Robert Hower, Ph.D.

Education:

Ph.D., 2005, Electrical Engineering, University of Michigan,

M.S.E., 1992, Electrical Engineering (Solid-state physics/fabrication, Computer architecture), University of Michigan

B.S.E., 1989, Electrical Engineering, University of Michigan

Employment and Experience:

The University of Michigan, Ann Arbor, MI

Research Assistant, Center for Integrated Micro-Systems, 1989 – 1999

Lead Engineer in Research, Michigan Nanofabrication Facility, 2005-Present

Advanced Sensor Technologies, Inc., Farmington Hills, MI

Director of Engineering, 1999 – 2005

Numed Technologies, LLC. Brighton, MI

President, 2005 - Present

Dr. Robert Hower's doctoral research at the University of Michigan focused on reducing the size, improving the manufacturability and reproducibility, and increasing the yield of integrated chemical sensors and their packaging. His thesis work includes the fabrication of integrated arrays of potentiometric and optical chemical sensors, increasing the number of analytes detectable while further improving sensor accuracy and precision. Dr. Hower integrated CMOS circuitry into the chemical sensing devices, thereby reducing noise from the high impedance signals associated with sensors. Customized processes were designed and developed that allow all sensor processing to be performed after standard CMOS processing, so that standard CMOS circuits could be utilized. Additionally he developed a SOI CMOS process to produce the circuits at the University Solid-State electronics Laboratory.

Work previously performed by others to reduce the size of the sensor dimensions resulted in compromised electrochemical performance. Dr. Hower has tuned his abilities to address these specific issues. He developed various micro-machining techniques for packaging schemes in addition to development of injection-molded packages for sensors.

At Advanced Sensor Technologies, Dr. Hower had several research projects involved utilizing specially constructed MEMS sensors and actuators in biological applications. First, his research work developed a micro-fluidic system to enhance the capabilities of microscopic blood and biological fluid chemical sensing systems. Second, he developed an integrated array of sensors to monitor both neuro-chemical and action potentials for monitoring neural communication in cell cultures. Third, he developed both transdermal sampling and delivery systems to monitor and deliver minute quantities of biological fluids for closed loop monitoring of interstitial fluids and delivery of drugs. Finally, developed micro-three-dimensional micro-fluidic systems to improve the functionality and capabilities of biological chemical sensing systems, utilizing biocompatible materials, while maintaining the accuracy of conventional systems. All of these projects demonstrated improvement of the biological sensing systems, as well as the design of integrated circuitry to: a) reduce environmental noise levels; b) reduce the number of interconnecting electronic leads from the sensors, c) improve temporal performance of the sensors, and d) reduce the power requirements of the devices.

Following the breakup of Advanced Sensor Technologies, Dr. Hower began aiding the University of Michigan by improving the capabilities for processing in the Michigan Nano-fabrication Facility (MNF). He currently is aiding researchers in developing new MEMS and nano-fabrication processes and characterizing the results. Numed Technologies is a newly formed company to allow the continued research and development of new medical devices and consulting with other local companies to improve the reproducibility and manufacturability of their new medical and MEMS devices.

Professional Affiliations:

Member of IEEE, the IEEE Electron Devices Society, IEEE Engineering in Biology and Medicine, and the IEEE Solid State Circuits Society

Representative Recent Publications:

Zhang W, Mnatsakanov A, Hower R, Cantor C, Wang Y. Urinary Iodine Assays and Ionophore based Potentiometric Iodine Sensors. Frontiers in Bioscience; 2005 Jan. 10:88-93.

Nam H, Cha GS, Strong TD, Ha J, Sim JH, Hower RW, Martin SM, Brown RB. Micro-potentiometric sensors. Proceedings of the IEEE; 2003 Jun. 91(6):870-80.

Lutze O, Meruva RK, Frielich A, Ramamurthy N, Brown RB, Hower R, Meyerhoff ME. Stabilized potentiometri solid-state polyion sensors using silver-calixarene complexes as additives within ion-exchanger-based polymeric films. Fresenius J Anal Chem. 1999;364:41-47.

Ambrose TM, Hower RW, Brown RB, Meyerhoff ME. Development of solid-state potentiometric heparin sensing cartridge based on photocrosslinked decyl methacrylate. Proceedings of Transducers '97; 1997 Jun 16-19; Chicago, IL.

Malinowska E, Oklejas V, Hower R, Brown RB, Meyerhoff ME. Enhanced electrochemical performance of solid-state ion sensors based on silicone rubber membranes. Sens Actuators B Chem. 1996;SNB033/1-3; 161-7.

Sakong DS, Shin MJ, Cha GS, Ryu MS, Hower RW, Brown RB. Asymmetric membrane-based potentiometric solid-state ion sensors. Sens Actuators B Chem. 1996;SNB032/2; 161-6.

Malinowska E, Oklejas V, Hower R, Brown RB, Meyerhoff ME. Enhanced electrochemical performance of solid-state ion sensors based on silicone rubber membranes. Proceedings of the 8th International Conference on Solid-State Sensors and Actuators, and Eurosensors IX; 1995 Jun 25-29; Stockholm, Sweden; (1)851-4.

Lee KS, Shin JH, Cha MJ, Cha GS, Trojanowicz M, Liu D, Goldberg HD, Hower RW, Brown RB. Mulitionophore-based solid-state potentiometric ion sensor and a cation detector for ion chromatography. Sens Actuators B Chem. 1994;20: 239-46.

Ryu MS, Shin JH, Cha GS, Hower RW, Brown RB. Polymer membrane matrices for fabricating potentiometric ion sensors. In Technical Digest of the 5th International Meeting on Chemical Sensors; 1994 Jul 11-14; Rome, Italy. 2:961-4.

Hower, RW, Shin, JH, Cha, GS, Meruva, RK, Meyerhoff, ME, Brown, RB. New Solvent System for the Improved Electrochemical Performance of Screen-Printed Polyurethane Membrane-Based Solid-State Sensors. Sensors and Actuators: B Chemical, vol. SNB033/1-3, 1996, pp. 168-172.

Hower, RW, Malinowska, E, Meruva, RK, and Brown, RB. Study of Screen Printed Wells in Solid-State Ion-Selective Electrodes. Technical Digest: Solid-State Sensor and Actuator Workshop, Hilton Head, SC, June 1996.

Sakong, DS, Shin, MJ, Cha, GS, Ryu, MS, Hower, RW, Brown, RB. Asymmetric Membrane-Based Potentiometric Solid- State Ion Sensors. Sensors and Actuators: B Chemical, vol. SNB032/2, 1996, pp. 161-166.

Hower, RW, Shin, JH, Cha, GS, Meruva, RK, Meyerhoff, ME, Brown, RB. New Solvent System for the Improved Electrochemical Performance of Screen-Printed Polyurethane Membrane-Based Solid-State Sensors. Proceedings: The 6th International Conference on Solid-State Sensors and Actuators, Eurosensors IX, Stockholm, Sweden, June 25-29, 1995, pp. 858-862.

Meruva, RK, Malinowska, E, Hower, RW, Brown, RB, Meyerhoff, ME. Improved EMF Stability of Solid-State Ion-Selective Sensors By Incorporation of Lipophilic Silver-Calix[4]arene Complexes Within Polymeric Films. Proceedings: The 6th International Conference on Solid-State Sensors and Actuators, and Eurosensors IX, Stockholm, Sweden, June 25-29, 1995, pp. 855-858.

Lee, KS, Shin, JH, Cha, MJ, Cha, GS, Trojanowicz, M, Liu, D, Goldberg, HD, Hower, RW, Brown, RB. Mulitionophore-Based Solid-State Potentiometric Ion Sensor and a Cation Detector for Ion Chromatography. Sensors and Actuators: B Chemistry, vol. 20, 1994, pp. 239-246.

Liu, D, Goldberg, HD, Hower, RW, Brown, RB, Meyerhoff, ME. “Optimizing screen-printed, microfabricated, potentiometric solid-state ion/biosensor arrays. 1994 Pittsburgh Conference, Feb. 1994, no. 502.

Ryu, RS, Shin, JH, Cha, GS, Hower, RW, Brown, RB. “Polymer Membrane Matrices for Fabricating Potentiometric Ion Sensors. Technical Digest: 5th Int. Mtg. on Chemical Sensors, vol. 2, Rome, Italy, July 11-14, 1994, pp. 961-964.

M. Poplawski, Hower, RW, Brown, RB. A Simple Packaging Process for Chemical Sensors. Technical Digest: Solid-State Sensor and Actuator Workshop, Hilton Head, SC, June 13-16, 1994, pp. 25-28.

Lee, KS, Shin, JH, Cha, MJ, Cha, GS, Trojanowicz, M, Liu, D, Goldberg, HD, Hower, RW, Brown, RB. Multiionophore-Based Solid-State Potentiometric Ion Sensor and a Cation Detector for Ion Chromotography. 7th International Conference on Solid-State Sensors and Actuators (Transducers ‘93) Yokohama, Japan, June 7-10, 1993, pp. 378-381.

Goldberg, HD, Liu, DP, Hower, RW, Poplawski, ME, Brown, RB. Screen Printing: A Technology for Partitioning Integrated Microsensor Processing. Technical Digest: IEEE Solid-State Sensor and Actuator Workshop, Hilton Head, SC, June 22-25, 1992, pp. 140-143.

Goldberg, HD, Cha, GS, Hower, RW, and Brown, RB. Improved Stability at the Polymeric Membrane/Solid-Contact Interface of Solid-State Potentiometric Ion Sensors. Proc. of the 6th International Conference on Solid-State Sensors and Actuators (Transducers 91), San Francisco, CA, June 24-28, 1991, pp. 781-784.

Goldberg, HD, Cha, GS, Hower, RW, and Brown, RB. Batch Fabrication of Solid-State Ion-Selective Sensors. Proceedings of the Third International Meeting on Chemical Sensors, Cleveland, OH, Sept 24-26, 1990, pp. 31-32.

Patents:

Cantor HC, Hower RW, Brown R., and Strong TD. Microscopic Combination Amperometric and Potentiometric Sensor, (pending), Nov. 1999.

Cantor HC, Hower RW, Brown RB, and Strong TD. Batch Fabrication of Electrodes, (pending), Nov. 1999.

Cantor, HC, Hower RW. Microscopic Multi-site Sensor Array, (pending), Nov. 1999.

Hower RW, Cantor HC, Mondro JR. Micro-fluidic System, (pending), Aug. 2000.

Hower RW, Cantor HC, Mondro JR. Micro-fluidic Pump, (pending), Aug. 2000.

Hower RW, Cantor HC, Mondro JR. Micro-fluidic Valves, (pending), Aug. 2000.

Hower RW, Cantor HC, Mondro JR. Micro-fluidic Actuator, (pending), Aug. 2000.

Hower RW, Brown RB. Micromachined device for receiving and retaining at least one liquid droplet, method of making the device, US Patent #6764652, July 2004.

Cantor HC, Hower RW, Swartz K, Agent Delivery System, (pending), Sept. 2006.

Funded Research Projects

Funding Agency: MEDC, Type: MLSC Grant, Contract Number: AIBS #1808

The objective of the Michigan Economic Development Corporation, Michigan Life Sciences Corridor project is to develop hardware capable of providing real-time electrochemical and electrophysiological recordings from neural tissue utilizing a single structure within AST's proprietary, microscopic, multi-site, neural sensor array.

Funding Agency: DARPA, Type: SBIR Phase 1 Grant, Contract Number: DAAH01-00-C-R145

Funding Agency: DARPA, Type: SBIR Phase 2 Grant, Contract Number: DAAH01-00-C-R177

The objective of the DARPA project is to develop a MEMS based micro-fluidic pumping and valving system for application in a near real-time monitoring of molecules present in interstitial fluid which has been obtained utilizing a transdermal sampling system.

Funding Agency: DARPA, Type: SBIR Phase 1 Grant, Contract Number: DAAH01-02-C-R144

The objective of the DARPA project is to develop a three-dimensional based micro-fluidic system that is compatible with integrated circuits and sensors, and that is capable of packaging the micro-fluidic sensors and actuators on a wafer level.

Funding Agency: NIH, Type: SBIR Phase 1, Contract Number: 1 R43 ES11684-01

Funding Agency: NIH, Type: SBIR Phase 2, Contract Number: 2 R44 ES11684-02

The objective of this project is to monitor minute quantities of an individual's blood to determine if there has been exposure to environmental toxins, and determine if it has been a long-term exposure or short-term exposure.

Funding Agency: DoD, Type: SBIR Phase 1 Grant, Contract Number: DAMD17-02-C-0103

The objective of this project is to produce a light-weight chemical sensing device that will be capable of monitoring environmental organophosphates from air, water or soil samples.

Funding Agency: NIH, Type: SBIR Phase 1, Contract Number: 1 R43 MH62852-01A1

Funding Agency: NIH, Type: SBIR Phase 2, Contract Number: 2 R44MH062852-02

The objective of this project was to develop designs for a melatonin-sampling chamber, construct a prototype and determine human feasibility for monitoring the melatonin transdermally.

Funding Agency: DoD, Type: SBIR Phase 1 Grant, Contract Number: DAMD17-03-C-0048

Funding Agency: DoD, Type: SBIR Phase 2 Contract, Contract Number: DAMD17-03-C-0048

The objective of the DOD project is to develop a glucose patch for the monitoring of glucose molecules present in interstitial fluid which has been obtained utilizing an electroporation sampling system.

Funding Agency: NSF, Type: SBIR Phase 1, Contract Number: DMI-0320195

The objective of the Phase 1 NSF project is to develop a closed loop delivery system for lithium.