

Philip H. Harding, Ph.D., P.E.

philip.harding@oregonstate.edu, Telnet (541)737-6240

ACADEMICS

[University of Washington, Chemical Engineering Dept.](#)

Ph.D. Chemical Engineering 1997: "The Energetics of Adhesion in Composite Materials"

This dissertation was an experimental and theoretical investigation into the relationship between surface energetics and adhesion. Surface characterizations were performed on both planar and capillary structures having inorganic and polymeric composition. A unique adhesion test was developed. Theoretical relationships were used to compare thermodynamic adhesion predictions with experimental adhesion measurements. The work resulted in seven refereed publications.

[Institute of Paper Science and Technology \(IPST\)](#)

M.S. Paper Science and Technology 1992: "Air Knife Flow Visualization"

[Oregon State University, Chemical Engineering Dept.](#)

B.S. Chemical Engineering 1987

EXPERTISE

Project management fundamentals, system analysis and integration, capillary and wetting phenomena, surface characterization, failure mode physics, reliability statistics/engineering/forecasting, transport phenomena/modeling, paper science and manufacturing

EMPLOYMENT

[Oregon State University](#) - Corvallis, OR, Sep 07 - present

Linus Pauling Chair in School of Chemical, Biological, and Environmental Engineering

This endowed professional faculty position has emphasis on preparing senior engineering students for workforce and professional endeavors. Responsibilities include teaching and organization of the capstone senior lab courses, involvement in student design competitions, laboratory equipment development, and working with industrial partners to identify and fund senior projects.

[Hewlett-Packard Company](#) - Corvallis, OR, Oct 97 – Sep 07

Technology Strategist (Master Level Engineer), 2006-2007

Manufacturing: Leading assessment and strategy development for worldwide inkjet printhead and ink supply manufacturing, including interaction between R&D and manufacturing sites, understanding funding models, and influencing management. Responsibilities include evaluation of new technology opportunities and business adjacencies.

Technical Lead (Expert Level Engineer), 2001-2006:

Microfluidic Sensing Applications: Technical team leadership and development of a low-cost, microfluidic platform for multi-step flow sequencing; Platform development included microfluidic design, prototyping, system integration, and testing; Activities in fluidic modeling, chemical reaction engineering, liquid and air management, mechanical design, and optical detection system capability.

Printed Electronics: Technical team leadership focused on creating low-cost electronics using additive processes such as inkjet printing to pattern conductors, resistors, dielectrics, and transistors; System modeling responsibilities for display applications to determine process and material set readiness and requirements; Analytical models for material deposition and liquid film stabilities and development of a drop-substrate interaction monitor for high-speed image capture of microscopic phenomena.

Fuel Cells: Technical team leadership for development SOFC power generation system with fuel/air delivery, thermal packaging, and instrumentation; System modeling for fuel cell technology comparisons including system (customer) requirements in performance and device size and integrating team contributions to make design tradeoffs and analyses; Mass and energy modeling for various fuel cell technologies, including sodium borohydride and direct methanol.

Reliability Engineer (Specialist Level Engineer), 1997-2001:

Developed web-based tool for integrated reliability forecasting, a task requiring negotiation and communication with experienced engineers world-wide. Tool capabilities included multi-failure mode statistics, computation of consumables production requirements based on printer sales, and forecasted reliability. Reliability engineering work relating in-house product and component testing to customer experience through accelerated testing and failure physics characterization; Results included product design changes, modification of thin film surface and use of coupling agents to promote adhesion, and thin film design for stress and bubble reduction

James River Corp. (now [Georgia-Pacific Corp.](#)) – Various sites, Jul 1987 – Aug 1992

Process and Process Control Engineering: Projects included justification and design of wood chip handling and screening system, continuous digester level control, optimization of paper machine additives, implementation of statistical process control to process unit operations.

AWARDS/ACTIVITIES

- Hewlett-Packard Oregon State University ChE Industrial Advisory Panel 2007
- Intel Northwest Science Expo Judge 2006
- Adhesion Society Member since 1998
- Guest lecturer for OSU ChE “Advanced Topics in Polymer Physical Chemistry” 2001
- Professional Engineer certifications: State of Washington since 1997 (#33897), State of Oregon since 2007 (#46013PE)
- President of A.C.E.S. Graduate Student Organization 1996-97
- Visiting Scientist, 1994: Swiss Federal Institute of Technology
- 1993-94 McCarthy Prize for Excellence as a Teaching Assistant
- Seven scientific publications and several conference presentations
- 1992 IPST Annual Alumni Award for Academic Achievement
- 1982 Mabel Norman Albright 4-year tuition scholarship

PATENTS (7 granted, 17 pending)

- "Method and Apparatus To Inhibit Bubble Formation In a Fluid" US 6,458,526
- “Layer With Discontinuity Over Fluid Slot” US 6,527,368
- “Fluid Ejection Device Having a Layer with a Discontinuity” US 7,024,768
- “Hydrogen generation cartridge and portable hydrogen generator” US 7,052,658
- “Regulator and Method of Regulating Fuel Flow to a Fuel Cell by Adsorption” US 7,052,788
- “Fuel Cell Reactant Supply” US 7,122,257
- “Method and System for Dispensing Pelletized Fuel for Use with a Fuel Cell” US 7,128,997

- “Gas Generation System” (20030194369 PENDING)
- “Hydrogen Production System” (20030194368 PENDING)
- “A Method of Facilitating a Chemical Reaction by Applying Radio Frequency Energy” (20030234172 PENDING)
- “Integrated Fuel Container and Impurity Removal Cartridge” (20040175600 PENDING)
- “Emulsion With Discontinuous Phase Including Particle Sol” (20050227096 PENDING)
- “Air Management in a Fluid Ejection Device” (20050280680 PENDING)
- “Ink-Jet Printing of Coupling Agents for Trace or Circuit Deposition Templating” (20060093732 PENDING)
- “Methods and Devices for Modulating Fluid Flow in a Micro-Fluidic Channel” (20060243934 PENDING)
- “Method for Mixing Fluids in Microfluidic Systems” (20060281192 PENDING)
- “Microfluidic Centrifugation Systems” (20060280653 PENDING)
- “A System for Optically Analyzing a Substance” (20070037272 PENDING)
- “Microfluidic Mixing Assembly” (20070028969 PENDING)
- “Micro-Fluidic Device with Neutralization and Neutralization Methods”, (20070065346 PENDING)
- “Reconfigurable Value Using Optically Active Material” (20070092409 PENDING) “Microfluidic Test Systems with Gas Bubble Reduction” (PENDING)
- “Liquid Sequestering Material for a Microfluidic Device” (PENDING)
- "Platform for Magnetic Particle-Based Microfluidic Assays" (PENDING)
- “Print Head Laminate” (PENDING)

PUBLICATIONS

- "Direct measurement of residual stress effects on adhesion", P.H. Harding, S. Page, J.C. Berg, J.-A. Manson, *J. Adhesion Sci. Technol.*, 12, 497, 1998.
- "Identification of a surface phase transition in synthetic calcium hydroxyapatite using inverse gas chromatography", P.H. Harding, G. Panjabi, J.C. Berg, *J. Mater. Sci. Lett.*, 17(10), 1998.
- "The adhesion promotion mechanism of organofunctional silanes", P.H. Harding, J.C. Berg, *J. Appl. Polym. Sci.*, 67, 1025-1033, 1997.
- "The characterization of interfacial strength using single particle composites", P.H. Harding, J.C. Berg, *J. Adhesion Sci. Technol.*, 11(8), 1063-1076, 1997.
- "The role of adhesion in the mechanical properties of filled polymer composites", P.H. Harding, J.C. Berg, *J. Adhesion Sci. Technol.*, 11(4), 471-493, 1997.
- "Fiber surface energy effects on the mechanical properties of unidirectional fiber composites", M. Connor, P.H. Harding, J.C. Berg, J.-A. Manson, *Proc. Intl. Conf. Composite Materials*, 10th, 6, 541-548, 1995.
- "Influence of the fiber surface properties on the mechanical strength of unidirectional fiber composites", M. Connor, P.H. Harding, J.-A. Manson, J.C. Berg, *J. Adhesion Sci. Tech.*, 9(7), 983-1004, 1995.

REFERENCES AVAILABLE UPON REQUEST