Dr. Da-Jeng Yao, Ph.D.

Professor and ASME Fellow

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Dr. Da-Jeng Yao is a Professor at Department of Power Mechanical Engineering (PME) and Institute of NanoEngineering and MicroSystems (NEMS), also an adjunct Professor at Department of Engineering and System Science (ESS), National Tsing Hua University, Taiwan. He was born at Taipei, Taiwan, in 1969. He received his MS from Department of Mechanical Engineering, Lehigh University in 1996, and Ph.D. from Department of Mechanical and Aerospace Engineering, University of California at Los Angeles (UCLA) in 2001.

There are more than 60 multidisciplinary projects running or completed under his research team with other organizations (NTHU LS, Chem, EE, PME, NEMS, and ESS, NTU ME, NCTU ME, Chang-Gung Hospital, and ITRI, etc.). Among them, they can be divided into four categories: Bio-sensing system, including proteins detection, DNA sequencing recognition, and electronic nose for odd vapor detection; Neuron Engineering, including multi-electrode arrays for brain research; Bio-sample preparation system, including EWOD (Electrowetting on Dielectrics) on microfluidic system; and Microfluidic Reproductive Medicine on a chip, including motile sperm separation and embryo formation on a digital microfluidic chip.

More than 70 journal papers were published at top journal among this research field, including *Biosensors and Bioelectronics*, Biomicrofludics, *Nanotechnology*, *Applied Energy*, *Journal of Micromechanics and Microengineering*, and *Lap on a chip*, etc. He got Wu-Da-Yu Memorial Award (Young Investigator) from National Science Council in 2009, Shen-Yin award in 2010, and Young Researcher from Society of Theoretical and Applied Mechanics of the Republic of China. He was awarded as ASME fellow since 2013.

E-NOSE Surface acoustic wave (SAW) sensor array – Electronic noses (E-nose) imitating human olfaction system are widely applied in environmental monitoring. We had developed a gas sensor based on polymer-coated surface acoustic wave (SAW) array for detecting volatile organic compounds such as amine, alcohol CO and acetone. The portable gas sensing instruments would be the development goal. Furthermore, an on-line wireless sensing network module has been constructed with this developed SAW sensor array. Some bio-applications has been applied for COPD, 2nd and 3rd hand smoke, and OSA disease recognition by exhaled gas by patients.

Fertilization on a chip – Our study presents an integrated microfluidic system which consists of laminar stream-based microchannels to enhance the sperm motility sorting efficiency. Recently, the selection of good sperms can be used for ICSI (Intracytoplasmic sperm injection) for IVF (in vitro fertilization). Integrated biochip for embryo formation has been developed with selected sperms and oocyte. The new-born mouse has been verified successfully the procedure of on-chip embryo formation.

Micro electrode array (MEA) on bio-medical application – Microelectrode array (MEA) can be applied to biomedical detection recording the signal of neural cell when be stimulated. We have developed SOI 16-channel MEA, silicon MEA with Multi-wall carbon nanotubes and three-dimensional flexible MEA fabricated by Parylene and SU-8.

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Intelligent gas Sensing System and Its Applications

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Abstract

Olfaction is one of the main human senses. The olfactory neural pathway is very close to the part of emotion in the cerebrum. Thus it is known long that odors can strongly affect one's emotion. In nowadays, olfaction is not only important to individuals but also to the group or to the industry. Applications of artificial olfaction (e.g. electronic nose) have drawn more and more attentions, including indoor/outdoor air quality control, factory safety, food quality control, hazardous gas detection, environmental quality control, medical diagnosis, and military application, etc.

Recent technological advances allow gases to be detected in various ways; because of its low-cost and room-temperature operation, the polymer type of chemical sensors, both resistant and surface acoustic wave (SAW), is a feasible option in handheld or portable systems. In contrast to metal oxide sensors, the polymer type of chemical sensors can be operated at room temperature and efficiently conserves power; the sensitivity, linearity, rapid response time, and ease to be produced by this technology facilitates its application. The sensor interface circuit could be simple and small, although sensitivity to humidity is a drawback of the conductive polymer chemical sensor, which can be overcome by the circuit design and operational algorithm. In addition to sensing chip and circuit design, the algorithms used to recognize and categorize the gas type and concentration would be very important for the developed detection system, especially in IOT (internet of things) applications.

This presentation will first show the development of gas sensing system. Then give several examples based on the developed system: a plug-in handheld smart gas sensing device; indoor or outdoor environmental gas sensing system (PM 2.5 detection); food safety detection including spoilage fish and fake alcohols; medical diagnostic applications for COPD, 2nd hand and 3rd hand smoke, and OSA; and ITO applications, etc.

Short Bio

Dr. Da-Jeng Yao is a Professor at Department of Power Mechanical Engineering and Institute of NanoEngineering and MicroSystems (NEMS), also an adjunct Professor at Department of Engineering System and Science, National Tsing Hua University, Taiwan. He received his MS from Department of Mechanical Engineering, Lehigh University in 1996, and Ph.D. from Department of Mechanical and Aerospace Engineering, University of California at Los Angeles (UCLA) in 2001.

His research can be divided into four categories: Bio-sensing system, including proteins detection, DNA sequencing recognition, and intelligent gas sensing system; Multi-electrode arrays for brain research; EWOD (Electrowetting on Dielectrics) on microfluidic system; and Microfluidic Reproductive Medicine on a chip. He got Wu-Da-Yu Memorial Award (Young Investigator) from National Science Council in 2009, Shen-Yin award in 2010, Young Researcher from Society of Theoretical and Applied Mechanics of the Republic of China in 2012, National Innovation Award in both 2012 and 2014, and Nanoscience Award by Publishing Division of Cognizure in 2015 . He was awarded as ASME fellow since 2013.