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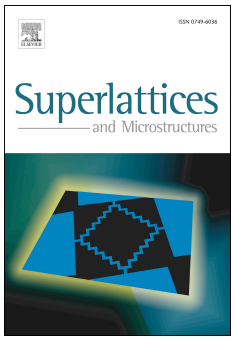

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Short Channel Effects in Tunnel Field-Effect Transistors with Different Configurations of Abrupt and Graded Si/SiGe Heterojunctions

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Abstract

The heterojunction technique has recently been considered as an effective approach to simultaneously achieve a high on-current and low ambipolar off-leakage in tunnel field-effect transistors (TFETs). In this paper, we propose the various configurations of abrupt and graded Si/SiGe heterojunctions for TFETs and investigate their short-channel effects by using two-dimensional simulations. It is shown that the semiconductor bandgap has to be properly considered together with the drain-induced barrier thinning in studying short-channel effects because scaling down the bandgap considerably deteriorates short-channel effects in TFETs. Among the basic configurations of Si/SiGe heterojunctions, the slantingly graded Si/SiGe heterostructure is most excellent in optimizing the electrical characteristics of the extremely scaled TFETs without short-channel effects. The slantingly graded Si/SiGe TFET with superior short-channel performance exhibits a potential device for low power and high packaging density integrated circuits.

Keywords: Short-channel effect, silicon-germanium, heterojunction technique, sub-10-nm transistor, tunnel field-effect transistor (TFET).

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