ECSEL Pilot Lines Success Stories & Impact

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Introduction

Which **A**rchitecture **Y**ields **T**wo **O**ther **G**enerations **O**f **F**ully depleted **A**dvanced **S**ubstrates and **T**echnologies

Main objective in the project (GF) - WP 3: Pilotline for Integration of 22FDX and beyond:

- Use the FDSOI technology developed in Dresden to be installed by the end of 2015
- Investigate the mobility of the material at the surface to the gate of the CMOS transistors and the interfacial layer towards the buried oxide layer by means of specific test structures

Work description:

- Early device development on advanced substrates in pilot line
- Develop teststructure and method for inferface (bulk-BOX) characterization by using back gating
- Investigate material property data related to charge traps and crystalline defects
- Perform device processing and evaluation on advanced fully depleted SOI substrates and feedback performance level

Projects Background/ Context

- Strategic significance: FDSOI is an European Initiative for number of applications

Consumer (STB/DTV)

Beats Energy Star goals and enables small form factors
- >50% lower power
- Thermal & reliability integrity enables smaller form factor

Wearables

Longer battery life and RF integration to reduce system cost
- 250mA battery life increases from 2.8 to 9 days while adding WiFi and BTLE
- Triple gate oxide minimizes leakage power in standby power modes

IoT

Integrated RF/MRAM, battery operation
- Low 0.6V operation and low-leakage power capability for battery life

Mobile

Meets display, video, and wireless needs w/o FinFET cost
- Perf/pwr to deliver 60fps on a 1080p display, CAT6, and also H.265 2K/4K decode
- Enables dual-core for lower area & cost (in lieu of quad-core)

Auto/ Infotainment

Lower Tj at 125C ambient and better Soft Error Rate (SER)
- Lower active current, 0.6V operation, better SER, and leakage at 150C
- Up to 40% analog content (FinFET not req'd)

WiFi/RF

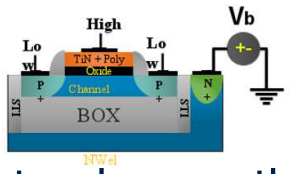
Achieves higher data rates at lower power
- 2X data rate for same pwr/area
- ½ RX Active Power

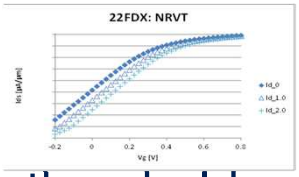
Motivations

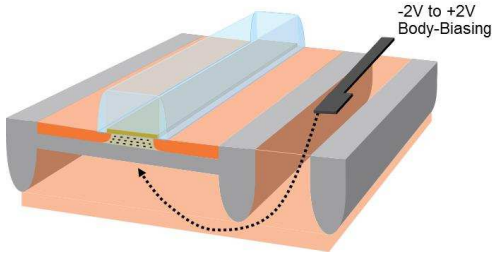
- 22FDX is a well suited compromise between excellent behavior of the features and low cost. The goal is to meet the 14nm FiNFET performance at 28nm bulk technology cost
- WAYTOGO-FAST is an important part for GLOBALFOUNDRIES' R&D work to improve the overall cost structure
- Substrate quality is the key for uniformity of transistor behavior and the product yield (strong cooperation with SOITEC and LETI)
- It is essential to tune this technology to a maximum to survive in the world of IoT-applications because the pricing for this kind of products is really low

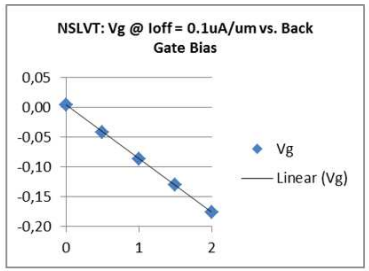
Project results

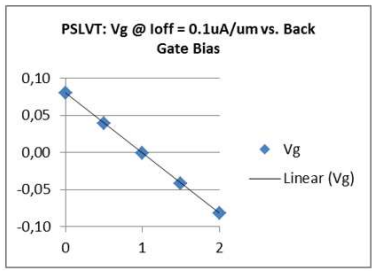
- Demonstration of electrical results of test chips realized in “normal” FDSOI substrate
- SOI thickness variation improvement verified by electrical data → Benefit of ~ 10% observed in Vt-mismatch distribution on large device areas observed on Gen2 of SOITEC’s substrates with improved smart cut process
- Interface states between BOX and bulk has been studied
- Back biasing has been demonstrated, which provides the ability to change the threshold voltage of a transistor over a wider range by applying a back gate voltage
- The benefits of back-bias can be further realized at the product level where simulations have shown comparable power-performance of 22FDX to FiNFETs







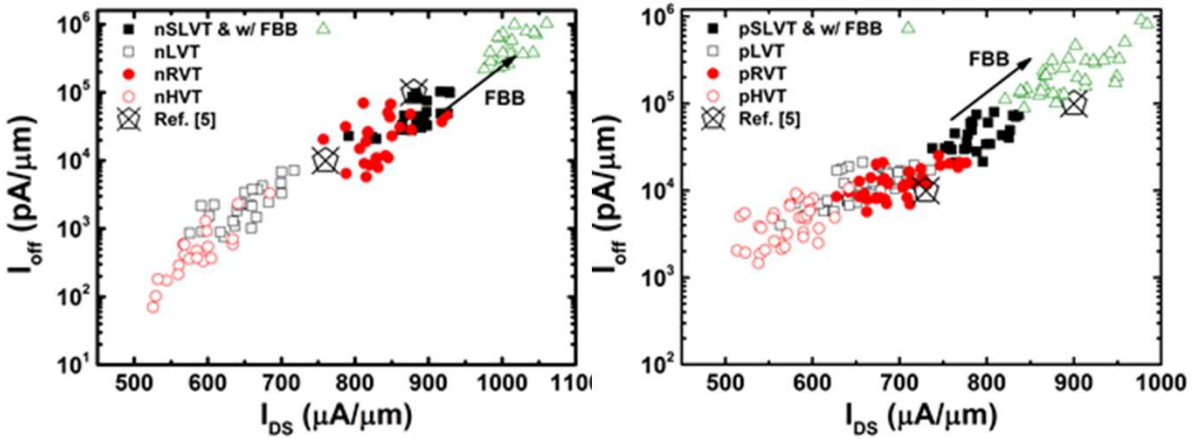




Project results

- Low off state leakage, 0.4V logic operation, high FT/FMAX performance, and low cost manufacturing make the technology a compelling offering to meet emerging markets in mobile, IoT, and RF

- 22FDX platform achieves the power and performance efficiency of a 16/14nm FiNFET technology in a cost effective, planar device architecture that can be implemented with ~30% fewer masks



Project results

IPCEI on Microelectronics

Development and Industrialization of the innovative FDSOI-Technology (RF, ULP, ULL, automotive)

ULTRA LOW POWER ELEVANCE PRIME MEMORY DESIGN

IP, design, devices for logic including back bias, RF and analog, selection device MRAM

WAY TO GO FAST

Pilotline for Integration of 22FDX and beyond

BEYOND5

Enabling RF Domains for sensing, Communication, 5G and beyond

CEAN12

Automotive market driver challenges by leveraging European based technology FDSOI
Opportunity to Carry European Autonomous driving further with FDSOI technology up to 12nm node

Reference

Leading edge ecosystem in the Radio Frequency communication applications based RFSOI substrates for novel applications

Impact & Conclusion

FDX™ Provides the Industry's Most Complete FDSOI Ecosystem

FDXcelerator™

50+ PARTNERS

Expedite & simplify FDX design

RFwave™

16 PARTNERS

Streamline & differentiate RF design