Channel geometry-dependent characteristics in silicon nano-ribbon and nanowire FET for sensing applications.

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Abstract : Silicon nano-structures have great potential in bionic sensor applications. Atomic force microscopy (AFM) anodic oxidation have many advantages for the nanostructure fabrication, such as simple process in atmosphere at room temperature, compatibility with conventional Si process. In this work, we fabricated simple FET structures with channel width W~ 10nm (nanowire) and 1μm (nano-ribbon) on ~10, 20 and 100nm-thinned silicon-on-insulator (SOI) wafers in order to investigate the surface effect on the transport characteristics of nano-channel. For further quantitative analysis, we carried out the 2D numerical simulations to investigate the effect of channel surface states on the carrier distribution behavior inside the channel. The simulated 2D cross-sectional structures of fabricated devices had channel heights of H ~ 10, 20, and 100nm, widths of L ~ 1μm and 10nm respectively, where we simultaneously varied the channel surface charge density from $1x10^{-9}$ to $1x10^{-7}$ C/cm2. It has been shown that the side-wall charge of nanowire channel mainly affect the I-V characteristics and this was confirmed by the 2D numerical simulations.

Key Words : nanowire, nanoribbon, silvaco, numerical simulation

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