●速報論文
「エレクトロニクス実装学会誌」**15**〔6〕483~491（2012）

ドリフト拡散デバイスシミュレーションを用いた1軸負荷に起因するnMOSFETの電気特性変動評価手法

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An Evaluation Method for Electrical Characteristics Variations on nMOSFETs under Uniaxial Stress Using Drift-Diffusion Device Simulation

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Abstract

This paper presents a practical method of drift-diffusion device simulation in order to evaluate the effects of mechanical stress on n-type silicon semiconductor devices. The device simulation incorporates an electron mobility model for considering the effects of mechanical stress. In our previous study, the changes in relative populations and momentum relaxation times (intervalley scattering) of electrons in conduction-band valleys were modeled in the electron mobility model. In this study, we added modeling of the change in the effective mass of electrons as a means of considering the effects of uniaxial stress. Stress-induced variations of electrical characteristics on nMOSFETs are evaluated using a device simulation including the proposed electron mobility model. Then, the electron mobility model and the simulation method are verified by comparing them with experimental results. It is demonstrated that experimental results can be reasonably estimated using this simulation method. In other words, the device simulation including the proposed electron mobility model can determine the uniaxial-load-direction dependence of the stress sensitivity of the change in electrical characteristics. To improve the accuracy of our simulation method, necessary improvements in the electron mobility model are identified.

***Key Words*:** *Device Simulation, Electron Mobility, Effective Mass, Uniaxial Stress, nMOSFET*