In-depth design and simulation analysis of vertical strained impact ionization MOSFET (VESIMOS)

Abstrak

The Vertical Strained Silicon Germanium (SiGe) Impact Ionization MOSFET (VESIMOS) has been successfully design and analyzed in this paper. VESIMOS device integrates vertical structure concept of Impact Ionization MOSFET (IMOS) and strained technology. The transfer characteristics of VESIMOS revealed an inverse proportionality between supply voltage, VD and sub-threshold, S due to lower breakdown strength of Germanium (Ge) content. The S=10mV/dec was successfully obtained at threshold voltage, VT=0.9V, with VD=1.75V. This VT is found to be 40% lower than VT for conventional Si-vertical IMOS. The output characteristics goes into saturation for VD more than 2.5V, attributed to the presence of Ge that has high and symmetric impact ionization rates. Electron mobility was improved by 40% compared to conventional Si-vertical IMOS. The increase in strain layer thickness, TSiGe, resulted in an increase of VT and lowered the mobility due to the strain relaxation in the SiGe layer. For high source-drain doping concentration, S/D=2x1018/cm3, the VT dropped to 0.88V, with VD of 1.75V due to high electric field effect in the channel, which is found to be contrary to the doping effects of conventional MOSFET. In every aspect, VESIMOS is projected to be premier candidate for future nanoelectronics device as to prolonged the scaling of conventional MOSFET into nano-regime.