ENSER Corporation

ENSER Corporation established its battery-based power systems line in 1993 and has won multiple Department of Defense (DOD) Awards for its strategic and tactical defense system batteries. It provides mission critical batteries to first tier and second tier Defense Contractors as well as Branches of the US DOD. ENSER Corporation has an outstanding record of design, development, and manufacture of batteries and battery packs. The Company has relevant CIHT cell engineering and production capabilities.

Validation Team:

Dr. James K, Pugh, The Director of Technology
Dr. Ethirajulu Dayalan, The Research Fellow

James K. Pugh, Ph.D.

Education

1999 - 2001 Lawrence Berkeley National Lab Berkeley, CA
Post-Doctoral, John Kerr Research Group

Design, synthesis and characterization of advanced polymers and molecules/monomers for mobile power sources, light emitting diodes and catalytic substrates.

- Investigation of degradation mechanisms for small organic/salt complexes and chemistry of the solid/electrolyte interface (SEI) in secondary batteries.
- Design of custom organic additives and non-flammable materials.
- Collaborative research with Phil Ross and Kim Kinoshita.

1998 - 2001 University of California at Berkeley Berkeley, CA
Post-Doctoral, Andrew Streitwieser Research Group

Synthesized U.V. active organic molecules for use in aggregation studies of lithium enolates.

- Determination of aggregation state and pKa measurements by U.V. spectroscopy, SVD analysis and computational modeling.
- Maintained UNIX workstations, Mac and PC computers.
- Managed undergraduate researchers.

1993 - 1998 Oregon State University Corvallis, OR
Ph. D. Physical Organic Chemistry, Peter Freeman Advisor

Research involving environmental and mechanistic photochemistry, kinetic analysis,

mechanistic carbene chemistry and organic synthesis.

- Instrumental in producing initial research from newly formed computational chemistry laboratory.
- Administered UNIX workstations and personal computers.
- Five years teaching experience.

1985 - 1991 Boise State University Boise, ID

B. S. Biology, Charles Baker Advisor

- Microbiology laboratory teaching assistant.
- Research on animal physiology and behavior.
- Courses included Biochemistry, Microbiology, Histology, Ecology, Physiology, Embryology and Anatomy.

Skills

- Synthesis: Experience with both small scale and multi-step organic and polymer synthesis.
- Isolation: Ability to separate and purify organic molecules via distillation, chromatography, recrystallization, sublimation and preparatory techniques.
- Electrochemical: cyclic voltammetry, two and three electrode systems, Impedance spectroscopy, cell cycling and design.
- Chromatography: GC, HPLC, GPC, column (flash and gravity) and TLC.
- Powder Analysis: Powder Rheometry, Particle Morphology, Tap Density, Angle of Repose, Hall Flowmeter, Scott Volumeter, Flodex, Moisture Analysis, Particle Size Analysis.
- Thermal: thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC)
- Spectroscopy: NMR, MS, UV/Vis, IR, Emission.
- Computational Chemistry: Extensive use of Gaussian and Spartan software, proficient in Hyperchem and Q-chem.
- Computer: Excellent PC skills, proficient in UNIX, Macintosh and web page authoring and maintenance.

Professional experience

May 2006 - Present The ENSER Corporation Pinellas Park, FL

Director of Technology

- Principal Investigator for Several SBIR Projects.
- Powder research investigating powder flow, powder analytical procedures and direct changes to fundamental powder properties to enhance and optimize production procedures.
- Novel techniques of thermal battery production involving the use of tape casting to form and fabricate complete thermal batteries.
- Use of automation techniques to optimize production techniques.
- New material analytical support.
- Internal procedure review and documentation.

- Patent research and evaluation.
- Failure Analysis.
- Proposal, report and patent writing.
- Involved in purchasing, scale-up and qualification of materials.
- Project management.
- Manager of four direct reports

Jan 2009 – July 2010 St. Petersburg College St. Petersburg, FL

Adjunct Faculty

- Organic Chemistry Laboratory Instructor
- General Chemistry Laboratory Instructor

Sep 2008 – April 2009 Solicore, Inc. Lakeland, FL

Consultant

- Aggregation Studies/Failure Analysis
- Data Analysis
- Expert consultant for thin film batteries
- Implementation of Document Control
- Novel Thin Film/Polymer Electrolyte Systems

June 2005 – June 2007 BrimStone Research Pinellas Park, FL

Consultant

- President of BrimStone Research, L.L.C.
- Developed acid sensing thin films.
- Expert consultant for thin film batteries. Duties involved safety testing and analysis, transportation requirements, failure analysis.

Sep 2002-May 2006 Solicore, Inc. Lakeland, FL

Senior Research Scientist

- Quality control – both analytical and observational.
- Materials scientist – both organic and inorganic, material design and formulation.
- Studies on the cause and effect of interfacial chemistry between ionically and electronically conducting materials and polymer separators.
- Novel electrode design and implementation.
- Monomer (small organic molecule) design and synthesis.
- Patent research and evaluation.
- Chairperson – safety committee.
- Involved in purchasing, scale-up and qualification of materials.
- Helped obtain 14 million dollars in venture capital funding.
- Marketing support – technical.
- Project management.
- Involved in proposal writing and grant support.

Feb 2001 – Sep 2002 Valence Technology Henderson, NV

Senior Research Scientist

- Project Leader – Organic Research. Research involved novel liquid, polymer and molten salt electrolytes as well as additives, novel salts and passivation enhancement agents. Additional research into redox shuttles.
- Managed two Ph.D. scientists and one technician.
- Designed and developed functional organic laboratory.
- Synthesized and critically evaluated molten salt technology – saving the company an eight million dollar purchase.
- Solved a mechanistic degradation problem that had intermittently stopped production for the last three years.
- Evaluated the chemistry behind a packaging material problem and proved cause and effect.
- Small scale, multi-step and polymer synthesis.
- Training of laboratory technicians and hiring of new personnel.
- Mechanistic investigation into additives.
- Member Patent Council.
- Involved in the theory, design, development and scale-up of novel materials.

1999 - 1999 Orrick, Harrington and Sutcliff Menlo Park, CA

Chemical Consultant

Outlined a developmental timeline of chemical invention.

- Analysis and interpretation of laboratory notebooks and reports.

1986 - 1991 Hewlett-Packard Boise, ID

LaserJet Printer Technician

- Technical support for nine printer products.
- Specialist in HPGL and PCL programming languages.
- Developed training materials and presentations.
- Edited and adapted application notes for technical documentation.

Publications and presentations

Publications: 1 JACS, 4 JOC, 1 Auk, 1 JIM, 3 JECS, 3 in preparation

Patents: 2 awarded, 3 in process, 3 provisional

Presentations: 3 (American Chemical Society), Invited Speaker U.S. Patent Office, Power Sources Conference

Professional memberships	American Chemical Society, Phi Lambda Upsilon, Phi Kappa Phi, Sigma Xi, Electrochemical Society
Awards received	Milton Harris Teaching Assistant Award, Laboratory Teaching Assistant Award, Four time recipient Tartar Research Fellowship, Biology and Chemistry department scholarships, 2 time recipient Oregon Sports Lottery scholarship

Ethirajulu Dayalan, Ph.D.

Dr. Dayalan has about 30 years of experience in research and development, process scale-up and manufacturing in the electrochemical and materials-related areas, including about 15 years experience within the battery industry and over 3 years experience in the electrolytic chlor-alkali industry. He has a Ph.D. in Electrochemistry from the Indian Institute of Technology, Madras, India. Dr. Dayalan has held several senior technical positions in battery industry including Engineering Fellow (ENSER Corporation), VP of product development (Planar Energy), Director of R&D (Solicore) and Staff Scientist (Eagle Picher). He helped develop and scale-up chemistries for manufacturing lithium ion, primary lithium polymer and molten salt high temperature batteries. He has also been involved in the development of thin film and all solid state battery technologies. He has developed novel methods for synthesis of ceramic materials. Recent work involved synthesis of higher energy cathodes and anodes for molten salt thermal batteries with potential for doubling the energy density.

Dr. Dayalan has extensive experience in writing proposals, working in, guiding and overseeing technical personnel in the funded projects, writing progress reports and making technical presentations. He has been involved in funded projects from NSWC, CECOM/CERDEC, NASA, MDA, USAF and USARMY.

He has published about 40 technical papers and made presentations at several national and international conferences.

Selected Publications:

1. Advances in Thermal Battery Anodes, R. Marcinski, E. Dayalan, J. Pugh, Proceedings of the 44rd Power Sources Conference, 7/2010

2. Innovative Fabrication of High Energy Cathode Materials and Integrated, On-board Power Solutions, J. R. Pitts, E. Dayalan, A. J. Manning, I. Oladeji, C. Nelson, Proceedings of Nanotech Conference and Expo 2009, Houton, TX.
3. *In-Situ* Cathode Thermal Battery, E. Dayalan, D. Harney, N. Shuster, Proceedings of the 43rd Power Sources Conference, 7/2008
4. Electrochemical Impedance Spectroscopy: An Important Tool in Understanding Cell Components and in
5. Development of Lithium-Ion Cells, E. Dayalan, Proceedings of the 39th Power Sources Conference, 6/2000
6. Graphite-Tin Composite Anodes for Lithium-Ion Battery, E. Dayalan in Lithium Batteries, eds. R. A. Marsh, Z. Ogumi, J. Prakash and S. Surampudi, Electrochemical Society Proceedings Volume **99-25**
7. A Novel Route for the Synthesis of $Sr_{1-x}Ba_xNb_2O_6$ Thin Films, A. Kasbani, M. S. Tomar and E. Dayalan, Journal of Materials Research, **10** (1995) 2404
8. Prediction of Erosion-Corrosion Penetration Rate in a Carbon Dioxide Environment with Sand J. R. Shadley, S. A. Shirazi, E. Dayalan and E. F. Rybicki, Corrosion, **54** (1998) 972
9. Modeling CO_2 Corrosion of Carbon Steels in Pipe Flow, E. Dayalan, G. Vani, J. R. Shadley, S. A. Shirazi and E. F. Rybicki, CORROSION/95, Paper # 118 (NACE International, Houston, TX, 1995)
10. Electrochemical Investigations in Microemulsion Media-3. In situ Determination of the Distribution of Electroactive Solutes Between Aqueous and Organic Domains, E. Dayalan, S. Qutubuddin and J. Texter, J. Colloid Interface Sci., **143** (1991) 423