國立交通大學

機械工程學系

MECHANICAL ENGINEERING

NATIONAL CHIAO TUNG UNIVERSITY

書報討論專題演講 Department Seminar

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MEMS Devices with Polymer-based Materials

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工程五館 B1 國際會議廳

Abstract

This talk presents three microdevices realized by using soft materials: an ultra-sensitive temperature sensor for non-contact real-time respiratory monitoring, a microgripper that can be wirelessly manipulated using magnetic fields, and a tactile sensor array that employs the tunneling piezoresistive effect for achieving high sensitivity.

The real-time respiratory monitoring device employs a sensing element with acrylate-based material with a positive temperature coefficient (PTC). The acrylate-based material exhibits an order-of-magnitude variation in resistivity over a temperature change of a few degrees, and is capable of detecting tiny temperature changes induced by exhalation air flow. The transient behaviors of the fabricated device were measured. The fabricated device possesses the advantages such as low cost, energy efficient, and simple operation compared to common existing methods.

The proposed microgripper can move freely in liquids when driven by direct current (dc) magnetic fields, and perform a gripping motion by using alternating current (ac) magnetic fields. The gripper is fabricated from a biocompatible hydrogel material that can be employed for intravascular applications. The actuation mechanism for gripping motions is realized by controlling the exposure dose on the hydrogel composite during the lithography process. The preliminary characterization of the device is also presented. The measurement results show that the gripping motion reached a full stroke at approximately 38 °C.

The proposed highly-sensitive tactile sensor is made by dispersing multi-wall carbon nanotubes into polydimethylsiloxane (MWCNT and PDMS) polymer patterned with microdome structures using nylon membrane filter substrate. The fabricated sensing device features advantages such as ultra-high sensitivity, flexibility, and simple fabrication process. The tunneling piezoresistive effects of the interlocked microdome structures with different MWCNT concentrations are demonstrated. The resistance change of the sensor array due to different types of motions was measured.

Biography

Yao-Joe Joseph YANG received his M.S. and Ph.D. degrees in electrical engineering from the Massachusetts Institute of Technology (MIT EECS). Also, he received his M.S. degree from UCLA and B.S. degree from NTU in mechanical engineering. Dr. Yang joined the Coventor Inc, (Cambridge, MA) as a senior application engineer for one year before he joined the Department of Mechanical Engineering at the National Taiwan University (NTU). He is currently a full professor and holds the NTU Distinguished Professorship. From 2011 to 2017, He served as the department chair. Since 2017, he serves as the director general of the Taiwan Instrument Research Institute, National Applied Research Labs. In addition, he serves as the Chairman of the Taipei Chapter of IEEE Instrumentation and Measurement Society, and the Chairman of ASME Taiwan Section. He also serves as the Board Director of the Chinese Institute of Automation Engineering, and the Board Director of the Chinese Metrology Society. His research interests include microelectromechanical systems, nanotechnology, high-precision micromachining, flexible sensing arrays, sensor network, parallel processing, and semiconductor devices and vacuum microelectronics modeling. He has been consulted by more than three U.S-based companies and four Taiwan-based organizations. He is also the recipient of the Outstanding Research Award as well as Dr. Da-Yu Wu Memorial Award (Outstanding Young Researcher Award) of the National Science Council. He also received the NTU Outstanding Researcher Award.