

# CLIFFORD K. HO

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Citizenship: United States

## EDUCATION

### UNIVERSITY OF CALIFORNIA AT BERKELEY

**Ph.D.** Mechanical Engineering, May, 1993. G.P.A ~ 3.9/4.0

*Courses:* Emphasis in heat and mass transfer, fluid dynamics, and engineering analysis (numerical methods and applied math)

*Thesis:* "Evaporation of Multicomponent Hydrocarbon Liquids in Porous Media"

*Advisor:* Professor Kent S. Udell

**M.S.** Mechanical Engineering, December, 1990

*Project:* "A Mass Transfer Model for the Removal of a Volatile Organic Compound from Heterogeneous Porous Media During Vacuum Extraction"

*Advisor:* Professor Kent S. Udell

### UNIVERSITY OF WISCONSIN—MADISON

**B.S.** Mechanical Engineering, May, 1989. G.P.A. ~ 3.9/4.0

## RESEARCH EXPERIENCE

### SANDIA NATIONAL LABORATORIES - ALBUQUERQUE, NEW MEXICO (6/93-Present)

*Senior Member of Technical Staff (1993-1997)*

*Principal Member of Technical Staff (1997-2003)*

*Distinguished Member of Technical Staff (2003-Present)*

- Develop microchemical sensor systems and novel characterization methods for real-time, continuous, in-situ sensing of volatile organic compounds ([www.sandia.gov/sensor](http://www.sandia.gov/sensor))
- Evaluate sensors and methods for detecting trace explosives for Homeland Security
- Perform probabilistic analyses of heat- and mass-transfer applications using stochastic methods for risk and performance assessment for long-term waste isolation ([www.sandia.gov/caps](http://www.sandia.gov/caps))
- Develop models of chemical transport processes through the skin for transdermal drug delivery ([www.sandia.gov/geobio](http://www.sandia.gov/geobio))
- Perform numerical simulations and analytical analyses of problems related to environmental restoration and nuclear waste management
- Predict flow and transport of groundwater and contaminants in heterogeneous and fractured porous media in thermally perturbed systems (<http://me.unm.edu/~cliff/thermo.html>)
- Validate mathematical models of heat and mass transfer processes in porous media through combined experimental and numerical studies

### BERKELEY ENVIRONMENTAL RESTORATION CENTER (BERC) - UNIVERSITY OF CALIFORNIA AT BERKELEY 8/89-5/93

*Research Assistant:* Investigated the recovery of volatile hydrocarbons from porous media during a soil decontamination process known as soil vapor extraction. Incorporated theoretical modeling and experimentation in the analysis of liquid and gas phase transport mechanisms. Developed exact and

numerical solutions to multi-component, multi-phase transport models. Designed one and two-dimensional flow visualization experiments for qualitative and quantitative validation of models.

## TEACHING AND LEADERSHIP EXPERIENCE

**ADJUNCT PROFESSOR** - DEPARTMENT OF MECHANICAL ENGINEERING, UNIVERSITY OF NEW MEXICO, ALBUQUERQUE, NEW MEXICO (<http://me.unm.edu/~cliff/>)

Teach undergraduate courses on a part-time basis in Mechanical Engineering in areas including thermal-fluid sciences, dynamics, and engineering analysis. Prepare homework, lectures, exams, and projects for the students and use innovative methods to create an interactive, dynamic classroom environment. Consistently receive high praise, feedback, and evaluations from the students. 8/96-Present.

*Awards:* Nominated one of five “Outstanding Professors” in the science and engineering departments at the University of New Mexico by student scholars in the NASA Training Project. 4/97

**PROFESSIONAL CONFERENCE SESSION CHAIR/ORGANIZER** - ASME, AICHE, ASCE, AGU  
*Session Chair/Organizer:* Led several professional conference sessions on multiphase, non-isothermal flow and contaminant transport in porous media. ASME/AICHE 1995 National Heat Transfer Conference, Portland, OR; ASCE International High-Level Radioactive Waste Management Conference (1995, 1996, 1998, 2001); AGU Winter Annual Meeting (1999).

**TOASTMASTERS INTERNATIONAL** - ALBUQUERQUE, NEW MEXICO

*President:* Organized, managed, and led weekly meetings for a club whose mission is to maintain and improve its members’ public speaking skills through speeches, contests, and workshops.

Assisted in organizing district conferences held in Albuquerque. 7/94-12/95

*VP Education:* Monitor educational progress of members and organize weekly schedules and events. 1/95-7/96

*Awards:* 1st Place in Humorous Speech Contest (10/95)–District 23 (New Mexico and El Paso); 3rd Place in Humorous Speech Contest (6/96)–Region III (8 states)

**GUEST LECTURER** - UNIVERSITY OF CALIFORNIA AT BERKELEY

Presented lectures on topics involving heat and mass transfer in porous media for Mechanical and Civil Engineering Departments at the University of California at Berkeley. 9/92-5/93.

## OTHER EXPERIENCE

**MCDONNELL DOUGLAS CORPORATION** - ST. LOUIS, MO

*Summer Intern:* Created FORTRAN programs, ran software, and wrote instructional reports pertaining to fatigue analysis of F/A-18 Hornet and Blue Angel aircraft. 5/88-8/88

**GENERAL MOTORS CORPORATION** - GM TECHNICAL CENTER, WARREN, MI

*Summer Intern:* Compared various methods of modeling the deflection of three-legged joints in automobile frames. Derived theoretical models and compared various finite element models using MSC/NASTRAN. Tested structural response of a three-legged joint, compared results to those of models, and documented findings into a GM report. 5/87-8/87

## COMPUTER AND ANALYTIC SKILLS

- Proficient in 3-D modeling and analyses (SolidWorks, CosmosWorks, Cosmos FloWorks, CFdesign, FLUENT)

- Extensive FORTRAN programming experience and working knowledge in C++
- Knowledgeable in HTML programming and WWW page creation
- Familiar with Macintosh, PC, and UNIX operating systems
- Proficient with many computer applications including word processors, spreadsheets, graphic displays, CAD packages, and FORTRAN software
- Knowledge of numerical methods, including finite difference and finite element methods for heat transfer and fluid dynamics applications, and probabilistic methods for risk-analysis modeling
- Experienced in the use of gas chromatography to analyze atmospheric and subsurface environmental pollutants

## PROFESSIONAL ORGANIZATIONS

- American Society of Mechanical Engineers
- American Geophysical Union

## HONORS

- Employee Recognition Award for Performance Testing of Trace Explosives Detectors for Vehicle Screening Team, Sandia National Laboratories, 2005
- Employee Recognition Award for In-Situ Chemiresistor Team, Sandia National Laboratories, 2003
- Employee Recognition Award for Outstanding Individual Leadership, Sandia National Laboratories, 2001
- Outstanding Professor Award, University of New Mexico, 1997
- Dean's Honor List, University of Wisconsin–Madison, 1985-89
- Bergenthal Scholarship, University of Wisconsin–Madison, 1988
- McDonnell Douglas Scholarship, St. Louis, MO, 1988
- Elected member of Tau Beta Pi, Pi Tau Sigma, Phi Kappa Phi, and Golden Key National Honor Society, University of Wisconsin–Madison, 1986-89

## PERSONAL REFERENCES

- Ray Finley, Manager, Geohydrology Department, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185. Tel. (505) 844-4462, e-mail: [refinle@sandia.gov](mailto:refinle@sandia.gov)
- Peter B. Davies, Director, Geoscience and Environment Center, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185. Tel. (505) 844-3072, e-mail: [pbdavie@sandia.gov](mailto:pbdavie@sandia.gov)
- Gudmundur “Bo” Bodvarsson, Director, Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA, 94720. Tel: (510) 486-4789, e-mail: [gsbodvarsson@lbl.gov](mailto:gsbodvarsson@lbl.gov)
- Professor John Wilson, Professor of Earth and Environmental Science, New Mexico Tech, Socorro, NM 87801. Tel: (505) 835-5308, e-mail: [jwilson@nmt.edu](mailto:jwilson@nmt.edu)

**PUBLICATIONS****Hydrologic Flow and Contaminant Transport**

- Walton, Z.P., C.K. Ho, and M.D. Schuhen, Testing of Flow Through Stress Corrosion Cracks, in Proceedings of the 2006 International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 30-May 3, 2006.
- Altman, S.J., A. Forsberg, W. Peplinski, and C.K. Ho, Testing the Concept of Drift Shadow with X-Ray Absorption Imaging, in Proceedings of the 2006 International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 30-May 3, 2006.
- Sleep, B.E., C.D. Shackelford, J.C. Parker, C.K. Ho, et al., 2006, "Chapter 2 Modeling of Fluid Transport through Barriers," in *Barrier Systems for Environmental Contaminant, Containment, and Treatment*, edited by C.C. Chien, et al., pp. 71-132, CRC Press, Taylor & Francis, Boca Raton.
- Ho, C.K., 2004, Asperity-Induced Episodic Percolation in Channels and Fractures, *J. Porous Media*, 7(3), 155-164.
- Ho, C.K., L.K. McGrath, and J.L. Wright, 2003, Survey of Subsurface Treatment Technologies for Environmental Restoration Sites at Sandia National Laboratories, New Mexico, SAND2003-2880, Sandia National Laboratories, Albuquerque, NM.
- Ho, C.K., 2001, A semianalytical solution for steady infiltration in unsaturated fractured rock, *Water Resources Research*, 37(8), 2285-2289.
- Ho, C.K., 2001, "Dual Porosity vs. Dual Permeability Models of Matrix Diffusion in Fractured Rock," SAND 2000-2336C, in Proceedings of the 9<sup>th</sup> International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 29-May 2, 2001.
- Ho, C.K., 2000, "Modeling Fast Flow Paths in Unsaturated Fractured Rock," *Vadose Zone Science and Technology Solutions*, B.B. Looney and R.W. Falta eds, Battelle Press, Columbus, OH, pp. 785-791.
- Ho, C.K. and S.W. Webb, 1998, Capillary Barrier Performance in Heterogeneous Porous Media, *Water Resources Research*, vol. 34, no. 4, pp. 603-609.
- McCurley, R., C.K. Ho, and M.L. Wilson "Analysis of Infiltration Uncertainty," SAND2000-2688C, in Proceedings of the 9<sup>th</sup> International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 29-May 2, 2001.
- Wilson, M.L. and C.K. Ho, "Abstraction of Seepage Into Drifts," SAND2000-2389C, in Proceedings of the 9<sup>th</sup> International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 29-May 2, 2001.
- Ho, C.K. and M.L. Wilson, Calculation of Discrete Fracture Flow Paths in Dual Continuum Models, in *Proceedings of the International Symposium on Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances*, LBNL-42718, Berkeley, CA, 2/99.
- Ho, C.K. and M.L. Wilson, Calculation of Discrete Fracture Flow Paths Using Dual-Continuum Models, SAND97-2709C, *Proceedings of the International High-Level Radioactive Waste Management Conference*, 5/98.
- Ho, C.K. and S.W. Webb, The Effects of Heterogeneities and Wavy Interfaces on Capillary Barrier Performance, SAND98-0859A, in *Proceedings of the TOUGH98 Workshop*, 5/98.
- Ho, C.K., S.J. Altman, S.A. McKenna, B.W. Arnold, 1996 Unsaturated Zone Flow Modeling for GWTT-95, SAND95-2497C.
- Altman, S.J., B.W. Arnold, R.W. Barnard, G.E. Barr, C.K. Ho, S.A. McKenna, R.R. Eaton, 1996, Flow Calculations for Yucca Mountain Groundwater Travel Time (GWTT-95), SAND96-0819.
- Altman, S.J., B.W. Arnold, C.K. Ho, and S.A. McKenna, 1996, Sensitivity Studies of Unsaturated Groundwater Flow Modeling for Groundwater Travel Time Calculations at Yucca Mountain, NV, SAND95-2541C.
- Ho, C.K., S.J. Altman, B.W. Arnold, 1995, Alternative Conceptual Models and Codes for Unsaturated Flow in Fractured Tuff: Preliminary Assessments for GWTT-95, SAND95-1546.
- Eaton, R.R., C.K. Ho, R.J. Glass, M.J. Nicholl, and B. W. Arnold, 1996, Three-Dimensional Modeling of Flow through Fractured Tuff at Fran Ridge, SAND95-1896.

Ho, C.K., "Assessing Alternative Conceptual Models of Fracture Flow", SAND95-0324C, in proceedings of the TOUGH2 Workshop '95, Lawrence Berkeley Laboratory, March 20-22, 1995.

Ho, C.K., "Multicomponent Three-Phase Equilibria, SAND95-1063, June, 1995.

Ho, C.K., 1994. Modeling Infiltration into a Tuff Matrix from a Saturated Vertical Fracture, SAND93-3503C, presented at the 1994 International High-Level Radioactive Waste Management Conference, Las Vegas, NV.

### Gas and Vapor Transport and Phase Change

Ho, C.K., 2000, "Scale-Dependent Mass Transfer During SVE," *Vadose Zone Science and Technology Solutions*, B.B. Looney and R.W. Falta eds., Battelle Press, Columbus, OH, pp. 1170-1176.

Gu, L., C.K. Ho, O.A. Plumb, and S.W. Webb, Vapor Diffusion in Partially Saturated Packed Beds, in *Proceedings of the 1999 ASME/JSME Joint Thermal Engineering Conference*, San Diego, CA, 3/99.

Webb, S.W. and C.K. Ho, Enhanced Vapor-Phase Diffusion in Porous Media LDRD Final Report, SAND98-2772, 12/98.

Ho, C.K., and S.W. Webb, 1998, Review of Porous Media Enhanced Vapor-Phase Diffusion Mechanisms, Models, and Data—Does Enhanced Vapor-Phase Diffusion Exist?, *Journal of Porous Media*, 1(1), pp. 71-92.

Ho, C.K., 1998, Analytical Inverse Model for Multicomponent Soil Vapor Extraction, *J. Environmental Engineering*, v. 124, no. 6, 504-509.

Ho, C.K., 1997, Evaporation of Pendant Water Droplets in Fractures, *Water Resources Research*, Vol. 33, No. 12, pp. 2665-2671.

Gu, L., C.K. Ho, O.A. Plumb, and S.W. Webb, 1998, Diffusion with Condensation and Evaporation in Porous Media, SAND98-0618C, *Proceedings of the 1998 Joint AIAA/ASME Thermophysics and Heat Transfer Conference*, 6/98.

Webb, S.W. and Ho, C.K., Pore-Scale Modeling Using TOUGH2, *Proceedings of the TOUGH98 Workshop*, SAND98-1976C, 5/98.

Webb, S.W. and Ho, C.K., Pore-Scale Modeling of Enhanced Vapor Diffusion in Porous Media, SAND97-2013C, *Proceedings of the 1997 ASME International Mechanical Engineering Congress and Exposition*, 11/97.

Ho, C.K., "Numerical Simulations of Multicomponent Evaporation and Gas-Phase Transport Experiments Using M2NOTS, SAND95-0566C, in proceedings of the ASME/AIChE National Heat Transfer Conference, Portland, OR, August 5-8, 1995.

Sobolik, S., C.K. Ho, E. Dunn, T. Robey, W. Cruz, "Sensitivity of Hydrological Performance Assessment Analyses to Variations in Material Properties, Conceptual Models, and Ventilation Models", SAND94-0779, 1/95.

Ho, C.K., E. Dunn, S. Sobolik, "Ventilation and Vapor-Phase Transport Near the ESF Tunnel, SAND94-2658A, in proceedings of the International High-Level Radioactive Waste Management Conference, Las Vegas, NV, May 1-5, 1995.

Ho, C.K. and K.S. Udell, 1995, Mass Transfer Limited Drying of Porous Media Containing an Immobile Binary Liquid Mixture, *Int. J. Heat Mass Transfer*, Vol. 38 No. 2, pp. 339-350.

Ho, C.K., S. -W. Liu, and K.S. Udell, 1994, Propagation of Evaporation and Condensation Fronts During Multicomponent Soil Vapor Extraction, *J. Contam. Hydrol.*, 16, pp. 381-401.

Ho, C.K. and K.S. Udell, 1993. Mechanisms of Multicomponent Evaporation During Soil Venting, ASME Multiphase Transport in Porous Media, HTD-Vol. 265, pp. 83-91, presented at the 1993 ASME Winter Annual Meeting, New Orleans, LA.

Ho, C.K. and K.S. Udell, 1992, An Experimental Investigation of Air Venting of Volatile Liquid Hydrocarbon Mixtures from Homogeneous and Heterogeneous Porous Media, *J. Contam. Hydrol.*, 11, 291-316.

### Heat Transfer and Coupled Processes

Birkholzer, J. and C.K. Ho, A Monte-Carlo Analysis of Episodic Preferential Flow into Superheated Fractured Rock, 2003, *J. Hydrology*, 284(1-4), 151-173.

- Birkholzer, J. and C.K. Ho, A Systematic Study of Episodic Localized Infiltration into Superheated Fractured Rock, SAND2002-2451A, Geological Society of America 2002 Annual Meeting and Exposition, October 27-30, 2002, Denver, CO.
- Arnold, B.W., C.K. Ho, and M.T. Itamura, "Effect of Capillary Forces on Fluid Inclusion Formation in the Vadose Zone: Implications For Geothermometry," SAND2000-2999C, in Proceedings of the 9<sup>th</sup> International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 29-May 2, 2001.
- Ho, C.K. and N.D. Francis, Coupled Thermo-Hydro-Mechanical Simulations of the Potential Repository at Yucca Mountain, SAND97-2711C, in *Proceedings of the International High-Level Radioactive Waste Management Conference*, 5/98.
- Itamura, M.T. and C.K. Ho, Scaling Analysis of Repository Heat Load for Reduced Dimensionality Models, SAND97-2830A, in *Proceedings of the International High-Level Radioactive Waste Management Conference*, 5/98.
- Ho et al., 1997, The Effects of Infiltration on the Thermohydrologic Behavior of the Potential Repository at Yucca Mountain, SAND97-0098C, In Proceedings of the ASCE Fourth Congress on Computing in Civil Engineering, Philadelphia, PA, June 16-18, pp. 387-394.
- Ho, C.K., 1997, Models of Fracture-Matrix Interactions During Multiphase Heat and Mass Flow in Unsaturated Fractured Porous Media, SAND97-1198C, in Proceedings of the ASME Fluids Engineering Division, FED-Vol. 244, pp. 401-412.
- Francis, N.D., S.R. Sobolik, C.K. Ho, R.R. Eaton, and D. Preece, 1997, Pre-Experiment Thermal-Hydrological-Mechanical Analyses for the ESF Heated Drift Test, SLTR97-0002, Sandia National Labs.
- Ho, C.K. and N.D. Francis, 1996, The Effects of Conduction, Convection, and Radiation on the Thermodynamic Environment Surrounding a Heat Generating Waste Package, SAND96-0032C, in proceedings of 1996 National Heat Transfer Conference, ANS session on Fundamental Aspects of Radioactive Waste Management, Houston, TX, Aug. 3-6.
- Ho, C.K., Pre-Test Simulations of Laboratory-Scale Heater Experiments in Tuff, SAND95-1905.
- Ho, C.K. and R.R. Eaton, 1995, TOUGH2 Model of the G-Tunnel Heater Experiment, SAND94-2636A, in proceedings of the 1995 International High-Level Radioactive Waste Management Conference, Las Vegas, NV, May 1-5.
- Ho, C.K. and R.R. Eaton, 1994, "Studies of Thermohydrologic Flow Processes Using TOUGH2", SAND94-2011.
- Ho, C.K., K. Maki, and R. J. Glass, 1994. Studies of Non-Isothermal Flow in Saturated and Partially Saturated Porous Media, SAND93-4045C, presented at the 1994 International High-Level Radioactive Waste Management Conference, Las Vegas, NV.
- Ho, C.K., K. Maki, and R. J. Glass, 1994. Experimental and Numerical Investigations of Non-Isothermal Flow in Saturated and Partially Saturated Porous Media, Sandia Report, SLTR93-0002.

### **Performance Assessment Modeling for Waste Management**

- Ho, C.K., T.A. Goering, J.L. Peace, M.L. Miller, 2006, Development of Probabilistic Fate and Transport Models for the Mixed Waste Landfill at Sandia National Laboratories, SAND2005-7321C, in Proceedings of the 2006 Waste Management Conference, Tucson, AZ, Feb. 26 – Mar. 2, 2006.
- Ho, C.K., T.A. Goering, J.L. Peace, M.L. Miller, 2005, Probabilistic Performance-Assessment Modeling of the Mixed Waste Landfill at Sandia National Laboratories, SAND2005-6888, Sandia National Laboratories, Albuquerque, NM.
- Peace, J.L. T.A. Goering, C.K. Ho, M.L. Miller, D.E. Fate, 2005, Mixed Waste Landfill - Corrective Measures Implementation Plan, 2005-7126 P, Sandia National Laboratories, Albuquerque, NM.
- Knowlton, R.G., B.W. Arnold, N.-C. Tien, F.-L. Chang, L.-M. Chi, C.K. Ho, W.-S. Chuang, and H.-N. Jow, 2006, Performance Assessment Methodology and Preliminary Results for Low-Level Radioactive Waste Disposal in Taiwan, in proceedings of the 2006 Waste Management Conference, Tucson, AZ, February 26 – March 2, 2006.

- Peterson, C. and C.K. Ho, 2005, Evaluation of FRAMES for Probabilistic Risk-Based Simulation of Long-Term Cover Systems, in proceedings of the Waste Management Symposium, SAND2005-0501C, February 27-March 3, 2005, Tucson, AZ.
- Bodvarsson, G.S., C.K. Ho, and B.A. Robinson (editors), 2003, *Journal of Contaminant Hydrology Special Issue on Yucca Mountain*, Vol. 62-63, 750 pp.
- Robinson, B.A., C. Li, and C.K. Ho, 2003, Performance Assessment Model Development and Analysis of Radionuclide Transport in the Unsaturated Zone, Yucca Mountain, Nevada, *Journal of Contaminant Hydrology*, Vol. 62, pp. 249-268.
- Ho, C.K., B.W. Arnold, J.R. Cochran, R.Y. Taira, and M. Pelton, 2004, A Probabilistic Model and Software Tool for Evaluating the Long-Term Performance of Landfill Covers, *Environmental Modelling and Software Journal*, 19(1), 63-88.
- Ho, C.K., B.W. Arnold, J.R. Cochran, and R.Y. Taira, 2002, Development of a Risk-Based Probabilistic Performance-Assessment Method for Long-Term Cover Systems—2<sup>nd</sup> Edition, SAND2002-3131, Sandia National Laboratories, Albuquerque, NM.
- Ho, C.K., B.W. Arnold, J.R. Cochran, and R.Y. Taira, Risk-Based Performance Assessments for Long-Term Cover Systems: Sensitivity and Uncertainty Analyses, SAND2002-1951C, In Proceedings of the Spectrum 2002 Conference, Reno, NV, August 4-8, 2002, ISBN: 0-89448-664-0.
- Wilson, M.W. and C.K. Ho, TSPA Model For The Yucca Mountain Unsaturated Zone, in proceedings of the Waste Management Symposium, SAND2001-3800C, Tucson AZ, February 24-28, 2002.
- Ho, C.K., B.W. Arnold, J.R. Cochran, S.W. Webb, and R.Y. Taira, Development of a Risk-Based Performance-Assessment Method for Long-Term Cover Systems—Application to the Monticello Mill Tailings Repository, SAND2001-3032, Sandia National Laboratories, Albuquerque, NM, 2001.
- Ho, C.K., et al., “Stochastic Simulations for Risk-Based Performance Assessments of Long-Term Cover Systems,” SAND2001-1132C, In Proceedings of the 2001 Containment and Remediation Conference, Orlando, FL, June 10-13, 2001.
- Ho, C.K., R. Baca, S. Conrad, G. Smith, L. Shyr, T. Wheeler, 1999, Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm, SAND98-2880, Sandia National Laboratories, 1/99.
- Westrich, H., J. Krumhansl, P. Zhang, H. Anderson, M. Molecke, C. Ho, B. Dwyer, G. McKeen, Stabilization of In-Tank Residual Wastes and External-Tank Soil Contamination for the Hanford Tank Closure Program: Applications to the AX Tank Farm, SAND98-2445, 11/98.
- Ho, C.K. and B.A. Robinson, Flow and Transport Calculations of Yucca Mountain Using TOUGH2 and FEHM, SAND97-2710C, *Proceedings of the International High-Level Radioactive Waste Management Conference*, 5/98.
- Stockman, H., J. Krumhansl, C.K. Ho, V. McConnell, “The Valles Natural Analogue Project, NUREG/CR-6221, SAND94-0650, December, 1994.

### **Yucca Mountain Reports Supporting the License Application**

- Contributing author of “Total System Performance Assessment for the Site Recommendation,” 2000, TDR-WIS-PA-000001 Rev 00, ICN 01, MOL.20001220.0045.
- Ho, C.K., 2000, “Abstraction of Flow Fields for TSPA,” Analysis and Model Report, ANL-NBS-HS-000023 Rev 00, ICN 01.
- Ho, C.K., 2000, “Abstraction of Flow Fields for RIP,” Analysis and Model Report, ANL-NBS-HS-000023 Rev 00, ICN 00. (<http://www.ymp.gov/documents/amr/index.html>)
- Ho, C.K., 2000, “Analysis of Base-Case Particle Tracking for Base-Case Flow Fields,” Analysis and Model Report, ANL-NBS-HS-000024 Rev 00.
- Pan, L. and C.K. Ho, 2000, “Analysis Comparing Advective-Dispersive Transport Solution to Particle Tracking” Analysis and Model Report, ANL-NBS-HS-000001 Rev 00.

Co-author and co-editor of “Unsaturated Zone Flow and Transport Model Process Model Report,” TDR-NBS-HS-000002 Rev 0.

Contributing author of “Viability Assessment of a Repository at Yucca Mountain—Volume 3: Total System Performance Assessment,” 1998, DOE/RW-0508.

Ho, C.K. et al., 1998, “Total System performance Assessment-Viability Assessment (TSPA-VA) Analyses Technical Basis Document—Chapter 2 Unsaturated Zone Hydrology Model,” B00000000-01717-4301-00002 Rev 01.

Ho, C.K. et al., 1996, “Thermo-Hydrologic Modeling of the Potential Repository at Yucca Mountain Including the Effects of Heterogeneities and Alternative Conceptual Models of Fractured Porous Media,” Rev.00 Level 3 Milestone T6536, MOL.19961219.0269, 186 pages.

## Microchemical Sensors

K.A. Peterson, K.D. Patel, C.K. Ho, B.R. Rohrer, C.D. Nordquist, B.D. Wroblewski, K.B. Pfeifer, LTCC Microsystems and Microsystem Packaging and Integration Applications, in proceedings of the 2006 International Conference on Ceramic Interconnect and Ceramic Microsystems Technologies, Denver, CO, April 25-27, 2006.

Ho, C.K., K.A. Peterson, L.K. McGrath, T.S. Turner, 2006, Development of LTCC Smart Channels for Integrated Chemical, Temperature, and Flow Sensing, SAND2006-1169C, in proceedings of the 2006 International Conference on Ceramic Interconnect and Ceramic Microsystems Technologies, Denver, CO, April 25-27, 2006.

Peterson, K.A., K. D. Patel, C. K. Ho, S. B. Rohde, C. D. Nordquist, C. A. Walker, B. D. Wroblewski, and M. Okandan, 2005, Novel Microsystem Applications with New Techniques in Low-Temperature Co-Fired Ceramics, *Int. Journal of Applied Ceramic Technology*, 2 (5) 371–389.

Ho, C.K. (Guest Editor), 2005, Special Issue on Sensors for Environmental Monitoring, *Sensors*, 5, 1-117.

Ho, C.K., A. Robinson, D.R. Miller, and M.J. Davis, 2005, Overview of Sensors and Needs for Environmental Monitoring, *Sensors*, 5, 4-37.

Ho, C.K. and J.L. Wright, 2005, Integrated Chemiresistor Sensors with Preconcentrators for Monitoring Volatile Organic Compounds in Water, SAND2005-1037C, in proceedings of the ASCE 2005 World Water and Environmental Resources Congress, Anchorage, AK, May 15-19, 2005.

Ho, C.K., L.K. McGrath, and J.L. Wright, 2005, FY04 Field Evaluations of an In-Situ Chemiresistor Sensor at Edwards Air Force Base, CA, SAND2005-0336, Sandia National Laboratories, Albuquerque, NM.

Davis, C.E., C.K. Ho, R.C. Hughes, and M.L. Thomas, 2005, Enhanced Detection of m-Xylene Using a Preconcentrator with a Chemiresistor Sensor, *Sensors and Actuators B: Chemical*, 104(2), 207-216.

Hua, L, Pitt, W.G., McGrath, L.K., and Ho, C.K., 2004, Modeling chemiresistor sensors 1: Conductivity model, 2004, in proceedings of the AIChE Annual Meeting, Nov. 7-12 2004, Austin, TX, p.9725-9732.

Hua, L, Pitt, W.G., McGrath, L.K., and Ho, C.K., 2004, Modeling chemiresistor sensors 1: Conductivity model, 2004, in proceedings of the AIChE Annual Meeting, Nov. 7-12 2004, Austin, TX, p.9725-9732.

Wang, Y., H. Gao, R.C. Hughes, C.K. Ho, M.L. Thomas, J.L. Wright, L.K. McGrath, C.E. Davis, and P.I. Pohl, 2004, Potential Application of Microsensor Technology in Radioactive Waste Management with Emphasis on Headspace Gas Detection, SAND2004-4813, LDRD Final Report, Sandia National Laboratories, Albuquerque, NM.

Ho, C.K., A. Robinson, D.R. Miller, and M.J. Davis, 2004, Sensors for Environmental Monitoring and Long-Term Environmental Stewardship, SAND2004-4596, Albuquerque, NM, 54 pp.

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## Explosives Detection

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### Miscellaneous

Robinson, A. and C.K. Ho, 2005, Investigation of Issues Regarding Colorimetric Stickers for Fruit: Final Report for RediRipe LLC, SAND2005-5175, Sandia National Laboratories NM Small Business Assistance Program, Albuquerque, NM.

Ho, C.K. and T.A. Bibeau, 2005, Finite Element Stress Analyses of Ties for Masonry Applications: Final Report for The Arquin Corporation, SAND2005-5877, Sandia National Laboratories, Albuquerque, NM.

### Invited Presentations

Ho, C.K., Continuous Monitoring of Volatile Organic Compounds in the Subsurface Using an In-Situ Chemiresistor Sensor, invited presentation to be made at the 2004 North American Environmental Field Conference, Tampa Bay, FL, January 13-16, 2004.

Ho, C.K., From Chemiresistor Sensors to Real-Time Subsurface Hydrocarbon Monitoring Systems: Lessons Learned, SAND2002-4095A, invited presentation at the National American Chemical Society Meeting, New Orleans, LA, March 23-27, 2003.

Ho, C.K., L.K. McGrath, and J. May, 2003, In-Situ Chemiresistor Sensors for Monitoring Subsurface Contaminants, invited presentation at the 2003 CUPA Conference, Anaheim, CA, 2/5/03.

Invited presentation to Senator Bingaman on microsensors for real-time water-quality monitoring, Cooperative Monitoring Center, Albuquerque (2/19/01).

Invited presentation to Sandia Leadership Council on microsensors for real-time soil- and water-quality monitoring, Albuquerque (4/02).

Invited presentation on unsaturated-zone flow and traceability of TSPA-VA to Nuclear Regulatory Commission and Nuclear Waste Technical Review Board (3/98 & 4/98).

Invited presentations on enhanced vapor diffusion at New Mexico Tech (9/23/96), Washington State University (10/4/96), and Intera (10/10/96).

### Intellectual Property

U.S. Patent No. US 7,003,405, Ho, C.K., "Characterization Methods for Real-Time In-Situ Sensing of Volatile Contaminants," SD-6894, Feb. 21, 2006.

SD-6976, Ho, C.K., M.W. Jenkins, R.C. Hughes, Waterproof microsensor for in-situ monitoring of volatile compounds, Sandia National Laboratories Patent Application filed 5/2002.

SD-6894, Ho, C.K., Method for characterizing subsurface volatile contaminants, Sandia National Laboratories Patent Application filed 10/24/02.

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- SD-7307, Ho, C.K., Portable vapor diffusion coefficient meter, Sandia National Laboratories Patent Application filed 10/24/02.
- SD-7095, Ho, C.K., Circular chemiresistors for microchemical sensors, Sandia National Laboratories Patent Application filed 1/23/03.
- SD-7372, Ho, C.K., Confined cavity chemiresistors for microchemical sensors, Sandia National Laboratories Patent Application filed 1/23/03.
- SD-7373, Ho, C.K., Multi-pin chemiresistors for microchemical sensors, Sandia National Laboratories Patent Application filed 1/23/03.
- SD-7542, Kooser, A.S., C.K. Ho, and L.K. McGrath, Molecular-imprinted chemiresistor sensors for chemical and biological detection, Sandia National Laboratories Technical Advance filed 8/19/03.
- SD-7830, Ho, C.K. and K.A. Peterson, Smart LTCC Channels with Integrated Chemical, Temperature, and Flow Sensors, Sandia National Laboratories Technical Advance, 9/29/04.
- SD-7850, Wang, Y., H. Gao, and C.K. Ho, Techniques for Improvement of Sensing Polymer Films, Sandia National Laboratories Technical Advance, 9/30/05.
- Cooperative Research and Development Agreement (#1669.0) between Sandia National Labs and Lighthouse Worldwide Solutions, Development of Chemiresistor Sensor Technology for Real-Time Monitoring of Volatile Organic Compounds During Hazardous Waste Site Remediation, Project Accomplishments Summary, 12/03.
- Ho, C.K., Intellectual Property Management for Projects with Commercially Viable Products, white paper posted on web fileshare (<https://wfsprod01.sandia.gov/groups/srn-uscitizens/documents/other/wfs048113.pdf>), 1/02.