Fundamentals of Nanotransistors

Unit 1: Transistor Fundamentals

Lecture 1.1: Course Introduction

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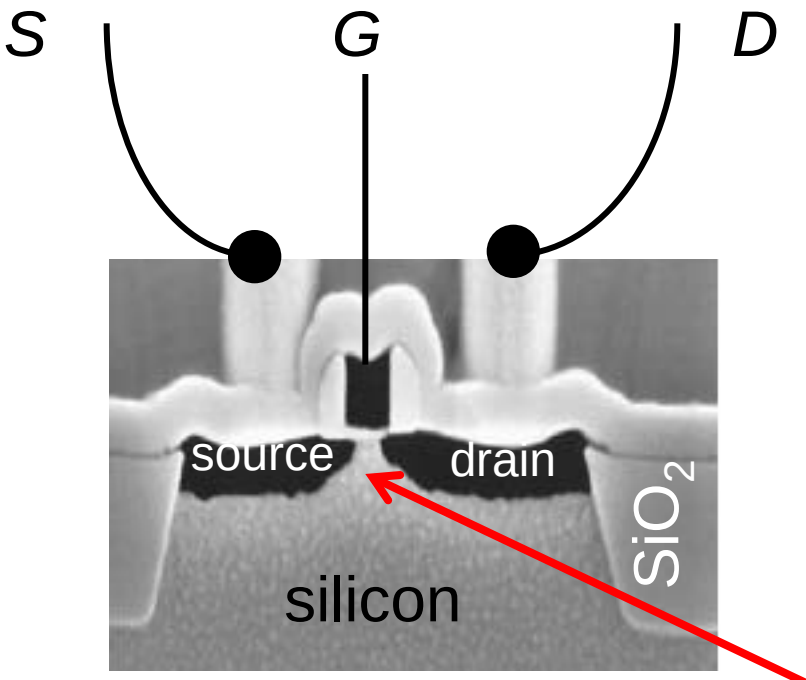
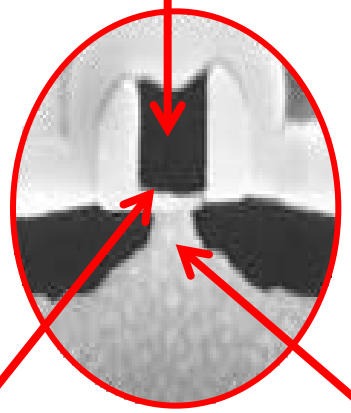
Silicon MOSFETs



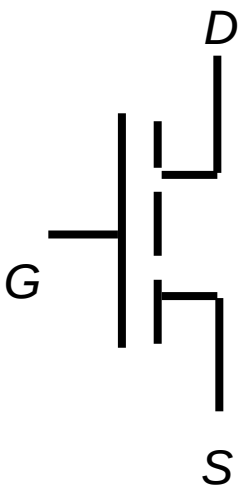
1960's: L ~ 10, 000 nm

(Source: Texas Instruments, ~ 2000)

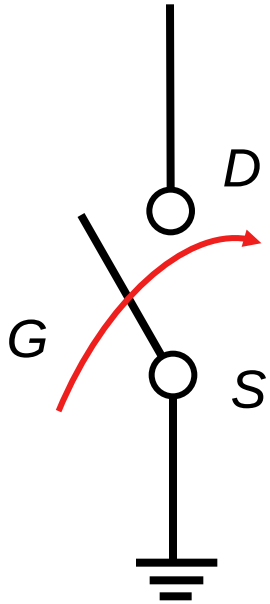


Transistors

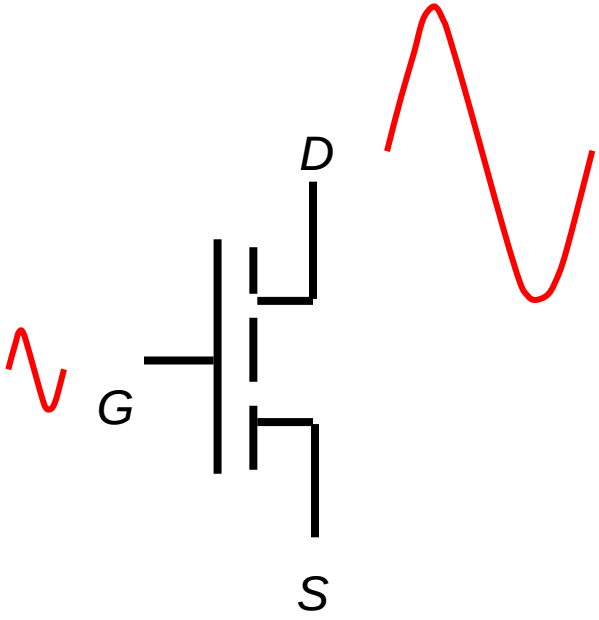
symbol



switch



amplifier

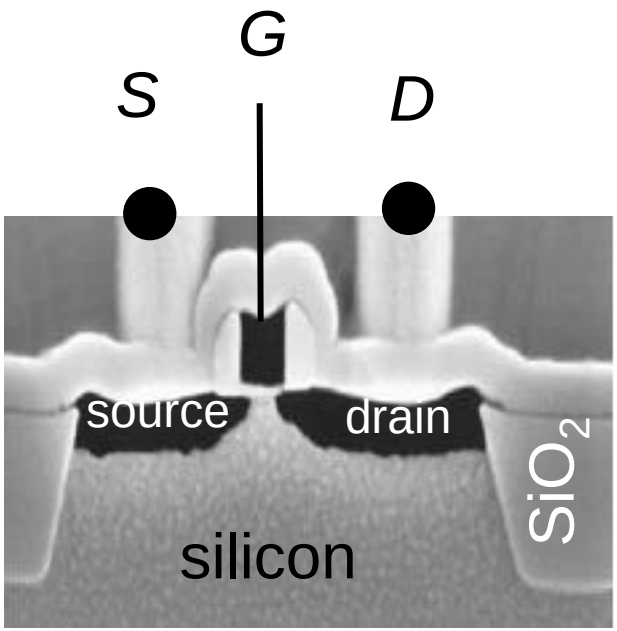


digital electronics

analog electronics

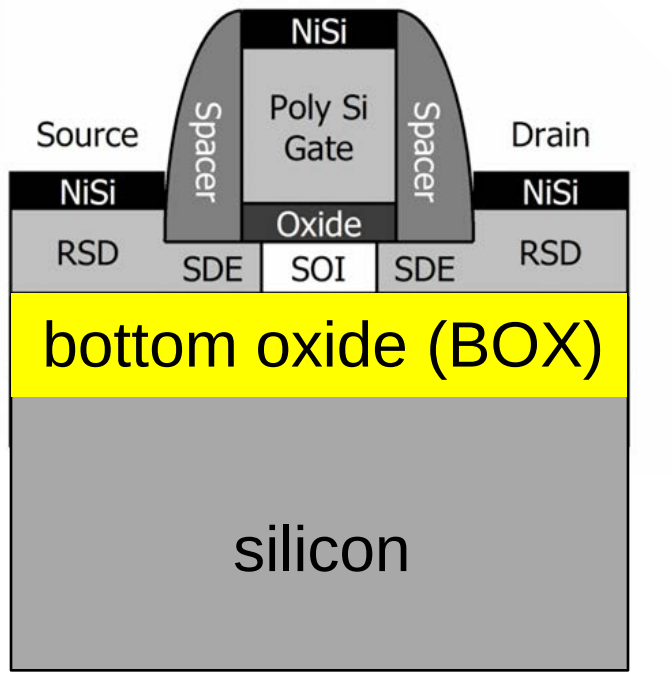
Modern MOSFETs

Bulk Silicon MOSFET



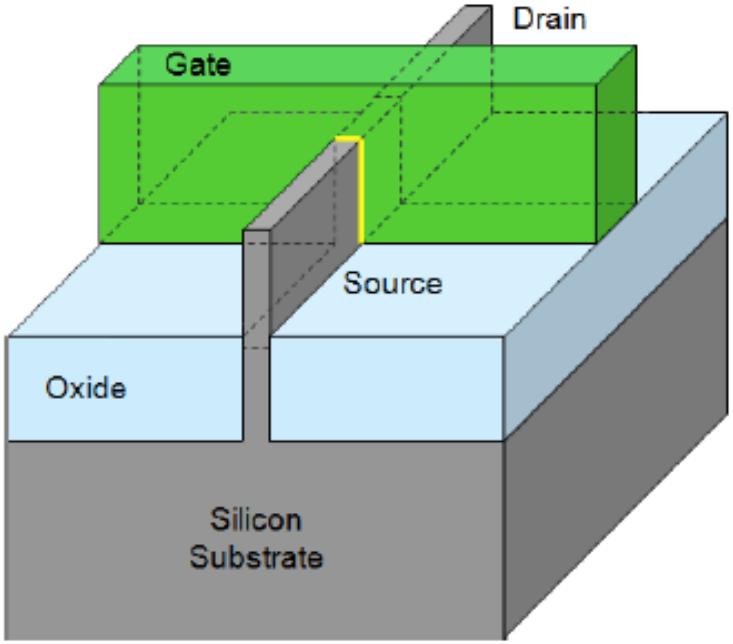
(Texas Instruments, ~ 2000)

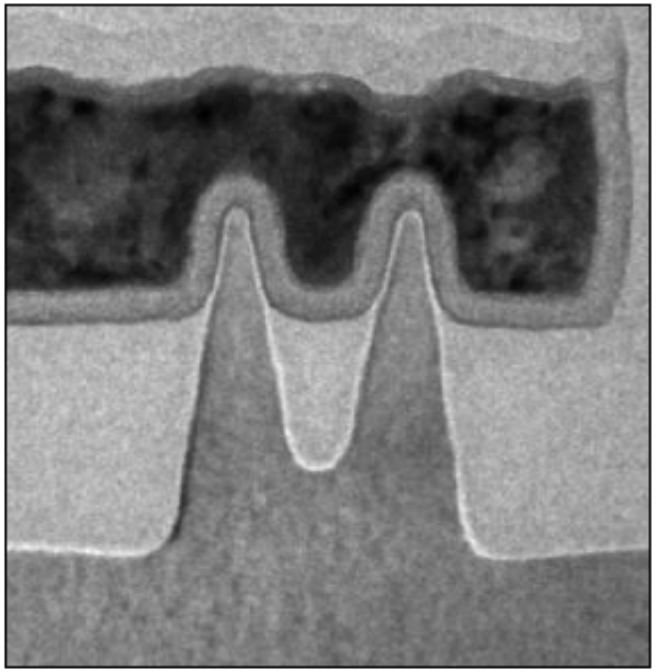
Extremely Thin Silicon On Insulator (ETSOI) MOSFET



(Source: IBM, 2009)

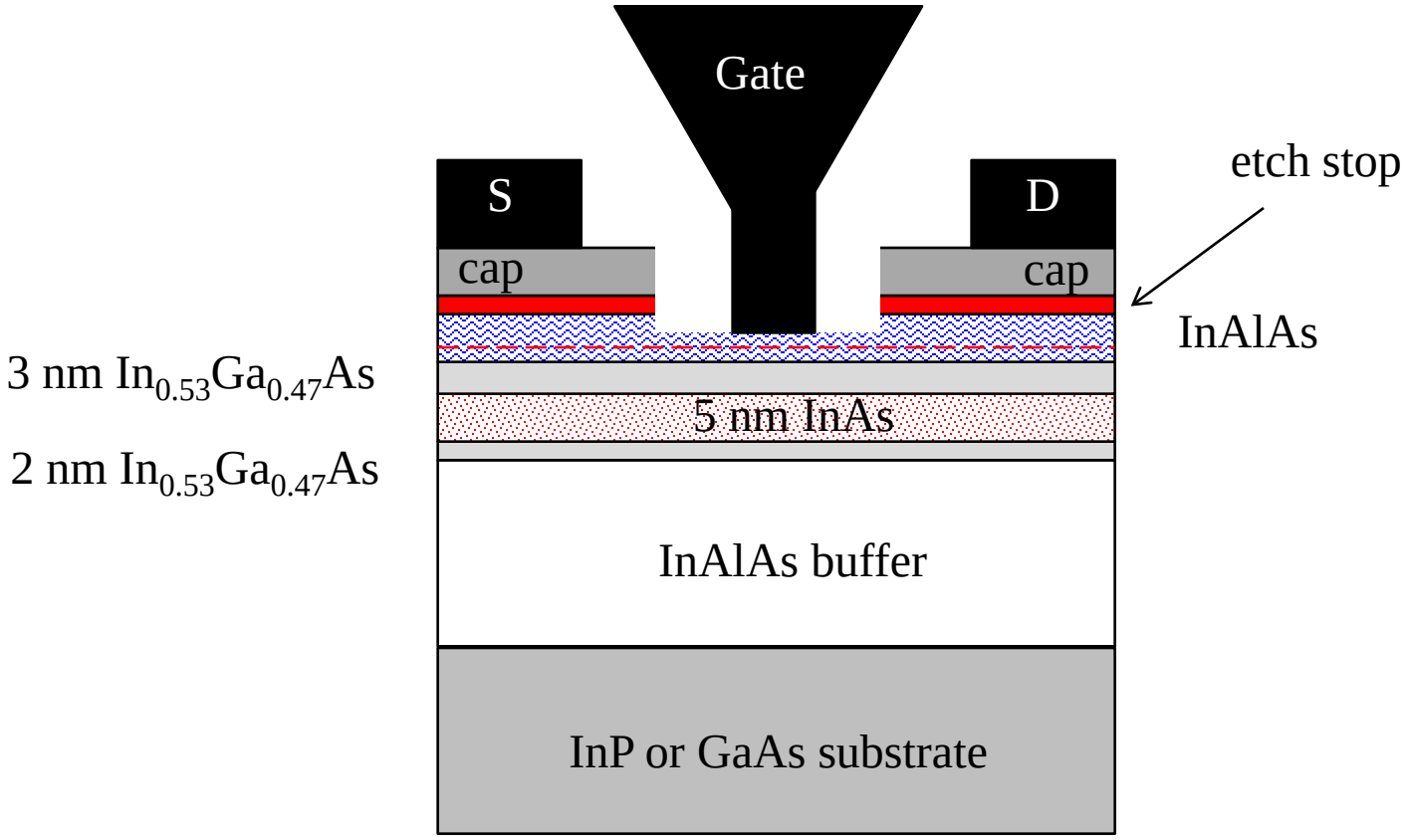
Modern MOSFETs: FinFETs





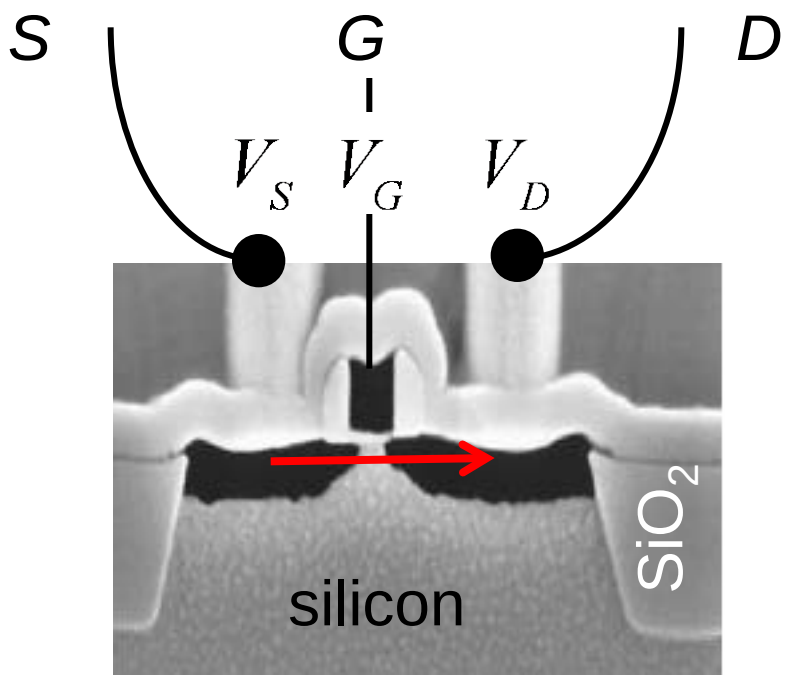
http://www.intel.com/content/www/us/en/silicon-innovations/intel-14nm-technology.html

III-V FETs: HEMTs and MOSFETs

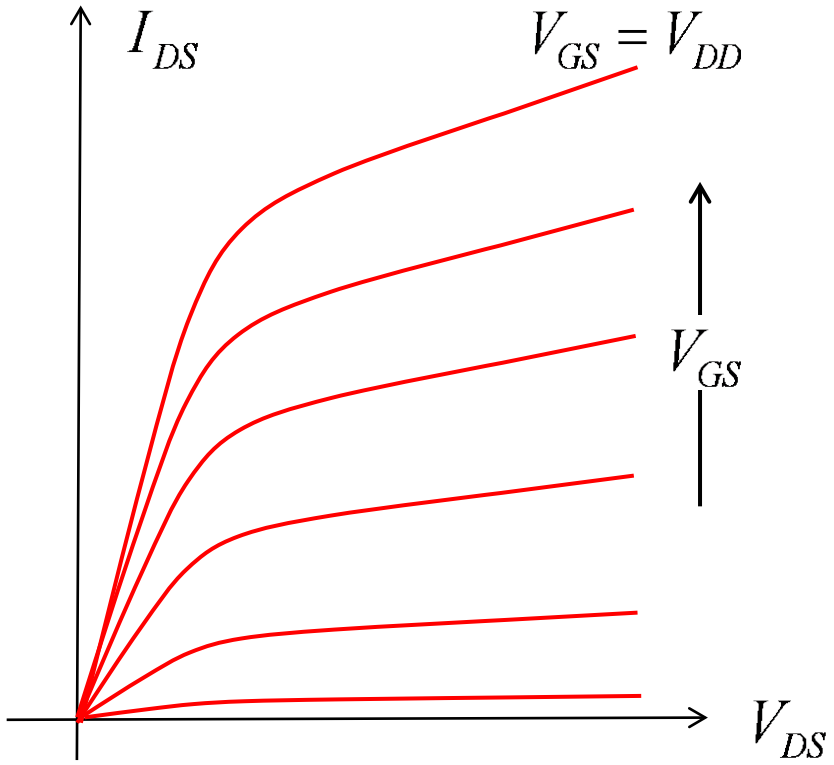


(after J. del Alamo, MIT)

Course objectives



(Source: Texas Instruments, ~ 2000)



1) Understand the physical operation of nanoscale transistors.

2) Relate that physical understanding to the *IV* characteristics.

Course outline

Unit 1: Transistor fundamentals

Unit 2: MOS electrostatics

Unit 3: The ballistic MOSFET

Unit 4: Transmission theory of the MOSFET

Prerequisite: Understanding of basic semiconductor physics.

Unit 1: Transistor Fundamentals

Lecture 1.1: Introduction
Lecture 1.2: The MOSFET as a Black Box
Lecture 1.3 MOSFET Device Metrics
Lecture 1.4 Transistors to Circuits
Lecture 1.5 Energy Band View of Transistors
Lecture 1.6 Traditional IV Theory
Lecture 1.7 The “Virtual Source Model”
Lecture 1.8 Unit 1 Summary

Please ask questions!

Additional resources

Links to relevant on-line resources will be provided.
(e.g. “Quick Review of Semiconductor Physics”)

A draft set of lecture notes to be published by World Scientific will also be provided to students of this course.

Please ask questions!