超細薄膜奈米雙閘場效電晶體含括返向通量比之物理解析式模型

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摘要

對於超細薄膜奈米雙閘場效電晶體，其物理解析式模型是建立在源極到通道能障的頂端上。而此模型之正確性可從一維 Schrödinger 和 Poisson 模擬、通道尺寸短至 10 奈米之二維彈道電流電壓模擬、及現存二維蒙地卡羅粒子和 Green 函數通道散射模擬等來驗證。此論文中將會對以下幾個方向有極具體的描述：(1)返向通量比在能障頂端的熱入射速度之重大效應；(2)此模型所萃取的 DIBL 值和次臨界電流電壓偏移的比較；(3)對於返向通量比以通道背向散射係數取代後之通道背向散射理論之驗證；以及(4)通道熱能區的寬度表示式改善的應用潛力等。

A Physically Based Analytic Model Including Backward to Forward Flux Ratio for Ultrathin Film Double-Gate MOSFETs

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Abstract

A physically based analytic model is established at the top of the source-channel barrier in ultrathin film double-gate MOSFETs. The validity of the model is corroborated using 1-D Schrödinger-Poisson simulation, 2-D ballistic I-V simulation down to 10-nm channel length, and existing 2-D Monte Carlo particle and Green's function simulations with the scattering included in the channel. Also presented specifically are the effect of backward to forward flux ratio on the thermal injection velocity at the top of the barrier, the comparison of DIBL extracted from the model with that from subthreshold I-V shift, the verification of the channel backscattering theory once the backward to forward flux ratio is replaced by the channel backscattering coefficient, and the potential applications of an improved expression for the width of the k_BT layer (a critical zone, part of the barrier).

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