MEMS and NEMS
Room: Hall D - Session MN-ThP

MEMS and NEMS Posters

MN-ThP1 Study on Aspect Ratio Characterization of Polydimethylsiloxane (PDMS) Pillar Arrays for Mechanobiological Traction Forces, ***Yu-Hsiang Tang***, National Applied Research Laboratories, Taiwan, Republic of China, *Y.H. Lin*, Instrument Technology Research Center, Taiwan, Republic of China

This paper describes a PDMS-based microchip, which consists of a uniform array of ordered arrangement, vertical, elastomeric micropillar(MP), to study the effects of substrate rigidity for mechanobiological traction forces. The PDMS substrates used have the advantage that their stiffness can be easily adjusted by altering their geometry and can precisely detect the biological activities. We developed the micropillar array substrates that a flexible polymer microfabrication technique was applied for manufacturing the elastomeric microstructures of various aspect ratios with height of 2, 4, 8, 12 mm and radius: period ratios of 1:4, 1:5, 1.5:7, and 2:7 mm. The PDMS micropillar was fabricated by replica molding technique for the standard and combines different steps including photolithography, deep reaction ion etching (DRIE) and soft lithography. The experiment result shows that the micropillar array is clean and in good situation. Meanwhile, more complex patterns of pillar rigidity will help us to study the physical and topographical effect of the substrate on mechanobiological behavior. This has significant implications when designing pillar arrays or comparing lateral forces measured on different pillar geometries. Furthermore, the results presented by this research are believed to be useful for biologists who are clarifying similar mechanobiological processes. Consequently, it was investigated how the substrate contribution to the total pillar deflection depends on the Poisson ratio of the material.

***Keywords*:** PDMS, Soft lithography, Micropillar arrays, Aspect-ratio structure

MN-ThP2 Mixing Effect of PDMS Microchannel with Biaxial Orientation Entry and Various Arrangements of Microstructures, ***Po-Li Chen***, *Y.H. Tang*, ITRC, NARL, Taiwan, Republic of China, *Y.S. Lin*, Hungkuang University, Taiwan, Republic of China, *C.N. Hsiao, M.H. Shiao, Y.H. Lin*, ITRC, NARL, Taiwan, Republic of China

Most active micromixers have the problem of high fabrication cost and low reliability since external actuators and stirrers were involved. In passive mixers, the mixing effect was obtained by changing channel geometry to enlarge the contact surface between different fluids, including serpentine, herringbone, zigzag, twisted, rotating, T-shape and Y-shape channels; and they were preferred due to their easy fabrication and integration in the actual micro system. However, most literatures focused on the studies for mixers with entries on the same plane (i.e. flow directions were all parallel to horizontal plane); in this study, we report a micromixer design with biaxial orientation entries (i.e. flow directions were parallel and vertical to horizontal plane) and investigate the mixing performance by placing various arrangements of rectangular microstructures with Computational Fluid Dynamics (CFD) techniques.

This study aims on achieving good mixing by changing the arrangements of microstructures to activate the interaction between different fluids. In this paper, several major parameters, including the width and height of microstructures, and the inline or staggered arrangements of various rectangular obstacles on the overall mixing channel pressure drop and mixing efficiency all were well predicted and compared. Simulated and experimental results showed that the microstructures played an important part and resulting in good fluid mixing at low Reynolds numbers.

MN-ThP3 An Integrated Volatile Organic Compounds Sensing Module for Exhaled Air Analysis, ***Po-Kai Huang***, *C.-Y. Kuo, P.-H. Kuo, T.-H. Tzeng, S.-S. Lu, W.-C. Tian*, National Taiwan University, Taiwan, Republic of China

The detection limit for the gas sensor has been an important factor for the low concentration compound measurement, especially for the detection of disease biomarkers from exhaled human breath air. In this study, we developed a CMOS-based volatile organic compounds (VOCs) sensor with either by a system on chip (SOC)-enabled negative feedback calibration (NFC) readout circuit or a custom-made voltage divider.

The sensor and the SOC-enabled NFC chip were both fabricated by the commercial TSMC 0.35μm two poly Si and four metal (2P4M) layer process. The sensing module included a stacked of interdigitated electrodes (IDEs) with polysilicon microheater and the sensing material of monolayer protected gold nanoclusters (MPCs) coated on the electrodes.

In order to conquer the sensor resistance variation created by the MPCs spraying process, the NFC readout circuit was used to overcome the resistance value fluctuation of the VOCs sensor. The sensitivity of our sensing module, consisting of the CMOS-based sensor and the SOC-enabled NFC readout circuit, was increased by approximately two times compared to the previous design. With our sensing module, a wide dynamic range of toluene detection from 30 ppm to 6000 ppm was demonstrated. The sensor responded rapidly, with the rising time and the recovery time both less than six seconds.

With this VOCs sensing module, the detection of lung disease biomarkers from exhaled human breath air could be achieved. Ultimately, the VOCs sensor and NFC readout circuit will be integrated on the same chip to further miniaturize the systems and to minimize the noises in the future.

Authors Index

Bold page numbers indicate the presenter