IEEE Ottawa Section

A piezoelectric and ultrasonic membrane sensor for non-invasive biomedical monitoring and diagnosis

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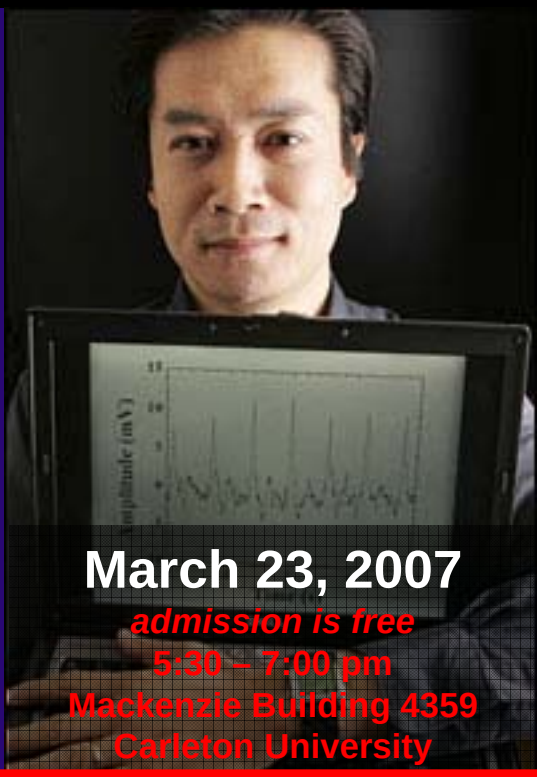
Due to dietary habits, lack of exercise, and the daily stresses of modern life and society, lifestyle diseases such as diabetes, obesity and heart diseases have become serious problems to maintaining a high quality of life. Daily monitoring of physiological activities and parameters, including pulse rate, blood pressure and breathing, would provide valuable information for the diagnosis and treatment of these diseases. In this study, a piezoelectric/ultrasonic membrane sensor has been developed for non-invasive biomedical monitoring and diagnosis. A porous piezoelectric ceramic film is deposited onto a metallic foil by a sol-gel spray technique. This membrane sensor has been worked as a unimorph-type bending sensor as well as an ultrasonic sensor. It is well-suited for biomedical applications as it is harmless, flexible, water proof, highly sensitive and mass-producible at low cost. For instance, the sensor is directly attached onto a wrist and signals corresponding to arterial pulse waves, associated with cardiac activities and conditions, have been successfully obtained. The signals have a signal-to-noise ratio of better than 20dB. Breathing curves are also measured on an abdomen, which could be used for diagnosis of sleep disorders such as obstructive sleep apnea syndrome. In addition, an ultrasonic signal reflected from a finger bone is observed with an ultrasonic pulse-echo technique. Thus, the sensor developed could be used as a wearable sensor, which does not disturb daily life activities including sleeping, for real-time and continuous monitoring of personal health conditions.

Yuu Ono received his B.Eng. degree in Electrical Engineering from Tohoku University, Sendai, Japan in 1990, and M.Eng. and Ph.D. degrees in Electrical and Communication Engineering in 1992 and 1995, respectively, from the same university. Right after completing his Ph.D. study, he became a Research Associate at the Graduate School of Engineering, Tohoku University, where he worked on the development of ultrasonic material characterization system and its application for electronic, semiconductor and optical materials and devices. In 2001, he was awarded Canadian Government Laboratory Visiting Fellowship (selected by NSERC) and joined the Industrial Materials Institute (IMI), National Research Council (NRC) of Canada, Boucherville, QC. In 2002, he became a Research Officer at the IMI, NRC. He was also appointed as an Adjunct Professor at the Department of Mechanical and Industrial Engineering, Concordia University, Montreal, QC in 2003-2006. Since July 2006, he has been an Associate Professor at the Department of Systems and Computer Engineering, Carleton University, Ottawa, ON. His research interests include: development of sensors and their applications for biomedical monitoring and diagnosis; biological tissue characterization; ultrasonic imaging; acoustic microscopy; sensors and techniques for real-time monitoring, control and optimization of material processes; materials characterization; and non-destructive evaluation of products and structures. He is a member of IEEE and the association of Professional Engineers of Ontario.



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