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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 H₂O and HCl with α -Al₂O₃(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](#)

- Senior Research Associate
- Postdoctoral Research Associate
- [Steve George Research Group](#)

Boulder, CO
February, 2000 - May 2002
June, 1996 - January, 2000

[University of Chicago](#)

- Ph.D. in Physical Chemistry

Chicago, IL
December, 1995

- Swift Fellowship
- [Donald Levy Research Group](#)

Cornell University

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

Ithaca, NY

June, 1988

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

- 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

PATENTS AND INFORMATION DISCLOSURES

- 1) J. W. Elam, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, “Synthesis of Transparent Conducting Oxide Coatings”, US Patent Application, (2006).
- 2) 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, (2006).
- 3) 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).
- 4) M. J. Pellin, J. W. Elam and J. N. Hryn, “Catalytic Nanoporous Membranes”, [US Patent Application 20050065028](#), (2003).
- 5) 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).
- 6) M. J. Pellin, J. R. Hryn and J. W. Elam, "Atomic Layer Deposition for High Temperature Superconductor Material Synthesis", [US Patent Application 20040178175](#), (2003).

- 7) 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).
- 8) 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).
- 9) J. W. Elam, M. J. Pellin, and P. C. Stair, "Method of Preparing Size-Selected Metal Clusters", [US Patent Application 20070265159](#), (2006).

PUBLICATIONS

- 1) 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).
- 2) H. Feng, J. W. Elam, J. A. Libera, M. J. Pellin, and P. C. Stair, "Catalytic Nanoliths", [Chemical Engineering Science](#), **64**, 560–567, (2009).
- 3) S. T. Christensen, J. W. Elam, F. A. Rabuffetti, Q. Ma, S. Weigand, B. Lee, S. Seifert, P. C. Stair, K. R. Poepfelmeier, 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).
- 4) A. B. F. Martinson, J. W. Elam, and M. J. Pellin, "Atomic Layer Deposition of Cu₂S for Application in Photovoltaics", [Appl. Phys. Lett.](#), **94**, 123107, (2008).
- 5) 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).
- 6) 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 SrTiO₃ (001)," [Chem. Mater.](#), **21**, 516 (2009).
- 7) T. Proslir, 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).
- 8) 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 Au₆₋₁₀ Clusters: The Effect of Hydrogen and Water on Selectivity and Activity", [Angew. Chem. Int. Ed.](#), **48**, 1467 – 1471, (2009).
- 9) T. W. Hamann, A. B. F. Martinson, J. W. Elam, M. J. Pellin, and J. T. Hupp, "Atomic Layer Deposition of TiO₂ on Aerogel Templates: New Photoanodes for Dye-Sensitized Solar Cells", [J. Phys. Chem. C](#), **112** (27), 10303–10307, (2008).
- 10) 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).
- 11) 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).

- 12) 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, \(2008\)](#).
- 13) 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, \(2008\)](#).
- 14) 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, \(2008\)](#).
- 15) 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, \(2007\)](#).
- 16) X. Zhang, J. Zhao, A. V. Whitney, J. W. Elam, and R. P. Van Duyne, "Ultrastable Substrates for Surface-Enhanced Raman Spectroscopy: Al₂O₃ Overlayers Fabricated by Atomic Layer Deposition Yield Improved Anthrax Biomarker Detection", [*J. Am. Chem. Soc.*, **128** 10304-10309 \(2007\)](#).
- 17) 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, \(2007\)](#).
- 18) 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, \(2007\)](#).
- 19) 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, \(2008\)](#).
- 20) 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, \(2007\)](#).
- 21) 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, \(2007\)](#).
- 22) A. B. F. Martinson, J. W. Elam, J. T. Hupp, and M. J. Pellin, "ZnO Nanotube Based Dye-Sensitized Solar Cells", [*Nano Letters*, **7** \(8\) 2183-2187, 2007](#).
- 23) J. W. Elam, J. A. Libera, P. C. Stair, and M. J. Pellin, Spatially Controlled Atomic Layer Deposition in Porous Membranes, *ECS Transactions*, **11** (7):177-184 (2007).
- 24) M. J. Pellin, J. W. Elam, and J. F. Moore, "ALD Capping Layers for Superconducting Radio Frequency Accelerator Cavities", *ECS Transactions*, **11** (7):23-28 (2007).
- 25) 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.
- 26) M. J. Pellin, J. W. Elam, J. A. Libera, A. B. F. Martinson, and J. T. Hupp, "Transparent Conducting Oxides at High Aspect Ratio", *Proceedings of the Electrochemical Society*, *ECS Transactions*, **3** (15): 243-247 2006.
- 27) 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, \(2006\)](#).

- 28) R. E. Winans, S. Vajda, G. E. Ballentine, J. W. Elam, B. D. Lee, M. J. Pellin, S. Seifert, G. Y. Tikhonov, and N. A. Tomczyk, "Reactivity of supported platinum nanoclusters studied by in situ GISAXS: clusters stability under hydrogen" [Topics in Catalysis](#), **39** (3-4): 145-149 (2006).
- 29) 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).
- 30) 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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- 32) 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).
- 33) S. Vajda, R. E. Winans, G. E. Ballentine, J. W. Elam, B. Lee, M. J. Pellin, S. Seifert, and G. Y. Tikhonov, "Highly stable gold and platinum model nanocatalysts fabricated from size-selected clusters", Abstracts of Papers of the American Chemical Society, **231**, 21 (2006).
- 34) J. W. Elam, J. A. Libera, M. J. Pellin, A. V. Zinovev, J. P. Greene, and J. A. Nolen, "Atomic layer deposition of W on nanoporous carbon aerogels", [Appl. Phys. Lett.](#), **89**, 053124, (2006).
- 35) J. W. Elam, A. B. F. Martinson, M. J. Pellin, and J. T. Hupp, "Atomic Layer Deposition of In₂O₃ Using Cyclopentadienyl Indium: A New Synthetic Route to Transparent Conducting Oxide Films", [Chemistry of Materials](#), **18**, 3571-3578, (2006).
- 36) C.-Y. Kim, J. W. Elam, M. J. Pellin, D. K. Goswami, S. T. Christensen, M. C. Hersam, P. C. Stair, and M. J. Bedzyk, "Imaging of atomic layer deposited (ALD) tungsten monolayers on α -TiO₂(110) by X-ray standing wave Fourier inversion", [J. Phys. Chem. B.](#), (25), **110**, 12616-12620 (2006).
- 37) J. W. Elam, A. Zinovev, C. Y. Han, H. -H. Wang, U. Welp, J. N. Hryn and M. J. Pellin, "Atomic Layer Deposition of Palladium Films on Al₂O₃ Surfaces", [Thin Solid Films](#), **515**, 1664-1673 (2006).
- 38) K. K. Yadavalli, A. O. Orlov, G. L. Snider and J. W. Elam, "Aluminum Oxide Tunnel Barriers for Single Electron Memory Devices", [Microelectronics Journal](#), **36**, 272-276 (2005).
- 39) J. W. Elam, M. J. Pellin, and P. C. Stair, "Method of Preparing Size-Selected Metal Clusters", ANL-IN-05-116, US Patent Application 20070265159 (2005).
- 40) F. H. Fabreguette, Z. A. Sechrist, J. W. Elam, S. M. George "Quartz crystal microbalance study of tungsten atomic layer deposition using WF₆ and Si₂H₆", [Thin Solid Films](#) **488** (1-2), 103-110 (2005).
- 41) G. Xiong, J. W. Elam, H. Feng, C. Y. Han, H. -H. Wang, L. E. Iton, L. A. Curtiss, M. J. Pellin, M. Kung, H. Kung, and P. C. Stair, "Effect of Atomic Layer Deposition Coatings on the Surface Structure of Anodic Aluminum Oxide Membranes", [J. Phys. Chem. B.](#), **109** (29), 14059-14063 (2005).

- 42) A. V. Whitney, J. W. Elam, S. Zou, A. V. Zinovev, P. C. Stair, G. C. Schatz and R. P. Van Duyne, "Localized Surface Plasmon Resonance Nanosensor: A High-Resolution Distance Dependence Study using Atomic Layer Deposition", *J. Phys. Chem. B*, **109** (43), 20522-20528, (2005).
- 43) M. J. Pellin, P. C. Stair, G. Xiong, J. W. Elam, J. Birrell, L. Curtiss, S. M. George, C. Y. Han, L. Iton, H. Kung, M. Kung, H. -H. Wang, "Mesoporous Catalytic Membranes: Synthetic Control of Pore Size and Wall Composition", *Catalysis Letters*, **102** (3-4), 127-130 (2005).
- 44) X. Xiao, J. W. Elam, S. Trasobares, O. Auciello and J. A. Carlisle, "Synthesis of a Self-Assembled Hybrid of Ultrananocrystalline Diamond and Carbon Nanotubes", [*Adv. Mater.*, **17**, 1496 \(2005\)](#).
- 45) J. W. Elam and M. J. Pellin, "GaPO₄ Sensors for Gravimetric Monitoring during Atomic Layer Deposition at High Temperatures", [*Anal. Chem.*, **77**, 3531 \(2005\)](#).
- 46) S. O. Kucheyeva, J. Biener, Y. M. Wang, T. F. Baumann, K. J. Wu, T. van Buuren, A. V. Hamza, and J. H. Satcher, Jr., J. W. Elam and M. J. Pellin, "Atomic Layer Deposition of ZnO on Ultralow-Density Nanoporous Silica Aerogel Monoliths", [*Appl. Phys. Lett.*, **86**, 083108 \(2005\)](#).
- 47) S. Vajda, R.E. Winans, J.W. Elam, B. Lee, M.J. Pellin, S.J. Riley, S. Seifert, G.Y. Tikhonov and N. A. Tomczyk, "In Situ GISAXS Studies of the thermal Stability and Temperature Induced Growth of Supported Cluster-Based Platinum and Gold Nanoparticles" *Am. Chem. Soc. , Div. Fuel Chem.*, **50** (1), pp. 190-191 (2005).
- 48) K. K. Yadavalli, N. R. Anderson, T. A. Orlova, A. O. Orlov, G. L. Snider and J. W. Elam, "Single Electron Memory Devices Utilizing Al₂O₃ Tunnel Oxide Barriers", [*J. Vac. Sci. Technol. B*, **22** \(6\), 3119-3123 \(2004\)](#).
- 49) Y. Zhang, M. L. Dunn, K. Gall, J. W. Elam, and S. M. George, "Suppression of Inelastic Deformation of Nanocoated Thin Film Microstructures", [*Journal of Applied Physics*, **95** \(12\), 8216-8225, \(2004\)](#).
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- 53) J. W. Elam, D. Routkevitch and S. M. George, "Properties of ZnO/Al₂O₃ Alloy Films Grown Using Atomic Layer Deposition Techniques", [*J. Electrochem. Soc.*, **150** G339-G347, \(2003\)](#).
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- 56) N. D. Hoivik, J. W. Elam, R. J. Linderman, V. M. Bright, S. M. George and Y. C. Lee, "Atomic Layer Deposited Protective Coatings for Micro-Electromechanical Systems", [*Sensors and Actuators A*, **103**, \(1-2\), 100-108 \(2003\)](#).

- 57) J. W. Elam, D. Routkevitch, P. P. Mardilovich and S. M. George, "Conformal Coating on Ultrahigh-Aspect-Ratio Nanopores of Anodic Alumina by Atomic Layer Deposition", [Chem. Mater., 15, 3507-3517 \(2003\)](#).
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- 59) M. D. Groner, J. W. Elam, F. H. Fabreguette and S. M. George, "Electrical Characterization of Thin Al₂O₃ Films Grown by Atomic Layer Deposition on Silicon and Various Metal Substrates ", [Thin Solid Films, 413, 186-197, \(2002\)](#).
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- 65) J. W. Elam, M. D. Groner and S. M. George, "Viscous Flow Reactor with Quartz Crystal Microbalance for Thin Film Growth by Atomic Layer Deposition ", [Rev. Sci. Instr., 73, 2981-2987 \(2002\)](#).
- 66) N. D. Hoivik, J. W. Elam, S. M. George, K. C. Gupta, V. M. Bright, and Y. C. Lee, "Atomic layer deposition (ALD) technology for reliable RF MEMS," in [Proc. IEEE MTT-S 2002 Int. Microwave Symp., Seattle, WA, June 02-07, 1229-1232 \(2002\)](#).
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- 70) C. E. Nelson, J. W. Elam, M. A. Tolbert and S. M. George, "H₂O and HCl Adsorption on Single Crystal α - Al₂O₃(0001) at Stratospheric Temperatures, [Appl. Surf. Sci., 171, \(1-2\), 21-33 \(2001\)](#).
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