MONTE CARLO SIMULATIONS OF HOT ELECTRON TRANSPORT IN SILICON DIOXIDE

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Abstract

In order to understand reliability issues in MOSFET technology, it is crucial that one understand the behavior of hot electrons in silicon dioxide. Yet, despite the importance of the MOS material system over the past few decades, this subject is poorly understood. Fortunately, recent years have produced a wealth of new experimental results. I will present a Monte Carlo solution of the Boltzmann transport equation for electrons in silicon dioxide which explains a wide variety of experiments. Theoretical and experimental results will be presented which demonstrate that substrate current in n-channel MOSFETs is generated by hot electron initiated impact ionization in the oxide layer. This is the most definitive evidence to date of band-to-band impact ionization in an insulating material. I will show how the rate of impact ionization depends on field and oxide thickness and relate the findings to charge build up and interface state generation in MOSFETs.