Joel B. Christian, P.E., Ph.D., BCEE

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Experience

Management Managed operating groups up to 35 people, including up to 5 Ph.D. level scientists, engineers, technicians, foremen, hourly workers, and tradesmen. Management of personnel, work, schedules, and budgets. Career mentoring for retention and mutual benefit.

Engineering Discovery of new structural and catalyst materials and expanded commercial applications for existing materials. Early determination of financial benefit. Responsible for inception, design, start-up and continued operation of numerous projects in the $5-$35M range. Expert in process modeling and simulation. Experience in quality troubleshooting and accident investigation, including explosions, and prevention measures for risk reduction.

Project Management Managed large projects, including a 1.3 MGD industrial wastewater treatment plant, delivered on-time and $2M under its $12M budget. Integration of long-term and large projects to existing business systems. Planning, visualization and communication of project to all stakeholders.

Environmental Compliance Experience in obtaining and maintaining regulatory compliance with Air, Water, and Solid Waste permits, including NPDES, Title V eligibility, and solid waste processing permits. Experience in estimating emission levels via process models. Experience in public and private sector, ISO documentation systems.

Employee Development Technical mentor for recent hires, supervisor of dozens of chemical engineering co-op terms.

Education

Ph. D. Materials Science, **Binghamton University**, December 2007.
Specializing in solid state chemistry and electrochemistry.
Advisor: M. S. Whittingham

Civil & Environmental Engineering, **Cornell University**.
Completed 21 hr PhD core in Environmental Engineering.

M. Eng. Chemical Engineering, **Cornell University**.
Bioprocess engineering emphasis.
GTE Division Fellow.

B. S. Chemical Engineering, **S.U.N.Y. at Buffalo**.
Biochemical Engineering emphasis.

Registration and Certification

Registered Professional Engineer; New York, Pennsylvania.

Board Certified Environmental Engineer; American Academy of Environmental Engineers and Scientists.

Six Sigma Green Belt, SBTI

Lean Manufacturing, Rochester Institute of Technology

Work Record

Consulting Engineer	July ‘15 to Present. **Professional Engineer**, design and environmental projects over a wide range of scope.
R&D Manager, Chemistry and Chemical Engineering	Dec. '14 to June ‘15. **Global Tungsten & Powders Corp.**, Towanda PA. Lead corporate R&D team to measurable goals in technology, productivity and profitability in manufacturing technology and new product development.
Manager, Advanced Research	Oct. '02 to Nov. '14. **Global Tungsten and Powders Corp.,** Towanda PA. Lead Process Development efforts in new areas of membrane and catalyst technology. Specifically focusing on theoretical and applied discovery of non-precious electrocatalysts, fuel processing catalysts and fuel processing schemes. Leadership in other proprietary high-risk technical projects.
Staff Engineer	May '00 to Sept. '02. **OSRAM SYLVANIA INC. Chem & Met Products, Research and Development**, Towanda PA. Lead new product initiative for electrocatalysts and gas—solid catalyst systems and related technology related to fuels, fuel processing, and PEM fuel cells.
Advanced Research Engineer	April '92 to May '00. **OSRAM SYLVANIA INC. Chem & Met Products, Research and Development**, Towanda PA. *Advanced Engineer, Chemical Development Laboratory*. Provide chemical process engineering support to the Division. Develop and facilitate process changes in manufacturing areas for new and existing processes. Environmental and safety aspects included in scope. Resource for product and environmental concerns. Batch and continuous process simulation coordinator for Division. Lead for accident investigation and new plant design after a major plant explosion.
Project Manager	August '89 to April '92. **GTE Chem & Met Division**, Towanda PA. *Project Manager*. Overall direction for design and construction of an $8.7 M wastewater treatment system, including concept development, technical direction of all engineering and scientific disciplines, project schedule and cost control.

Engineering Supervisor	August '86 to August '88. **GTE Chem & Met Division**, Towanda PA. *Engineering Supervisor, Plant Services and Environmental Engineering*. Manage the operations of 25 service departments, with 24 people. Lead environmental compliance for Division.
Senior Engineer	June '81 to August '86. **GTE Chem & Met Division**, Towanda PA. *Sr. Engineer*, Plant Services. Designed several major expansions and many smaller improvements. Led hydrogen safety initiative.
Summer Employee	Summer 1978 & 9. **Eastman Kodak Company**, Rochester, NY. Summer help, R&D Stockroom, B-82.

Publications

19. Joel B. Christian , Héctor D. Abruña and M. Stanley Whittingham, *"Synthesis and characterization of tungsten oxides and their potential application as catalysts and supports", in preparation,* Journal of Molecular Catalysis A *(2016).*

18. *Nick Troescher and Joel B. Christian, "Determination of Free Energy of Formation of Aqueous Thiomolybdate Ion, MoS42-(aq)", in preparation,* Hydrometallurgy *(2016).*

17. Joel B. Christian, Juan R. L. Trasorras, *"Aqueous Process Modeling to Determine Free Energy of Formation for Ammonium Paratungstate and Future Process Capabilities"*, **Proceedings, 18th Plansee Seminar**, RM 32, p318 (2013).
16. Joel B. Christian , M. Stanley Whittingham, *"Structural Study of Ammonium Metatungstate"*, **Journal of Solid State Chemistry** 181 (2008) p1782-1791.
15. Sean P. E. Smith, Joel B. Christian, *"Mechanism of the coupled 24-electron reduction and transformations among the blues browns and reds of ammonium metatungstate,"* **Electrochemica Acta** 53 (2008) p2994-3001.
14. Joel B. Christian, *"Tungsten Fuel Cell Catalysts,"* Ph.D. Dissertation, SUNY at Binghamton, NY, USA.
13. Joel B. Christian , Sean P. E. Smith, M. Stanley Whittingham and Héctor D. Abruña, *"Tungsten Based Electrocatalyst for Fuel Cell Applications"*, **Electrochemistry Communications, 9** (2007) p2128-2132.
12. *"Simulating Aqueous Processes"* **Chemical Engineering Progress**, **99**(9) (Sept 2003), p32-39. (2007).
11. *"Use Utility Functions to Select Capital Equipment"* **reprinted** *in* Nalven, Gail F., editor, **Plant Operation and Optimization,** American Institute of Chemical Engineers, NY. (1996), p319-321.
10. "Utility Functions — Decision Making Tools" **Encyclopedia of Chemical Processing and Design**, John J. McKetta, Editor. Marcel Dekker, Inc. *Volume 60, p194-205.*
9. Tungsten Carbide; Processing and Use" **Encyclopedia of Chemical Processing and Design**, John J. McKetta, Editor. Marcel Dekker, Inc. *Volume 59, p153-162.*
8. "Tungsten; Processing and Use" **Encyclopedia of Chemical Processing and Design**, John J. McKetta, Editor. Marcel Dekker, Inc. *Volume 59, p109-130.*
7. "Thickeners and Clarifiers Design and Operation" **Encyclopedia of Chemical Processing and Design**, John .J. McKetta, Editor. Marcel Dekker, Inc. *Volume 58 p61-77* (1996).
6. *"Engineers, Invest Young! — Applying the Principles of Engineering Economics to Your Personal Life"* **Chemical Engineering Progress**, **91**(7) (July 1995), p109-112.
5. *"Estimate Emissions With a Process Screening Air Model"* **Chemical Engineering Progress**, **91**(6) (June 1995), p59-62.

4. *"Use Utility Functions to Select Capital Equipment"* **Chemical Engineering Progress**, **91**(3) (March 1995), p92-94.
3. *Improve Clarifier and Thickener Design and Operation"* **Chemical Engineering Progress**, **90**(7) (July 1994), p50-56.
2. *"Combine Fault and Event Trees for Safety Analysis"* **Chemical Engineering Progress**, **93**(4) (April 1997), p72-75.
1. *"Computer Simulation of Tungsten Hydrometallurgy"*, **Proceedings, 10th Annual General Meeting**, International Tungsten Industry Association, London (1997).

25 proprietary Technical Documents published for OSRAM SYLVANIA, INC. internal use.

U.S. Patents:

U.S. Patent 5,120,447 "Method for Removing Heavy Metals from Wastewater" J.B. Christian, June 9, 1992.
U.S. Patent 5,806,206 "Gas distributor for vertical gas/solid reactors" J.B. Christian, Aug 22, 1997.
U.S. Patent 6,551,569 "Supported Tungsten Carbide Catalyst" Christian et al. (2003)
U.S. Patent 6,656,870 "Tungsten Containing Fuel Cell Catalyst and Method of Making Same" Christian et al., Dec 2, 2003.
U.S. Patent 6,696,184 "Supported Tungsten Carbide Material" Christian et al. (2004)
U.S. Patent 7,060,648 "Tungsten Containing Fuel Cell Catalyst and Method of Making Same" Christian et al., (2006).
U.S. Patent 7,727,927," Method of making tungsten-containing fuel cell catalyst" Christian et al., (2010).

Presentations and Invited Talks

"Non-noble Catalysts and Materials", Basic Energy Sciences DOE Workshop, May 13-15, 2003, Rockville, MD.

"Next Generation Electrocatalysts", Gordon Research Conference – Fuel Cells, July 2004, Roger Williams University, Bristol, RI.

"Tungsten Fuel Cell Catalysts", (Paper A9.18) Materials Research Society Annual Meeting, Dec. 1, 2005, Boston, MA.

J. Christian et al., "Tungsten Cathode Catalyst for PEM Cells", 2006 DOE Hydrogen, Fuel Cells Infrastructure Technologies Program Review, May 17, 2006, Arlington, VA.

"XRD Characterization of the Thermal Decomposition Products of Ammonium Metatungstate", 34th Northeast Regional Meeting (NERM), American Chemical Society, October 5-7, 2006, Binghamton, NY.

"Rare Earth Metals", PowderMet 2013, June 24, 2013, Chicago, IL.

Professional Interests

Materials Discovery

Discovery of new materials for specific product applications. Experience with calalysts, ion exchange materials, intercalated materials, chemical, metal, and composite materials discovery. Development of intermediates in high-value applications. Discovery using a wide variety of screening methods including design of experiments (DOE), computer modeling, structure analog discovery, biomimetics, and conventional techniques. Testing of new materials physical, chemical, and catalytic properties.

New Product Development

Development of new products and new uses for existing products. Identification of new product ideas, early development of cost models and financials, integrating development effort with existing resources, and early and frequent communication with potential customers. Idea generation for project que, project ranking based on financial and risk factors, and project execution. Integration of new products within the product portfolio and manufacturing capabilities.

Engineering Design

Design of chemical processes to meet manufacturing objectives as well as minimize effects on the environment and worker safety. Design of buildings and facilities on residential, commercial, and industrial scale. Scaling of reactions and mixing systems with focus on mixing, reaction kinetics and mixture rheology. Pilot scale process and product confirmation.

Process Simulation

Utilizing computers to model processses to aid design of new processes and improve existing ones. Experience with SimSci Pro/II and Process, AspenPlus, HYSYS, OLI Electrolytes, HSC Chemistry, and F.A.C.T. System. Expert user in Aspen Plus using Electrolyte Thermodynamics for continuous and batch process simulation. Mathematical and Aspen Plus simulations and validation to data for kinetic and equilibrium reaction models. Scale-up using models of laboratory reactions scaled to microreactor, pilot, and plant scale. Separation simulations including HPLC and SMB (simulated moving bed).

Bioprocess Engineering

Bioprocess/biochemical engineering, scale-up and scale-out of processes using GMP principles. Specialty in separation by membrane, ion exchange, and advanced chromatography methods. Process development including scale-down, pilot plant, and modular chemical plants.

Technical Communication

Written, oral, and video training mediums applied to communicating technical concepts. Training program development.

Risk Analysis and Decision Science

With application in market analysis, product safety, process safety, and medical treatment schemes, the science of decision making and the interface of man with technology is a vast unexplored field. Safety and risk analysis using advanced rigorous probabilistic statistical techniques as well as more common HAZOP and FMEA methods.

Incident Investigation

Incident investigation, including survey of accident scene, data collection, determination of root cause, recommend new preventative measures. Lead investigator for 1993 plant explosion, report led to successful financial settlement for replacement plant.

Quality System Management

Using data-driven approach to maintaining consistent product quality; focusing on people, process, and product. Modern tools including probabilistic trees and matrices, decision science, risk analysis, design of experiments, training and re-training systems, worker involvement, and measurement systems. Experience with ISO 9000, 14001 compliant systems.

Environmental Quality

Evaluation of water quality, design and operation of physical, chemical and biological water treatment systems. Stormwater management. Permitted water and wastewater treatment systems. Evaluation and modeling of air emissions, design and operation of control systems. Full cycle of estimating, permitting, verification, long-term operation, air and stack monitoring, emission models, Title V compliance. Minimization of generation and disposal of residual, solid, and hazardous wastes. Hazardous Materials Management. Proper classification, selection, qualification and shipment to treatment and disposal facilities. Establishing storage protocols. Experience in permitting TSD facilities.

Regulatory Issues

Industry-specific focus on state and federal regulation and compliance issues. Experience with DEP, DEC, and EPA on issue resolution with and without legal counsel. Experience with materials processing including metals, wood, paints, solvents, water and contaminants, receiving stream studies, air emissions, worker exposure, exposure doses, air pollution modeling, monitoring. Experience with monitoring regulatory changes and providing public comment.

Materials and Catalysts for Energy Systems

The design and application of specialized materials for energy storage, conversion, and generation. Special emphasis on low-cost, poison-tolerant catalysts for fuel cell applications.

Hydrometallurgy

The application of inorganic equilibrium chemistry to purification processes involving electrochemistry, redox reactions, digestion and dissolution, precipitation and crystallization, exploiting differences in reaction kinetics and thermodynamic equilibrium to improve product quality and reduce operating costs. Includes purification methods such as continuous ion exchange chromatography, liquid ion exchange, membrane and filtration systems.

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