Silicon on insulator technology: Nano-MOSFETs with giga-effects

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The nanosize metal-oxide semiconductor (MOS) transistor shows giga potential. It stands as the perfect device for a smooth transition from microelectronics to nanoelectronics. Recent results on state-of-the-art silicon-on-insulator (SOI) MOS transistors reveal the impact of the device miniaturization. Nanometer thick gate oxide and silicon film enable, respectively, gate-induced floating body effects (GIFBE) and super-coupling. GIFBE is shown to depend on the device geometry and frequency. In ultra-thin SOI films, the coupling effects are amplified leading to interesting consequences for multiple-gate operation. The self-heating problem in SOI metal-oxide semiconductor field effect transistors (MOSFETs) can be alleviated by thinning the buried oxide. Even better a solution is to replace it with alumina or a different dielectric that offers improved thermal conductivity. It is shown that a ground plane avoids degrading the electrostatic behaviour of the nano-MOSFET. We discuss the key challenges for device scaling beyond the 10-nm channel-length barrier. The operation principles and main features of SOI transistors with double, triple or quadruple gates are addressed.

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