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RESEARCH EXPERIENCE

Chemist, Argonne National Laboratory
• Directs atomic layer deposition research program
• Leads research, development and commercialization of ALD coating technology
• Process Technology Research Group, Energy Systems Division

Visiting Scientist, Argonne National Laboratory
• Lead research and development of industrial ultra-nanocrystalline diamond coatings
• R&D100 Award winner, "Ultrananocrystalline Diamond (UNCD) Mechanical Seals" 2008
• Initiated atomic layer deposition research program

Senior Research Associate, University of Colorado
Principle Investigator: Professor Steven M. George
• Directed the Atomic Layer Deposition Laboratory
• Designed and constructed viscous flow reactors for atomic layer deposition
• Studied atomic layer growth of metals, oxides, nitrides and composite materials

Postdoctoral Research Associate, University of Colorado
Principle Investigators: Professors Steven M. George and Margaret A. Tolbert
• Employed ultra-high vacuum techniques to investigate the atomic layer deposition of metals
• Studied the interactions of H_2O and HCl with α-Al_2O_3(0001) surfaces modeling rocket exhaust

Research Assistant, University of Chicago
Thesis Advisor: Professor Donald H. Levy
• Designed and constructed apparatus for studying laser desorption phenomena
• Thesis title: "Laser Desorption of Organic Compounds"

Undergraduate Research Assistant, Cornell University
Research Advisor: Professor John R. Wiesenfeld
• Assisted in developing photoacoustic laser spectrometer
• Developed graphical software for visualizing molecular dynamics simulations

EDUCATION

University of Colorado — Boulder, CO
- Senior Research Associate — February, 2000 - May 2002
- Postdoctoral Research Associate — June, 1996 - January, 2000
- Steve George Research Group

University of Chicago — Chicago, IL
- Ph.D. in Physical Chemistry — December, 1995

- Swift Fellowship
- Donald Levy Research Group

Cornell University Ithaca, NY

- B.A. in Chemistry, *Summa cum Laude* June, 1988
- Dean's List

AREAS OF EXPERTISE

- Atomic layer deposition, viscous flow reactors, thin film growth and characterization, in situ techniques, atomic force microscopy, ellipsometry, stylus profiler, four-point probe, mercury probe
- Ultra-nanocrystalline diamond thin film growth using plasma-enhanced chemical vapor deposition, Raman microanalysis, scanning electron microscopy, EDAX analysis
- Design and construction of scientific apparatus, computer interfacing for experimental control and data acquisition, precision machining
- Surface chemistry and ultra-high vacuum techniques, Auger electron spectroscopy, low energy electron diffraction, temperature programmed desorption, laser induced thermal desorption
- Laser spectroscopy, YAG, excimer and pulsed dye lasers, harmonic generation, time of flight mass spectrometry, position sensitive detectors

PROFESSIONAL ACTIVITIES

- Session Chair - ALD and Applications Session 6, 218th ECS Meeting, 2010
- Program Committee – 10th International Confererence on Atomic Layer Deposition, Seoul, South Korea, June 20-23, 2010
- Conference Chair – 9th International Conference on Atomic Layer Deposition – ALD2009, Monterey CA, July 19-22, 2009.
- Program Committee – 8th International Conference on Atomic Layer Deposition - ALD2008, Bruges, Belgium, June 29-July 2, 2008
- Co-Organizer – ALD and Applications Session 2-5, ECS Meetings, 2006-2009
- Editor – Atomic Layer Deposition Applications 2-4, ECS Transactions, 2006-2008
- Member – Institute for Atom-Efficient Chemical Transformations (IACT)
- Member – Argonne-Northwestern Solar Energy Research Center (ANSER)
- Member – Argonne Center for Electrical Energy Storage (CEES)

PATENTS AND INFORMATION DISCLOSURES

1) J. W. Elam, J. A. Libera, and M. J. Pellin, “Spatially Controlled Atomic Layer Deposition in Porous Materials”, US Patent Application 2009/0304920 A1, (2009).
2) S. Vajda, M. J. Pellin, J. W. Elam, C. L. Marshall, R. A. Winans, and K.-H. Meiwes-Broer, “Subnanometer and Nanometer Catalysts, Method for Preparing Size-Selected Catalysts, US Patent Application US 2009/0233790 A1, (2009).

3) J. W. Elam, M. J. Pellin, J. A. Libera, P. C. Stair, G. Zajac, and S. A. Cohen, "Catalyst and Systems Incorporating the Catalyst", US Patent Application US 2009/0191101 A1, (2009).

4) J. W. Elam, P. Guyot-Sionnest, "Atomic Layer Deposition for Functionalizing Colloidan and Semiconductor Nanoparticles", US Patent Application US 2009/0315016 A1, (2009).

5) J. W. Elam, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, "Synthesis of Transparent Conducting Oxide Coatings", US Patent Application 2008/0286448 A1.

6) M. J. Pellin, J. W. Elam, U. Welp, A. B. Martinson, and J. T. Hupp, "Heterojunction Photovoltaics Assembled with Atomic Layer Deposition", US Patent Application 2009/0000660 A1, (2006).

7) J. A. Carlisle, M. J. Pellin, J. W. Elam and J. Wang, "Hermetic bio-inert coatings for bio-implants fabricated using atomic layer deposition", US Patent Application 20060251875, (2004).

8) M. J. Pellin, J. W. Elam and J. N. Hryn, "Catalytic Nanoporous Membranes", US Patent 7,625,840, (2002).

9) J. Birrell, J. A. Carlisle, J. W. Elam, D. M. Gruen and X. Xiao, "Synthesis of a self assembled hybrid of ultrananocrystalline diamond and carbon nanotubes", US Patent Application 20060222850, (2003).

10) M. J. Pellin, J. R. Hryn and J. W. Elam, "Atomic Layer Deposition for High Temperature Superconductor Material Synthesis", US Patent Application 20040178175, (2003).

11) V. M. Bright, J. W. Elam, F. H. Fabreguette , S. M. George, N. Hoivik, Y. C. Lee and R. J. Linderman, M. K. Tripp, "Atomic Layer Deposition on Micro-Mechanical Devices", US Patent 7,426,067, (2002).

12) N. N. Naguib, J. Birrell, J. W. Elam, J. A. Carlisle, and O. H. Auciello, "Use of Tungsten Interlayer to Enhance the Initial Nucleation and Conformality of Ultrananocrystalline Diamond (UNCD) Thin Films", US Patent Application 20070257265, (2006).

13) J. W. Elam, M. J. Pellin, and P. C. Stair, "Method of Preparing Size-Selected Metal Clusters", US Patent Number 7,713,907, (2006).

PUBLICATIONS

1) A. Yanguas-Gil and J. W. Elam, "Growth rate control in ALD by surface functionalization: alkyl alcohols on metal oxides", ECS Trans. **33** (2), 333 (2010).

2) D. Hess, M. Mushfiq, R. Dalvi, R. Winter, U. Sampathkumaran, K. Goswami, A. Yangaus-Gil, and J. W. Elam, "Dye-Sensitized Solar Cells Fabricated from Atomic Layer Deposited Photoanodes on Aerogel Scaffolds", ECS Trans. **33** (2), 245 (2010).

3) D. J. Comstock, S. T. Christensen, J. W. Elam, M. J. Pellin, and M. C. Hersam, "Synthesis of nanoporous activated iridium oxide films by anodized aluminum oxide templated atomic layer deposition", Electrochemistry Communications, **12**, 1543-1546, (2010).

4) D. J. Comstock, S. T. Christensen, J. W. Elam, M. J. Pellin, and M. C. Hersam, "Tuning the Composition and Nanostructure of Pt/Ir Films via Anodized Aluminum Oxide Templated Atomic Layer Deposition", Advanced Functional Materials, **20**, 3099-3105, (2010) - ***Selected as "frontspiece" – full page callout***.

5) S. Lee, B. Lee, F. Mehmood, S. Seifert, J. A. Libera, J. W. Elam, J. Greeley, P. Zapol, L. A. Curtiss, M. J. Pellin, P. C. Stair, R. E. Winans, and S. Vajda, "Oxidative Decomposition of Methanol on

Subnanometer Palladium Clusters: The Effect of Catalyst Size and Support Composition", Journal of Physical Chemistry C, **114**, 10342–10348, (2010).

6) Q. Peng, Y.-C. Tseng, S. B. Darling, and J. W. Elam, "Patterned Nanomaterials with Tunable Dimensions via Atomic Layer Deposition on Block Copolymers", Advanced Materials, *Web Published*, (2010).

7) S. T. Christensen, H. Feng, J. A. Libera, N. Guo, J. T. Miller, P. C. Stair, and J. W. Elam, "Supported Ru-Pt Bimetallic Nanoparticle Catalysts Prepared by Atomic Layer Deposition", Nano Letters, **10**, 3047-30-51, (2010).

8) Y. Lei, F. Mehmood, S. Lee, J. Greeley, B. Lee, S. Seifert, R. E. Winans, J. W. Elam, R. J. Meyer, P. C. Redfern, D. Teschner, R. Schlögl, M. J. Pellin, L. A. Curtiss, and S. Vajda, "Increased Silver Activity for Direct Propylene Epoxidation via Subnanometer Size Effects", Science, **328**(5975), 224-228, (2010).

9) R. J. Narayan, S. P. Adiga, M. J. Pellin, L. A. Curtiss, S. Stafslien, B. Chisholm, N. A. Monteiro-Riviere, R. L. Brigmon, and J. W. Elam, "Atomic layer deposition of nanoporous biomaterials", Materials Today, **13** (3), 60-64, (2010).

10) W. Setthapun, W. D. Williams, S. M. Kim, H. Feng, J. W. Elam, F. A. Rabuffetti, K. R. Poeppelmeier, P. C. Stair, E. A. Stach, F. H. Ribeiro, J. T. Miller, and C. L. Marshall, "Genesis and evolution of surface species during Pt atomic layer deposition on oxide supports characterized by in-situ XAFS analysis and water-gas shift reaction", J. Phys. Chem. C, **114** (21), 9758–9771 (2010).

11) J. W. Elam, J. A. Libera, E. T. Huynh, H. Feng, and M. J. Pellin, "Atomic Layer Deposition of Aluminum Oxide in Mesoporous Silica Gel" J. Phys. Chem. C, 114 (41), 17286-17292, (2010).

12) H. Feng, J. W. Elam, J. A. Libera, W. Setthapun, and P. C. Stair, "Palladium Catalysts Synthesized by Atomic Layer Deposition for Methanol Decomposition", Chemistry of Materials, **22**, 3133-3142, (2010).

13) R. J. Narayan, S. P. Adiga, M. J Pellin, L. A Curtiss, A. J. Hryn, S. Stafslien, B. Chisholm, C.-C. Shih, C.-M. Shih, S.-J. Lin, Y.-Y. Su, C. Jin, J. Zhang, N. A Monteiro-Riviere1, and J. W. Elam, "Atomic Layer Deposition-Based Functionalization of Materials for Medical and Environmental Health Applications", P. Trans. R. Soc. A., **368** (1917), 2033-2064, (2010).

14) D. J. Comstock, J. W. Elam, M. J. Pellin, M. C. Hersam, "Integrated ultramicroelectrode-nanopipette probe for concurrent scanning electrochemical microscopy and scanning ion conductance microscopy", Analytical Chemistry, **82** (4) 1270-1276, (2010).

15) H. Feng, J. W. Elam, J. A. Libera, M. J. Pellin, and P. C. Stair, "Oxidative Dehydrogenation of Cyclohexane over Alumina-Supported Vanadium Oxide Nanoliths", Journal of Catalysis, **269**, 421-431, (2010).

16) R. J. Narayan, N. A. Monteiro-Riviere, R. L. Brigmon, M. J. Pellin, and J. W. Elam, "Atomic Layer Deposition of Titanium Oxide Thin Films on Nanoporous Alumina Templates for Medical Applications", JOM, **61** (6), 12-16, (2009).

17) Z. Feng, C.-Y. Kim, J. W. Elam, Q. Ma, Z. Zhang, M. J. Bedzyk, "Direct atomic-scale observation of redox-induced cation dynamics in an oxide supported monolayer catalyst: WO_x / α-Fe2O3(0001)", JACS, **131**, 18200–18201, (2009).

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19) J. A. Libera, J. W. Elam, T. Rajh, N. F. Sather, and N. M. Dimitrijevic, "Iron(III)-oxo centers on TiO_2 for visible light photocatalysis", Chemistry of Materials, **22**, 409-413, (2010).

20) S. T. Christensen and J. W. Elam, "Atomic layer deposition of Ir-Pt alloy films", Chemistry of Materials, **22**, 2517–2525, (2010).

21) S. Vajda, S. Lee, K. Sell, I. Barke, A. Kleibert, V. von Oeynhausen, K-H Meiwes-Broer, A. F. Rodríguez, J. W. Elam, M. J. Pellin, B. Lee, S. Seifert, and R. E. Winans, "Combined temperature-programmed reaction and in situ x-ray scattering studies of size-selected silver clusters under realistic reaction conditions in the epoxidation of propene", Journal of Chemical Physics, **131**, 121104-1 – 121104-4 (2009). - ***Journal of Chemical Physics Editor's Choice 2009 Award***.

22) S. Vajda, M. J. Pellin, J. P. Greeley, C. L. Marshall, L. A. Curtiss, G. A. Ballentine, J. W. Elam, S. Catillon-Mucherie, P. C. Redfern, F. Mehmood, and P. Zapol, "Subnanometre platinum clusters as highly active and selective catalysts for the oxidative dehydrogenation of propane", Nature Materials **8**, 213 – 216 (2009).

23) H. Feng, J. W. Elam, J. A. Libera, M. J. Pellin, and P. C. Stair, "Catalytic Nanoliths", Chemical Engineering Science, **64**, 560–567, (2009).

24) S. T. Christensen, J. W. Elam, F. A. Rabuffetti, Q. Ma, S. Weigand, B. Lee, S. Seifert, P. C. Stair, K. R. Poeppelmeier, M. C. Hersam, and M. J. Bedzyk, "Controlled Growth of Platinum Nanoparticles on Strontium Titanate Nanocubes by Atomic Layer Deposition", Small, **5** (6), 750–757, (2008).

25) A. B. F. Martinson, J. W. Elam, and M. J. Pellin, "Atomic Layer Deposition of Cu_2S for Application in Photovoltaics", Appl. Phys. Lett., **94**, 123107, (2008).

26) A. Pourret, P. Guyot-Sionnest, and J. W. Elam, "Atomic Layer Deposition of ZnO in Quantum Dot Thin Films", Advanced Functional Materials, **21**, 232–235, (2008).

27) S. T. Christensen, J. W. Elam, B. Lee, Z. Feng, M. J. Bedzyk, and M. C. Hersam, "Nanoscale structure and morphology of atomic layer deposition platinum on $SrTiO_3$ (001)," *Chem. Mater.*, **21**, 516 (2009).

28) T. Proslier, J. Zasadzinski, J. Moore, M. Pellin, J. Elam, L." Cooley, C. Antoine, J.Norem, and K. E. Gray, "Improvement of the superconductivity of cavity-grade niobium coated by Atomic Layer Deposition", Appl. Phys. Lett., **93**, 192504 (2008).

29) S. Lee, L. M. Molina, M. J. Lopez, J. A. Alonso, B. Hammer, B. Lee, S. Seifert, R. E. Winans, J. W. Elam, M. J. Pellin, and S. Vajda, "Selective Propene Epoxidation on Immobilized Au_{6-10} Clusters: The Effect of Hydrogen and Water on Selectivity and Activity", Angew. Chem. Int. Ed, **48,** 1467 – 1471, (2009).

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31) T. Y. Shvareva, S. V. Ushakov, A. Navrotsky, J. A. Libera, and J. W. Elam, "Thermochemistry of nanoparticles on a substrate: Zinc oxide on amorphous silica", J. Mater. Res., **23** (7), 1907-1915, (2008).

32) A. B. F. Martinson, J. W. Elam, J. Liu, J. T. Hupp, and M. J. Pellin, "Radial Electron Collection in Dye-Sensitized Solar Cells", Nano Letters, **8** (9) 2862-2866 (2008).

33) J. A. Libera, J. W. Elam, and M. J. Pellin, "Conformal ZnO Coatings on High Surface Area Silica Gel Using Atomic Layer Deposition", Thin Solid Films, **516**, 6158–6166, (2008).

34) S. P. Adiga, L. A. Curtiss, J. W. Elam, M. J. Pellin, Chun-Che Shih, Chun-Ming Shih, Shing-Jong Lin, Yea-Yang Su, J. Zhang, R. J. Narayan, "Nanoporous Materials for Biomedical Devices", JOM, **60** (3), 26-32, (2008).

35) T. W. Hamann, A. B. F. Martinson, J. W. Elam, M. J. Pellin, and J. T. Hupp, "Aerogel Templated ZnO Dye-Sensitized Solar Cells", Advanced Materials, **20**, 1560-1564, (2008).

36) J. W. Elam, M. J. Pellin, S. D. Elliott, A. Zydor, M. C. Faia and J. T. Hupp, "Mechanism for Zirconium Oxide Atomic Layer Deposition using Bis(methylcyclopentadienyl)methoxymethyl Zirconium", Appl. Phys. Lett., **91** 253123-1 – 253123-3, (2007).

37) X. Zhang, J. Zhao, A. V. Whitney, J. W. Elam, and R. P. Van Duyne, "Ultrastable Substrates for Surface-Enhanced Raman Spectroscopy: Al_2O_3 Overlayers Fabricated by Atomic Layer Deposition Yield Improved Anthrax Biomarker Detection", J. Am. Chem. Soc., **128** 10304-10309 (2007).

38) A. V. Whitney, J. W. Elam, P. C. Stair, and R. P. Van Duyne, "Towards A Thermally Robust Operando Surface-Enhanced Raman Spectroscopy (SERS) Substrate", J. Phys. Chem. C., **111** (45) 16827-16832, (2007).

39) Jiha Sung, K. M. Kosuda, J. Zhao, J. W. Elam, K. G. Spears, and R. P. Van Duyne, "Stability of Silver Nanoparticles Fabricated by Nanosphere Lithography and Atomic Layer Deposition to Femtosecond Laser Excitation", J. Phys. Chem. C., 112 (15), 5707-5714, (2007).

40) J. W. Elam, D. A. Baker, A. J. Hryn, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, "Atomic Layer Deposition of Tin Oxide Films Using Tetrakis(dimethylamino) Tin", J. Vac. Sci. Tech. A., **26** (2) 244-252, (2008).

41) J. W. Elam, J. A. Libera, P. C. Stair, and M. J. Pellin, "Spatially Controlled Atomic Layer Deposition in Porous Materials", Appl. Phys. Lett., **91** 243105-1 – 243105-3, (2007).

42) J. W. Elam, D. A. Baker, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, "Atomic Layer Deposition of Indium Tin Oxide Films Using Nonhalogenated Precursors", J. Phys. Chem. C, **112**, 1938-1945, (2007).

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46) J. W. Elam, A. V. Zinovev, M. J. Pellin, D. J. Comstock, and M. C. Hersam, "Nucleation and Growth of Noble Metals on Oxide Surfaces Using Atomic Layer Deposition", ECS Transactions, **3** (15): 271-278 2006.

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48) T. F. Baumann, J. Biener, Y. M. Wang, S. O. Kucheyev, E. J. Nelson, J. H. Satcher, Jr., J. W. Elam, M. J. Pellin, and A. V. Hamza, "Atomic Layer Deposition of Uniform Metal Coatings on Highly Porous Aerogel Substrates", Chem. Mater., **18**, 6106-6108, (2006).

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50) S. Vajda, R. E. Winans, J. W. Elam, B. D. Lee, M. J. Pellin, S. Seifert, G. Y. Tikhonov, and N. A. Tomczyk, "Supported gold clusters and cluster-based nanomaterials: characterization, stability and growth studies by in situ GISAXS under vacuum conditions and in the presence of hydrogen", Topics in Catalysis, **39** (3-4): 161-166 (2006).

51) P. C. Stair, C. Marshall, G. Xiong, H. Feng, M. J. Pellin, J. W. Elam, L. Curtiss, L. Iton, H. Kung, M. Kung, and H. -H. Wang, "Novel, uniform nanostructured catalytic membranes" , Topics in Catalysis, **39**, (3–4), 181-186, (2006).

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53) J. W. Elam, G. Xiong, C. Y. Han, H. Hau Wang, J. P. Birrell,U. Welp, J. N. Hryn, M. J. Pellin, T. F. Baumann, J. F. Poco, and J. H. Satcher, Jr, "Atomic Layer Deposition for the Conformal Coating of Nanoporous Materials", Journal of Nanomaterials, **2006**, 1–5, (2006).

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56) J. W. Elam, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, "Atomic Layer Deposition of In_2O_3 Using Cyclopentadienyl Indium: A New Synthetic Route to Transparent Conducting Oxide Films", Chemistry of Materials, **18**, 3571-3578, (2006).

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