based Deposition and Etching," *1998 International Conference on Characterization and Metrology for ULSI Technology*, Gaithersberg, MD, March 1998.

S. Ruegsegger, A. Wagner, Jim Freudenberg and **D. S. Grimard**, "Optimal Feedforward Recipe Adjustment for CD Control in Semiconductor Patterning, *1998 International Conference on Characterization and Metrology for ULSI Technology*, Gaithersberg, MD, March 1998.

M. Buie, S. C. Shannon, J. P. Holloway, M. Brake, **D. S. Grimard** and F. L. Terry, Jr.**,** "Characterization and Optimization of Argon Sputter Etching of SiO_2 in the GEC Reference Cell,"*IEEE International Conference on Plasma Science*, May 1997.

Conferences S. Ruegsegger, **D. S. Grimard** and Jim Fruedenberg," Lot-to-Lot Gate CD Control via Feedforward Control from Lithography to RIE," Annual *SRC Research Program Review*, May 1997.

C. Garvin, **D. S. Grimard** and J. W. Grizzle, "Measuring and Controlling RF Quantities for Plasma Processing," Annual *SRC Research Program Review*, May 1997.

H. M. Park, C. Garvin, **D. S. Grimard** and J. W. Grizzle, "Independent Control of Ion Energy for Selectivity Enhancement," Annual *SRC Research Program Review*, May 1997.

O. D. Patterson, P. P. Khargonekar, X. Dong, V. N. Nair and **D. S. Grimard**, "Empirical Modeling for Real-Time Feedback Variable Selection," Annual *SRC Research Program Review*, May 1997.

D. S. Grimard, *et al*, "A Mono-Polar Polyimide ESC for the AMAT MERIE P5000," *SEMICON/West Technical Seminar Series on Enabling Technology*, July 1994.

D. S. Grimard, *et al*, "Advanced Image Processing Techniques for Fourier Imaging," *SRC Techcon*, October 1990.

D. S. Grimard, M. L. Passow, F. L. Terry, Jr. and M. E. Elta, "*In Situ* Monitors and Sensors for Plasma Etching," *SEMICON/Southwest Technical Conference on Metrology for Advanced Materials/Process Characterization*, February 1990.

D. S. Grimard, F. L. Terry, Jr. and M. E. Elta, "*In Situ* Measurement of Wafer Topography Using Real-Time Fourier Imaging," *4th Annual SRC/DARPA Workshop on Computer Integrated Manufacturing,* August 1989.

D. S. Grimard, F. L. Terry, Jr. and M .E. Elta, "*In Situ* Monitoring for Plasma Etching," *SRC/MIT Topical Research Conference on Plasma Etching*, February 1989.

D. S. Grimard, F. L. Terry, Jr. and M. E. Elta, "Process Characterization and Monitoring for RIE," *SRC Techcon*, October 1988.
T. J. Cotler, **D. S. Grimard**, M. S. Barnes and M. E. Elta, "A Microtopography Model for Investigating Plasma/Reactive Ion Etching Trends," *4th International Conference on Plasma Chemistry and Processing*, November 1987.

T. J. Cotler, **D. S. Grimard**, M. S. Barnes and M. E. Elta, "Predicting Plasma/Reactive Ion Etching Topography Using Monte Carlo Methods," *40th Annual Gaseous Electronics Conference*, October 1987.

Awards Excellence in Staff Service Award (UM 2003), First Plateau Award (IBM 1995), Corporate Blue Chip Award (IBM 1995), Outstanding Technical Achievement Award (IBM 1995), First Patent Application Award (IBM 1995), IBM Fellowship (UM 1988, 1989), DeVlieg Fellowship (UM 1986, 1987), Salisbury Award (WPI 1979)

Honors Tau Beta Pi and Eta Kappa Nu

Personal In my leisure time I enjoy playing competitive ice hockey and walking my dog. I also volunteer my time to groups working with young children, senior citizens and the underprivileged.

References Supplied upon request.