考虑量子效应的 FinFET 栅电容物理模型研究

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摘　要：基于 FinFET 栅电容结构微观物理特性原理，通过能带结构关系推导了考虑量子效应的栅电容物理模型公式，使用 TCAD 搭建了 FinFET 器件结构，通过 MATLAB 仿真出栅电容随栅电压变化的特性曲线，与理想状态对比得到在反型状态量子效应会使栅电容增大的结论，量子电容成为影响栅电容大小的主导因素，同时分析了不同状态下决定栅电容的因素，仿真了不同拟合参数对特性曲线的影响，为改善晶体管栅电容线性度的研究提供理论依据，提出的栅电容模型对基于 FinFET 结构的电路设计研究具有了现实意义.

关键词：FinFET；量子效应；栅电容；物理模型

Study on the QM-based modeling of gate capacitance in FinFET

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Abstract：The physical model formula of gate capacitance considering quantum effect is derived by the band structure relationship based on the principle of microscopic physical properties of FinFET gate capacitance structure which is constructed by TCAD. And the characteristic curve of gate capacitance with gate voltage is simulated by MATLAB. Compared with the ideal state, the quantum effect in the inverse state will increase the gate capacitance, and the quantum capacitance becomes the dominant factor affecting the gate capacitance. At the same time, the factors determining the gate capacitance under different states are analyzed, and the characteristic curves of different fitting parameters are simulated in order to provide theoretical basis for improving the linearity of transistor’s gate capacitance. The proposed gate capacitance model has practical significance for circuit design based on FinFET structure.

Key words：FinFET; quantum effect; gate capacitance; physical model

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