Using Nitrogen passivation treatment to improve leakage current of InGaAs Gate-All-Around MOSFETs

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Abstract

As the technology nodes down scaling to the sub-10 nm, suppressing short channel effects (SCEs) has become a strict challenge due to the seriously V_T roll-off. To address this issue, gate-all-around (GAA) MOSFETs have been shown great potential to be the most resistant to SCEs. However, for the III-V based transistor, leakage current is a crucial issue due to the strong band to band tunneling of the small bandgap materials and the poor interface quality of high-k and semiconductor. In this work, InGaAs GAA MOSFETs with nearly vertical shape of channel sidewall is fabricated to enhance the gate controllability. Moreover, in-situ N_2 post remote plasma (RP) treatment is employed to improve the interface of the high-k and semiconductor. This device exhibits an extremly low off-current (I_{OFF}) of 1.14×10^{-4} μA/μm for InGaAs gate-all-around MOSFETs. Besides, subthreshold performances are significantly improved with SS of 65 mV/dec and DIBL of 40 mV/V. This can be attributed to a strong electrostatic control and a high high-k/InGaAs interface quality obtained by scaled channel and RP passivation effects. These results are potential for future low-power high-switching speed CMOS logic applications.