Single-Walled Carbon Nanotube based pH Sensor

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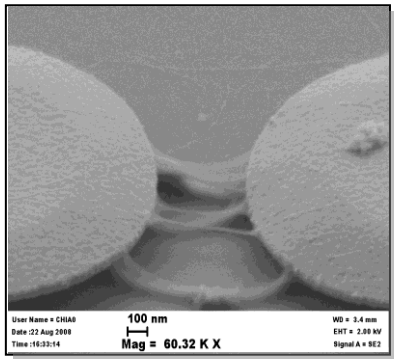
Presentation

Short Description: **A Single-Walled Carbon Nanotubes (SWNTs) based pH sensor is fabricated on a silicon substrate. SWNTs are assembled utilizing Dielectrophoretic (DEP) assembly at room temperature. An Electroless zincation process is developed to improve the SWNT to metal electrode contacts as well as to attach the nanotubes on the DEP electrodes. The SWNTs based pH sensor can be used in low cost high performance sensor systems.**

Keywords: Single-walled carbon nanotubes, Dielectrophoretic assembly, nanotube sensors.

Abstract: Single-Walled Carbon nanotubes, due to their large surface area to volume ratio, high aspect ratio and miniature size are excellent candidates for nanoscale sensors. Several applications of SWNTs based sensors are demonstrated which include biological and optical sensors. The measurement of pH in solution is one of the most common tasks in environmental analysis, process control and clinical analysis. Theoretical studies have shown significant changes in the electronic properties of SWNTs because of the hydroxide (OH^-) in pH solution. Due to the attachment of the OH^- group on the wall of the SWNTs in the buffer solutions, the changes of conductivity from the SWNTs shows that it can be a promising candidate as pH sensors. In this work, we have designed and fabricated a SWNTs based pH sensor utilizing low temperature Dielectrophoresis (DEP) assembly process. In order to improve the electrical contact between SWNTs and metal electrodes, an electroless zincation process was performed after assembling of SNWTs. The resistivity of the SWNTs was measured by using HP34401A multimeter with LabVIEW program at room temperature. To describe the pH response of the SWNTs, 0.1μL of pH buffer solution is placed on top of the SWNTs. The experimental results show that the resistance of SWNTs decrease corresponding to an increase in pH value of the buffer solution. In summary, a SWNTs based pH sensor has been demonstrated and its integration with CMOS circuitry has been demonstrated which paves the way for future integrated low cost high performance nanotube based sensor systems.



References

[1] Wei Zhao, "Water-Soluble and Optically pH-Sensitive Single-Walled Carbon Nanotubes from Surface Modification", J. AM. CHEM. SOC. , VOL. 124, No. 42, 2002 12419.
[2]Byeong-Kwon Ju, "pH sensitive multiwalled carbon nanotubes" ,Materials Letters 61 (2007) 3201-3203
[3]Yi cui, " Nanowire Nanosensors for Highly Sensitive and Selective Detection of Biological and Chemical Species", Science 293, 1289 (2001);