MEMS and NEMS Group
Room Hall B - Session MN-ThP

MEMS and NEMS Group Poster Session

MN-ThP1 The Ni-Co Micro-porous Array with High Dimensional Accuracy Control by Electroforming Process, ***YuHsin Lin***, *H.J. Wen,* ITRC,NARL, Taiwan, Republic of China*; C.J. Tsia,* NCTU, Taiwan, Republic of China*; M.-K. Wang, N.N. Chu, C.C. Chen, C.-N. Hsiao,* ITRC,NARL, Taiwan, Republic of China

In this project, the Ni-Co micro-porous array membrane for ultra-high sensitivity gas detector for nano particle distribution measurement is developed for cascade impactor application. The thick film lithography and electroforming technologies have been integrated, here. The dimension of micro-porous can be precisely controlled and reproducible. Finally, the micro-porous metal film will be integrated with base structure by laser welding technology. The component is used for cascade impactor equipment.

The fabrication process of Ni-Co micro-porous array membrane is used MEMS process. Here, the 6 inch silicon wafer as a substrate is used. The Cr/Au with 30/200nm thickness as a seedlayer is made by Sputter. The gold has good electrical conductivity to get well Ni-Co thickness uniformity at electroforming process. The AZ6112 photoresist is patterned on the seedlayer by lithography. The Cr/Au is etched to define a circle pattern. Then the thick photoresist SU8 pillar with 150μm thickness is fabricated at the center of the circle seedlayer pattern. The diameter of SU8 at the bottom is used to control the final diameter of Ni-Co porous. The Ni-Co membrane with 130μm thickness has been fabricated by electroforming process. Finally, the SU8 pillar is removed and the Ni-Co porous membrane is peel off from substrate. The Ni-Co micro-porous array membrane with good hole's dimension control have successful fabricated.

***Keywords*: Micro-porous, Electroforming, cascade impactor**

Acknowledgements: This work was sponsored in part by the Ministry of Science and Technology Taiwan under contract number MOST 106-2622-E-492 -024 -CC3 and 106-2622-E-492-004 -CC3.

MN-ThP2 Reactive Etching of AlGaN using BCl_3 and Ar/BCl_3, ***Meng-Kun Wang***, *Y.-H. Lin, C.-N. Hsiao, C.C. Chen, J.S. Su, N.C. Chu, C.-T. Lee,* ITRC,NARL, Taiwan, Republic of China

In this paper, we study the self- limited reaction of Ar/BCl_3 and AlGaN. We performed AlGaN surface oxidation reaction with oxygen ions before Ar/BCl_3 etching on the AlGaN surface, and used the same power of inductively coupled plasma (ICP), the same working pressure, and the same The etching time was compared to the difference in etching rate of AlGaN between Ar/BCl_3 and BCl_3. And using Atomic force microscopy (AFM) and scanning electron microscopy (SEM) to observe the change and morphology of the surface roughness after etching. The results show that the mixed gas of Ar/BCl_3 has a faster etching rate, the etching rate is about 4.79 nm/min, and the etching rate of BCl_3 gas is slow, and the etching rate is about 0.90 nm/min.

MN-ThP4 III-V_Si Wafer Bonding using Silicon Oxide Interlayer, ***WoongSun Lim***, *S.H. Jung,* Korea Advanced Nano Fab Center, Republic of Korea*; S.Y. Hwang,* Korea Advancnced Nano Fab Center, Republic of Korea*; G.Y. Yeom,* Sungkyunkwan University, Republic of Korea

In recently, the interests to integrate III–V based materials with Si can be divided into various application using the material advantages of combining III–V with Si. Therefore, Si wafer to III-V material wafer bonds were performed at low temperatures under 250 °C. The advantage of the low temperatures of these bonds was that wafers with common integrated circuit metals could withstand this temperature without degradation. Also, it is essential to study that low temperature bonding for heterogeneous wafers, because the higher temperature bonding may induce cracks, defects, bowing, and destruction by different thermal expansion coefficients of the heterogeneous wafers.

In this paper, we have investigated low-temperature direct bonding (<250°C) of SiO2 by the surface activation method in plasma. In the method, Oxyzen plasma treatment is used to make a clean surface which has strong bonding ability.The strength of Si oxide to Si oxide bonding prepared at room temperature by the method is equivalent to the bulk strength. Therefore, heating and pressure were applied to the wafers 20 minutes. Si oxide surfaces did not prove to bond spontaneously at room temperature and the bond-strength started to increase only after annealing at about 200°C.

A field emission scanning electron microscopy (FE-SEM) was used to determine the excellent bonding quality of the interface of wafer to wafer bonding. Silicon oxide surface roughness was examined using atomic force microscopy(AFM), respectively. After bonding, the bonded interfaces were evaluated using infrared transmission imaging.

MN-ThP5 Flexible Nanocomposite Sensors for Biomedical and Energy Harvesting Applications, *A.K. Batra,* ***Bir Bohara***, Alabama A&M University*; R. Currie,* NASA

Recently, an increase in demand for sensors for biomedical and ambient energy harvesting applications has led to the development of new hypersensitive smart materials. Biomedical sensors need to be able to be both lightweight, flexible and demonstrate high piezoresistive resolution. In order to meet the pressure sensor requirements for the next generation of prosthetics, efforts were made to develop and characterize multifunctional smart flexible nanocomposite films. The developed improved films could be used for both biomedical and energy harvesting applications. Nanocomposites PVDF and P(VDF-TrFE) film-sensors were fabricated via embedding smart nanocomposites particles along with a variety of carbon nano-particles via the modified solution casting method. The fabrication methods involved in this study aimed at improving the sensitivity of sensors while maintaining flexibility and cost efficiency. The fabricated films were characterized by infrared and dielectric spectroscopy; performance of the sensors was determined via customized strain measurement and energy harvester testing system. Results obtained will be described along with unique features of system developed for performance determination. [This work is funded by NSF-HRD-1546965 grant.]

MN-ThP6 Comparative Studies of Electrical Behavior of PLZT Thin Film Capacitors using Coplanar and Interplanar Configurations, ***Vaishali Batra***, *R. Paul, S. Kotru,* The University of Alabama

Lanthanum doped lead zirconate titanate (PLZT) is an interesting ferroelectric material which finds applications in optical MEMS & modulators/transducers, and smart sensors. Recent studies revealing the existence of bulk photovoltaic (PV) effect in this material thereby eliminating the need of fabricating a p-n junction, has generated curiosity among research community to explore this material for future energy/photo sensing applications. Various approaches are being explored to improve the PV output obtained from these devices.

In this work, capacitors with two electrode configurations viz. coplanar and interplanar were used to measure electrical properties. The capacitors were fabricated using thin films of $Pb_{0.95}La_{0.05}Zr_{0.54}Ti_{0.46}O_3$ (PLZT) and top and bottom electrodes of conducting materials. A chemical solution deposition method was used to prepare the films. The capacitance-voltage and polarization-voltage measurements demonstrated that the coplanar configuration shows higher capacitance, lower polarization, and higher coercive voltage as compared to the interplanar configuration. Further, the capacitors with coplanar configuration also demonstrated higher PV parameters, such as short circuit current density (J_{sc}) and open circuit voltage (V_{oc}). As an example, J_{sc} of 1.86 μA/cm^2 and V_{oc} of -1.1 V were obtained using coplanar configuration with Au electrodes for unpoled devices. Poling showed an improvement in PV parameters for both the coplanar and interplanar configurations, with higher values obtained from the coplanar configuration. After poling, J_{sc} of 1.32 μA/cm^2 and V_{oc} of -0.93 V for interplanar configuration, and J_{sc} of 2.04 μA/cm^2 and V_{oc} of -2.01 V for coplanar configuration were obtained. These results suggest that coplanar configuration is better for measuring the PV properties of PLZT thin film based capacitor structures.

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