Design and fabrication of silicon nanowire based sensor

ABSTRACT

This paper reports the process development of silicon nanowires sensor requires both the fabrication of nanoscale diameter wires and standard integration to CMOS process. By using silicon-on-insulator (SOI) wafer as a starting material, the nanowires is fabricated using a top-down approach which involved Scanning Electron Microscope based Electron Beam Lithography method. The silicon nanowires are well developed with the smallest dimension is 65nm in width. The effect of line width and exposure dose on the pattern structure is investigated experimentally using the negative photoresist ma-N2403 for EBL. The exposure doses for the resist layer are varied in the range of 50μC/cm2 to 180μC/cm2 at 20 kV accelerating voltage with a beam current of 0.075nA. The nanowires resist masks are well developed with dimension less than 100 nm in width for the dose exposure parameters of 80μC/cm2, 100μC/cm2 and 120μC/cm2. Subsequently, the two metal electrodes which are designated as source and drain are fabricated on top of individual nanowire using conventional lithography process. Morphological, electrical and chemical characteristics have been proposed to verify the outcome of the fabricated device. Finally, the fabricated device is performed as pH level detection. Three types of standard aqueous pH buffer buffer solutions which are pH 4, pH 7 and pH 10 are used to test the electrical response of the device. The SiNWs sensor show the highest resistance value for pH 4 and the lowest resistance value for pH 10. In terms of sensitivity, the device with smaller nanowire is found to be more sensitive than larger nanowire as a result of the high surface-to-volume ratio.

Keyword: Electron beam lithography; Silicon nanowire; Resisitivity; ph detection.