 Proceedings of ICCES'08, pp.535-535

Nanomechanical Detection of Biomolecules Using Ultrathin Nanomembrane Transducer

Tae June Kang[1] and Yong Hyup Kim[2]

Summary

An ultra-thin conductive membrane with nanoscale thickness may allow extraordinary sensitivity and dynamic range, which make it a candidate for next generation membrane-based sensor arrays such as bio-/chemical, pressure, tactile and acoustic sensors. To achieve a highly sensitive and robust sensing platform of nanomembrane transducers, membrane thickness and corresponding properties should be investigated over the choice of materials and the resolutions of fabrication process.

In the present study, we fabricated and tested the nanomembranes with the thickness of 7-26 nm freely suspended over large (hundred micrometres) openings. The nanomembranes were fabricated with molecular level precision by spin-assisted layer-by-layer assembly, and all the processing steps could be performed with conventional microfabrication methods. Nanocomposite membranes were composed of multilayered molecular composites combined with polymeric monolayers and SWNT interlayer. The electrical conductivity of the nanomembranes was easily tuned by controlling the density of SWNT interlayers, and they showed a very low electrical percolation threshold. In the mechanical point of view, the outstanding mechanical stability of the nanomembranes was successfully achieved by a load sharing capacity of SWNT interlayers and electrostatic interactions between building materials.

Nanomembrane transducer integrated with sensing component and microfluidics was also demonstrated for biomolecular sensing. Bio/chemical reactions occured preferentially on one side of the nanomembrane surface generate a surface stress that changes the curvature of the nanomembrane. The curvature can be converted to an electrical signal, and the use of capacitive readout makes the system viable for miniaturization and multiplexing. Nanomembrane-type biosensors presented here have important significances, since the detection surface is physically isolated from the sensing surface and the differential capacitance measurement can be utilized for lab-on-a-chip sensors while providing comparable sensitivity to conventional optical readout.

[1]School of Mechanical and Aerospace Engineering, Seoul National University, San 56-1, Sillim-dong, Kwanak-gu, Seoul 151-742, Korea

[2]School of Mechanical and Aerospace Engineering and the Nano-Systems Institute-National Core Research Center, Seoul National University, Korea. Tel: +82-2-887-2662, Fax: +82-2-880-7385, E-mail: yongkim@snu.ac.kr