Ulrich Wulf et al., J Phys Chem Biophys 2018, Volume 8
DOI: 10.4172/2161-0398-C2-031

4th International Conference on Physics

September 17-18, 2018 | Berlin, Germany

Semiempirical quantum transport model for SOIFETs and FinFETs

Ulrich Wulf and **Klaus Czajkowski**
Brandenburg University of Technology Cottbus-Senftenberg, Germany

In a series of recent publications a semiempirical quantum model for conventional bulk- metal-oxide-semiconductor field-effect transistor (MOSFETs) was developed. This model was verified comparing with the traces of a variety of experimental devices. After reviewing the semiempirical model we demonstrate the essential extensions necessary to be able to describe silicon on insulator field-effect transistor (SOIFETs) or fin field-effect transistor (FinFETs) used in state-of-the-art semiconductor industry. In these devices the source- and the drain contact as well as the conduction channel of the transistor are confined in depth direction to a thin silicon film (Si-film). In the first step we demonstrate that the quantum mechanical raise of the Fermi energy in the source and the drain which is associated with the narrow confinement in the depth direction leads to an increase of the effective channel length. This increase reduces a degradation of the output traces caused by source-drain tunneling. In the second step we calculate the supply functions in our semiempirical model to assess the decrease of the usable signal current through the conduction channel with decreasing width of the Si-film. In the third step we calculate the complete output characteristics to compare bulk FETs with SOIFETs or FinFETs within the semiempirical model. The trade-off between desirable reduction of source-drain tunneling on the one hand and detrimental decrease of signal current on the other hand is discussed.

Biography

Ulrich Wulf after his PhD at the Max-Planck Institute in Stuttgart, Germany, went to a Postdoctoral stay at the Indiana State University in Bloomington IN, USA. In 1993 he returned to Germany to the Brandenburg Technical University as an Associate Professor. Besides teaching, he runs a small theory group with the focus of quantum transport and nanoelectronics. Since 2013 they maintain a close cooperation with Global Foundries in Dresden which provided the devices to verify their semiempirical model.

ulrich.wulf@b-tu.de

Notes: