Study of SiGe condensation for strained channels development: application to advanced CMOS technologies

Damien VALENDUCQ

Supervisor: E. Blanquet
Co-supervisor: O. Gourhant (STMicroelectronics)

Wednesday, March 31st 2021 – 2:00 p.m.

SIMaP/visioconférence

Jury :

GEORGES BREMOND, PROFESSEUR DES UNIVERSITES, INSA-LYON	Rapporteur
ALAIN ESTEVE, DR, CNRS DELEGATION OCCITANIE OUEST	Rapporteur
ISABELLE BERBEZIER, DR, CNRS DELEGATION PROVENCE ET CORSE	Examinateur
MARC FIVEL, DR, CNRS DELEGATION ALPES	Examinateur

Abstract: In recent years, electronic devices downscaling has suffered from different emerging effects. Therefore, improving the performance of basic building blocks of integrated circuits, CMOS transistors, is achieved by modifying their architecture, the materials composing their structure and by integrating performance "boosters" according to the requirements of targeted applications. The use of new materials for conduction channels such as germanium (Ge) coupled with the integration of strain allows a significant improvement of carrier mobility thanks to more interesting intrinsic properties than silicon.

This improvement is made possible thanks to a step of crystal growth of SiGe on an SOI substrate which is followed by a step called " SiGe condensation" allowing the selective thermal oxidation of Si from the SiGe alloy and the in depth structure homogenization by the activation of solid diffusion. The difficulty lies in the manufacturing of SGOI structures of high Ge content of good quality, that is to say having a maximum Ge concentration, a maximum strain while limiting the degradation of crystal quality of the SiGe layer.

A preliminary study of the thermal oxidation of SiGe in an industrial furnace has enabled us to fully understand the two phenomena involved in SiGe condensation in an industrial equipment by studying SiGe oxidation kinetics and the redistribution of Ge during thermal treatment. The study of the influence of various oxidation parameters on strain and crystal defect formation within SiGe allowed us to determine the most favorable conditions for high quality SGOI films manufacturing as well as existing limitations for the use of SiGe condensation process for an application on an industrial scale.