Experience Profile

J. Thomas McKinnon, Jr.

Thesis

Chemical and physical mechanisms of soot formation in flames

Education

Ph.D. Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA, 1989
B.S. Chemical Engineering, Cornell University, 1979

Expertise

- Thermochemical biofuel production
- Carbon nanomaterials synthesis
- Water mist fire suppression
- Synthetic nitrogen fixing
- Combustion chemistry - molecular weight growth, soot formation, kinetic modeling

Industries/Experience

Boulder Electroride, Inc., Boulder, CO

Boulder ElectroRide is **developing a unique electric motorcycle** that will combine long range, reasonable cost, and low-carbon footprint vehicles with the incredible exhilaration that only can be found in two-wheeled electric transport.

Colorado School of Mines, Golden, CO

My research group has conducted projects on: combustion chemistry, combustion modeling, pyrolysis of halogenated hydrocarbons, fine water mist fire suppression systems, and nanomaterial synthesis. Experimental work in molecular beam mass spectrometry, flow tube pyrolysis reactors, and microgravity drop tower experiments.

- **PI on the water mist fire suppression experiment** that flew as one of the three Combustion Module experiments on the Space Shuttle STS-107.
- **PI of the OpenChem Workbench modeling software** project with $1.3M of DOE funding.
- Teaching duties included undergraduate and graduate courses in **chemical kinetics, undergraduate thermodynamics, energy technology, and chemical process principles** (introduction to chemical engineering).

Novare Biofuels, Inc., Boulder, CO

Novare Biofuels, Inc. was a start-up company developing and **commercializing the novel Hub-and-Spoke thermal process for creating carbon-neutral, or even carbon-negative, liquid transportation fuels** from cellulosic biomass. The technology was sold in 2009 to Bye Energy.

Fullerene Sciences, Inc., Boulder, CO

FSI was created to commercialize a discovery from my laboratory at CSM. We created **the first and only method for creating bulk quantities of pure carbon nanospheres carbon balls** approximately 100 nm in diameter with walls tens of carbon layers thick. Incorporated into lithium-ion batteries, these materials permit an

order of magnitude increase in battery charging rate relative to conventional graphite anodes. We raised over $500k from an Asian petrochemical company as well as NSF SBIR funding. Three patents were awarded.

RES Group, Inc., Cambridge, MA

RES Group, Inc. **commercialized university-developed software** such as the OpenChem Workbench from my group at CSM and several MIT-developed modeling tools. Our clients included major automotive and chemical companies in Japan and Korea.

University of Colorado, Boulder, CO

- Co-principal investigator of a **solar photo-thermal hazardous waste destruction project**
- Co-supervisor of an experimental project to **measure the high-temperature optical absorption properties of reacting mixtures**
- Organized the **Center for Combustion Research seminar series**

TDA Research, Inc., Wheat Ridge, CO

- Principal investigator of a project to **synthesize fullerenes from combustion soot**
- Principal investigator of a project to **model the photo-thermal destruction of hazardous waste**
- Responsible for a project to **develop dissociation of methanol as a heat-sink for hypersonic ramjet engines**. Modeled oxidation chemistry of dimethyl ether as an ignition enhancer for methanol diesel engines

Solar Energy Research Institute, Golden, CO

Worked on several renewable fuel projects. My main emphasis was the **demonstration of the feasibility of fueling an automobile engine with dissociated methanol.** Other projects included analysis of farm-scale ethanol production and biologically catalyzed water photolysis. Supervised team of technicians. Note: SERI has since been renamed to the National Renewable Energy Laboratory (NREL).

Patents

Jack B. Howard and J. Thomas McKinnon, "Combustion Method for Producing Fullerenes," US Patent #5,273,729 (1993). European Patent #01200232.5-2111

- A spin-off technology from my PhD research on soot formation. This patent led to the formation of Nano-C, Inc. by Jack Howard as well as a large facility built by Mitsubishi in Japan for producing industrial quantities of fullerenes.

J.T. McKinnon and J.H Miller, "Use of Tunable Diode Lasers as a Diagnostic for Hazardous Waste Incinerators," #5,252,060 (1993).

- My modeling work showed that carbon monoxide was the best target species for monitoring the proper performance of an industrial incinerator. This patent coupled my chemical modeling with Prof. Miller's laboratory background in these solid-state near infrared lasers.

J.T. McKinnon, A.M. Herring, B.D. McCloskey, "Laser Pyrolysis Method for Producing Carbon Nano-spheres," PCT/US2004/004454, US Patent 7,601,321. Korean patent 2005-7015454.

- Our ability to produce bulk quantities of these unique materials was a serendipitous discovery as part of our work on cellulose pyrolysis. The patent led to the formation of Fullerene Sciences, Inc. and over $650k in investment.

J. Butz, J.T. McKinnon, C. Turchi, A. Kimball, E. Riedel, “Fine Water Mist Multiple Orientation Discharge Fire Extinguisher,” WO/2008/100348.

- This patent was a spin-off from our research project aboard the Space Shuttle STS-107. Fire extinguishers based upon this design are currently being developed for the International Space Station.

M.J. Wager, J.T McKinnon, J. Cox, K. Gneshin, “Hollow Carbon Nanosphere Based Secondary Cell Electrodes”, US Patent Number 12/368,009, issued 2/09/2009.

- The most useful application, to date, for our carbon nanospheres is as an anode for lithium-ion cells, allowing cells to charge up to an order of magnitude faster than conventional anodes.

Publications

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M.R. Nimlos, T.A. Milne, and J.T. McKinnon. "Photothermal Oxidative Destruction of Chloronaphthalene." Environmental Science and Technology, 28 816-822, 1994.

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M.W. Mackey, J.W. Daily, J.T. McKinnon, E.P. Riedel. "High Temperature UV-Visible Absorption Spectrum Measurements and Estimated Primary Photodissociation Rates of Formaldehyde, Chlorobenzene, and 1-Chloronaphthalene." J. Photochemistry and Photobiology, A: Chemistry, 105, 1-6, 1997.

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