STEPHEN NIKSA, Ph. D.

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EDUCATION

B. S. in Chemical Engineering, Case Western Reserve University, Summa cum Laude, 1975
Ph. D. in Chemical Engineering, Princeton University, 1982
Business Practices for Japanese Clients, SRI International, 1995

PROFESSIONAL EXPERIENCE

7/97 – Present	Niksa Energy Associates LLC, Founder and President
9/92 – 7/97	SRI International, Program Manager of the Energy Group
9/85 - 9/92	Stanford University, Assistant Professor of Mechanical Engineering
1/82 - 9/85	Sandia National Laboratories, Livermore, Member of Technical Staff in the Combustion Research Facility
3/80 - 12/81	Princeton University, Research Associate in the Department of Chemical Engineering

HONORS

Who's Who in the World, 21st Edition, 2003
Who's Who in America, 49th Edition, 1995
Who's Who in Science and Engineering, 2nd Edition, 1993 through 6th Edition, 2002
Sigma Xi, 1989
Carl F. Prutton Prize in Applied Chemistry (CWRU Commencement)
C. Reinberger Merit Scholarship, 1975
American Chemical Society Student Prize, 1975

PROFESSIONAL SOCIETIES

The Combustion Institute
American Institute of Chemical Engineers
American Chemical Society
American Society of Mechanical Engineers
Air & Waste Management Association

PERSONAL

Married with three grown children

RESEARCH INTERESTS

Dr. Niksa is recognized throughout the world as the author of over 260 technical papers on the mechanisms of air pollutant formation and control, including over 100 in the archival literature; monographs entitled "*Coal Combustion Modelling*" and "*Fundamentals of Coal Combustion*" published by IEA Coal Research; two books entitled, "*Process Chemistry of Coal Utilization: Impacts of Coal Quality and Operating Conditions*" and "*Process Chemistry of Coal Utilization: Chemistry Toolkit for Furnaces and Gasifiers*" published by Elsevier; and a book chapter entitled, "Predicting Hg Emissions Rates With Device-Level Models and Reaction Mechanisms." One long-standing interest has been the release of NO_x, particulates, and polynuclear aromatic compounds during pulverized fuel combustion. His reaction mechanisms for coal devolatilization, called FLASHCHAIN®, spawned a predictive capability for NO_x and LOI emissions from full-scale, coal-fired utility boilers that was distributed to over 80 American utility companies. Another package called PC Coal Lab® is used to assign fuel conversion kinetics by about four dozen utility OEMs in the USA, Canada, Japan, Korea, Taiwan, China, UK, Europe, South Africa, and India. Custom software applications based on PC Coal Lab® are used at utility OEMs in the USA and Japan. Dr. Niksa's second main interest has been transformations in combustors of minerals, alkali compounds, and trace metals. He formulated the most comprehensive mechanism to predict Hg and Se emissions from coal-fired gas cleaning systems, and developed it into a commercial software package called MercuRator™ that was installed at six American and Japanese utility services companies. A second Hg emissions predictor called the iPOG™ is distributed worldwide by the United Nations Environment Programme. He has also developed packages to predict alkali vapor emissions from pressurized fluidized bed combustors, and corrosion potentials due to alkali chlorides in slags. A third interest has been catalyst deactivation during hydrothermal treatment of residual petroleum fractions, and during flue gas cleaning in utility SCRs. A fourth has been catalysis for combustion, including predictive mechanisms for multipollutant (NO_X, SO_2, Hg^0) conversion across SCR catalysts, the thermal and chemical behavior of catalytic converters, and thermal shock issues in catalytic combustors for natural gas.

BUSINESS DEVELOPMENT

Dr. Niksa is President and founder of Niksa Energy Associates LLC. This consulting and software business serves major technology developers in the U.S. and Japan. At SRI International, Dr. Niksa created a $500,000 per year business based on R&D testing on pyrolysis and combustion of fossil fuels, fuel-nitrogen conversion, pollutant formation, gasification mechanisms, alkali transformations, ionization intensities, and thermal shock. He also directed a $200,000 per year business based on software products for the coal-burning utilities, and negotiated royalty-bearing license agreements. He was the manager of the Energy Group in the Chemistry and Chemical Engineering Laboratory, responsible for staffing decisions and evaluations. At Stanford he oversaw a group of 15 graduate students in mechanical engr., including 5 who finished with Ph.D.'s and 2 with Engineer's Degrees.

TEACHING AND COMMUNICATIONS

Dr. Niksa regularly reports his research findings at major technical conferences around the world. While a member of Stanford's Mechanical Engineering Department, he taught graduate courses in Radiation Heat Transfer; Combustion and Pollution; Physical Gas Dynamics; Introduction to Heat Transfer; Advanced Combustion; Analysis and Solution of Partial Differential Equations; and Spectroscopy Lab, FTIR Section.

PUBLICATIONS OF STEPHEN NIKSA

1. S. Niksa, W. B. Russel, and D. A. Saville, "Captive Sample Reactor for Kinetic Studies of Coal Pyrolysis and Hydropyrolysis on Short Time-Scales," Fuel, **61**(12), 1217-1202 (1982).

2. S. Niksa, W. B. Russel, and D. A. Saville, "Time-Resolved Weight Loss Kinetics for the Rapid Devolatilization of a Bituminous Coal," Proc. Combust. Inst., 19, 1151 (1982).

3. A. R. Kerstein and S. Niksa, "Prediction and Measurement of the Critical Porosity for Fragmentation During Char Conversion," Proc. 1983 Int. Conf. on Coal Science, IEA, 1983, p. 743.

4. S. Niksa and R. E. Mitchell, "Interpreting Spatially-Resolved Mass Conversions and Two-Color, Single-Particle Temperatures for Burning Polydisperse Pulverized Fuel Streams," Proc. 1983 Int. Conf. on Coal Science, IEA, 1983, p. 583.

5. A. R. Kerstein and S. Niksa, "Fragmentation During Char Conversion: Predictions and Measurements," Proc. Combust. Inst., 20, 941 (1984).

6. D. A. Tichenor, R. E. Mitchell, K. R. Hencken, and S. Niksa, "Simultaneous In Situ Measurements of the Size, Temperature and Velocity of Particles in a Combustion Environment," Proc. Combust. Inst., 20, 1213 (1984).

7. S. P. Musarra, T. H. Fletcher, S. Niksa, and H. A. Dwyer, "Heat and Mass Transfer in the Vicinity of a Devolatilizing Coal Particle," in Heat Transfer in Fire and Combustion Systems, ed. C. K. Law et al., HTD-Vol. 45, ASME, New York, 1985, p. 47.

8. S. Niksa, R. E. Mitchell, K. R. Hencken, and D. A. Tichenor, "Optically-Determined Temperatures, Sizes, and Velocities of Individual Carbon Particles Under Typical Combustion Conditions," Combust. Flame **60**, 183 (1985).

9. S. Niksa, L. E. Heyd, W. B. Russel, and D. A. Saville, "On the Role of Heating Rate in Rapid Coal Devolatilization," Proc. Combust. Inst. 20, 1445 (1984).

10. S. P. Musarra, T. H. Fletcher, S. Niksa, and H. A. Dwyer, "Heat and Mass Transfer in the Vicinity of a Devolatilizing Coal Particle," Comb. Sci. Tech. **45** (5+6), 289 (1986).

11. S. Niksa and A. R. Kerstein, "The Distributed-Energy Chain Model for Rapid Coal Devolatilization Kinetics. Part I: Formulation," Combust. Flame **66**, 95-109 (1986).

12. S. Niksa, "The Distributed-Energy Chain Model for Rapid Coal Devolatilization Kinetics. Part II: Transient Weight Loss Correlations," Combust. Flame **66**, 111-119 (1986).

13. A. R. Kerstein, and S. Niksa, "Polymer Scission with Irreversible Reattachment: A Kinetic Model of Pyrolysis with Char Formation," Macromolecules **20**, 1811-1818 (1987).

14. S. Niksa, A. R. Kerstein, and T. H. Fletcher, "Predicting Devolatilization at Typical Coal Combustion Conditions with the Distributed-Energy Chain Model," Combust. Flame **69**, 221-228 (1987).

15. S. Niksa and A. R. Kerstein, "On the Role of Macromolecular Configuration in Rapid Coal Devolatilization," Fuel, **66**(10), 1389-1399 (1987).

16. S. Niksa, A. R. Kerstein, and T. H. Fletcher, "Predicting Devolatilization at Typical Coal Combustion Conditions with the Distributed-Energy Chain Model," Proc. 1987 ASME-JSME Thermal Engr. Joint Conf., Vol. 1, 1987, pp. 235-240.

17. B. C. Young and S. Niksa, "Combustion Rates for Selected Low-Rank Coal Chars," Proc. 1987 Int'l Conf. on Coal Science, Maastricht, Netherlands, IEA, 1987, p. 819.

18. S. Niksa and A. R. Kerstein, "On the Role of Macromolecular Configuration in Rapid Coal Devolatilization," Proc. 1987 Int'l Conf. on Coal Science, Maastricht, Netherlands, IEA, 1987, p. 593.

19. B. C. Young and S. Niksa, "Combustion Rates for Selected Low-Rank Coal Chars," Fuel, **67**(2), 155-164 (1988).

20. S. Niksa, "Rapid Coal Devolatilization as an Equilibrium Flash Distillation," AIChE J. **34**(5), 790-802 (1988).

21. S. Niksa, "Modeling the Devolatilization Behavior of High Volatile Bituminous Coals," Proc. Combust. Inst. 22, 105 (1984).

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23. J. Chen, Y.-C. Chang, and S. Niksa, "Rapid Coal Devolatilization in a Radiant Coal Flow Reactor," Proc. 1989 Int'l Coal Science Conf., IEA, Tokyo, 1989, p. 527.

24. S. Niksa, "Modelling the Devolatilization Behavior of Various Coals," Proc. 7th Pittsburgh Coal Conf., Univ. Pittsburgh, 1990, p. 13.

25. J. Chen and S. Niksa, "Secondary Pyrolysis and Soot Formation During the Initial Stages of Pulverized Coal Combustion," 2nd Int'l Congress on Toxic Combustion By-Products, Salt Lake City, March 1991.

26. J. Chen and S. Niksa, "Effects of Secondary Reactions on Nitrogen Distributions from Rapid Coal Pyrolysis," Proc. 1991 Int'l. Conf. on Coal Science, IEA, Newcastle, UK, p. 580.

27. S. Niksa and A. R. Kerstein, "Modelling the Devolatilization Behavior of Various Coal Types," Proc. 1991 Int'l. Conf. on Coal Science, IEA, Newcastle, UK, p. 488.

28. D. Marlow, S. Niksa, and C. H. Kruger, "Secondary Pyrolysis and Combustion of Coal Volatiles," Proc. 1991 Int'l. Conf. on Coal Science, IEA, Newcastle, UK, p. 335.

29. A. Akan-Etuk and S. Niksa, "Synthesis of Carbons with Controlled Macrovoidage," Energy Fuels **5**(4), 614 (1991).

30. S. Niksa, "Flashchain Theory for Rapid Coal Devolatilization. Part 3: Modeling the Behavior of Various Coals," Energy Fuels **5**(5), 673-683 (1991).

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32. S. Niksa and A. R. Kerstein, "Flashchain theory for Rapid Coal Devolatilization. Part 1: Formulation," Energy Fuels **5**(5), 647-664 (1991).

33. J. Chen and S. Niksa, "A Radiant Flow Reactor for High-Temperature Reactivity Studies of Pulverized Solids," Rev. Sci. Instrum. **63**, 2073-2083 (1992).

34. J. Chen, C. Castagnoli, and S. Niksa, "Coal Devolatilization During Rapid Transient Heating. Part 2: Secondary Pyrolysis," Energy Fuels **6**, 265-271 (1992).

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36. A. L. Boehman, S. Niksa, and R. J. Moffat "Catalytic oxidation of carbon monoxide in a large scale planar isothermal passage," SAE Paper No. 922332, 1992.

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41. S. Niksa and A. R. Kerstein, "Predicting the Devolatilization Behavior of Any Coal From Its Ultimate Analysis," Proc. 10th Pittsburgh Coal Conf., 1993, p. 1128.

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43. A. L. Boehman and S. Niksa, "Conversion of Various Hydrocarbons Over Supported Pd During Simulated Cold-Start Conditions," SAE Paper No. 932761, 1993.

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45. S. Niksa and A. R. Kerstein, "Modeling Devolatilization Rates and Yields From Various Coals with Flashchain," Proc. Int. Conf. on Coal Science, Vol. 1, IEA, 1993, p. 397.

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47. S. Cho, D. Marlow, and S. Niksa, "Burning Velocities of the Noncondensible Fuels From Various Coals," Proc. Int. Conf. on Coal Science, Vol. 1, IEA, 1993, p. 3.

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49. A. L. Boehman, S. Niksa, and R. J. Moffat, "A Comparison of Rate Laws for CO Oxidation Over Pt on Alumina," SAE Paper No. 930252, 1993.

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58. S. Niksa, "Predicting the Devolatilization Behavior of Any Coal From Its Ultimate Analysis," Combust. Flame, 100, 384-394 (1995).

59. S. Cho and S. Niksa, "Elementary Reaction Models and Correlations for Burning Velocities of Multicomponent Organic Fuel Mixtures," Combust. Flame, 101, 411-427 (1995).

60. S. Cho, D. Marlow, and S. Niksa, "Burning Velocities of Multicomponent Organic Fuel Mixtures Derived from Various Coals," Combust. Flame, 101, 399-410 (1995).

61. A. L. Boehman and S. Niksa, “A Catalytic Flow Reactor for Kinetic Sudies of Multicomponent Reacting Mixtures on Supported Catalysts, Rev. Sci. Instrum., 66, 1096-1104 (1995).

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63. A. L. Boehman and S. Niksa, "Conversion of Various Hydrocarbons over Supported Pd During Simulated Cold-Start Conditions," Appl. Catalysis, B: Environ., 8, 41-56 (1996).

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67. S. Niksa, "Coal Combustion Modelling," IEA Perspectives Series No.31, IEA Coal Research, London, UK, December, 1996.

68. S. Niksa, “Primary Devolatilization During the Initial Stages of Pressurized Coal Combustion and Gasification,” Proc. Ninth Int. Conf. on Coal Science, Vol. 2, Eds. A. Ziegler, K. H. vanHeek, J. Klein, and W. Wanzl, DGMK Tagungsberichte, Essen, Germany, 1997, pp. 565-568.

69. S. Niksa, “Assessing Coal Quality Impacts on P. C. Combustion Behavior,” Proc. Ninth Int. Conf. on Coal Science, Vol. 2, Eds. A. Ziegler, K. H. vanHeek, J. Klein, and W. Wanzl, DGMK Tagungsberichte, Essen, Germany, 1997, pp. 947-950.

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RELEVANT EXPERTISE

From 1998 through 2016, NEA performed sponsored research in excess of $3,000,000 to develop and validate detailed chemical reaction mechanisms to predict the partitioning of mercury (Hg) along coal-fired utility gas cleaning systems. These mechanisms accurately describe the fate of Hg as flue gas moves through economizers, SCR units, air preheaters, ESPs and fabric filters, and FGD scrubbers in utility power plants. They also accurately predict Hg capture efficiencies for bromine and chlorine additives, activated carbon injection, and the full domain of gas cleaning conditions. The predictions have been validated with measured Hg speciation from over 200 field tests at commercial power plants, including several in China, Russia, South Africa, Vietnam, Indonesia, and Japan.

This work is documented in the attached listing of 44 technical publications, which include 6 on the impact of bromine addition and 7 on activated carbon injection. NEA's reaction mechanism for bromine/chlorine/Hg chemistry is regarded worldwide as the best-in-class. Collectively, NEA's publications on Hg control have been cited more than 1000 times. NEA's research also spawned three patent applications, one of which was awarded to Dr. Niksa and Breen Energy Solutions (Dry adsorption of oxidized mercury in flue gas, No. 7,288,233). The work also spawned two software packages. MercuRator™ was licensed by NEA to six utility equipment suppliers in the US and Japan, and iPOG™ has been distributed by the UN Environment Programme to hundreds of users worldwide. Dr. Niksa has also served as an expert witness on five cases of patent infringement involving Hg control with bromine and activated carbon at coal-fired power stations, one of which went to trial. He has been deposed twice.

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