3.5.4 Silicon-On-Insulator (SOI) Solutions for Automotive Applications

L. Demeuș, P. Delatte, G. Picun, V. Dessard, Pr. D. Flandre

1 CISSOID S.A., The SOI Design Specialist
Place des Sciences 4 bte 7, 1348 Louvain-la-Neuve, Belgium
Phone: +32/10/489210, Fax: +32/10/489219
E-mail: laurent.demeus@cissoid.com

2 Microelectronics Laboratory, Université catholique de Louvain
Place du Levant 3, 1348 Louvain-la-Neuve, Belgium

Keywords: high temperature sensors, Low-Power, SOI, reliability, harsh environment, sensors

Abstract

This paper will focus on the use of SOI (Silicon-On-Insulator) technology for automotive applications. SOI has been recognized since a long time for its advantages for High Temperature electronics, low-power electronics and since some years, for MEMS applications. These three fields fit all future automotive requirements for electronics products.

1 Introduction

Silicon-On-Insulator (SOI) is an emerging semiconductor fabrication technology. SOI is already well known for its advantages for high speed application but the Automotive sector can also take advantage of this new technology. Two major needs in electronics systems for automotives can be reached with SOI technology, either High Temperature operation, or low-power consumption, to an extend depending on the exact used SOI process. MEMS applications can also take significant advantage for micromachining on SOI substrates. This paper will mainly concentrate on High temperature application.

The basic idea of SOI technology is to isolate the mechanical silicon substrate of a wafer from the active silicon layer (See figure 1). This yields to a number of advantages: less leakage currents, less parasitic capacitances, no latch up, better sub threshold slope, intrinsic isolation between transistors, no wells, better radiation resistance, ...
SOI technology is a generic name for Silicon processes using SOI wafers, but each SOI process has its own specifications. The first distinction we can make is between thick (about 1 µm of active silicon) and thin (between 50 and 200 nm of active silicon) SOI technologies. Thick SOI requires additional trench isolation between transistors and is mainly used when vertical devices are required, this is not the subject of this paper. Thin SOI can only use lateral devices and is divided into two main families: Fully Depleted (FD) and Partially Depleted (PD) SOI, depending on the depth of the depletion region compared to the thickness of the active silicon layer. The most advantageous processes are Fully Depleted but are the most difficult to develop. The majority of processes available at this moment are Partially depleted processes.

As a conclusion, depending on the application and its requirement, we have to choose the best-suited SOI technology. But even if a SOI technology is optimised for one advantage, for example, High Temperature, it will still present other advantages, for example, lower power consumption than a BULK technology.

2 High Temperature Operation

Electronics in Automotive applications moves to hotter localizations, close to engine, wheels and exhaust system. Operating temperatures for these electronics components far exceed the 150-175°C maximum rating of standard devices.

Since last year, High Temperature SOI technology for industrial applications is available in Europe and open the way to design highly reliable electronics circuits for years of operation up to 225°C. This technology is a Partially Depleted SOI process, optimised for High Temperature operation, including a specific High Temperature metallisation to avoid early electromigration. Fully depleted SOI processes are also available but only for research purpose.