

Silicon Germanium ($\text{Si}_{1-x}\text{Ge}_x$)

With the development of the microelectronics, the epitaxial structures of semiconductors become more and more complex. SiGe_x system is widely studied for high speed heterojunction transistors (HBT). Indeed the insertion of SiGe_x in bipolar transistor produces higher cut-off and maximal frequencies (around 100 GHz) and simultaneously reduces the noise and power dissipation. These devices, when incorporated into RF or microwave components, make SiGe_x a strong competitor to GaAs.

The need of precise characterisation technique capable to determine at the same time the thickness and the composition of such samples is obvious.

Spectroscopic Ellipsometry(*), which is **contactless, non destructive and allows on-line control**, is an excellent technique to perform such characterisation.

Figure 1 shows several SiGe_x refractive indices with different Germanium contents determined with one of the **SOPRA Ellipsometers**. The optical properties of these materials depends on the composition; as shown in figure 1, the position of the optical band gap E_1 shifts with the Ge content x .

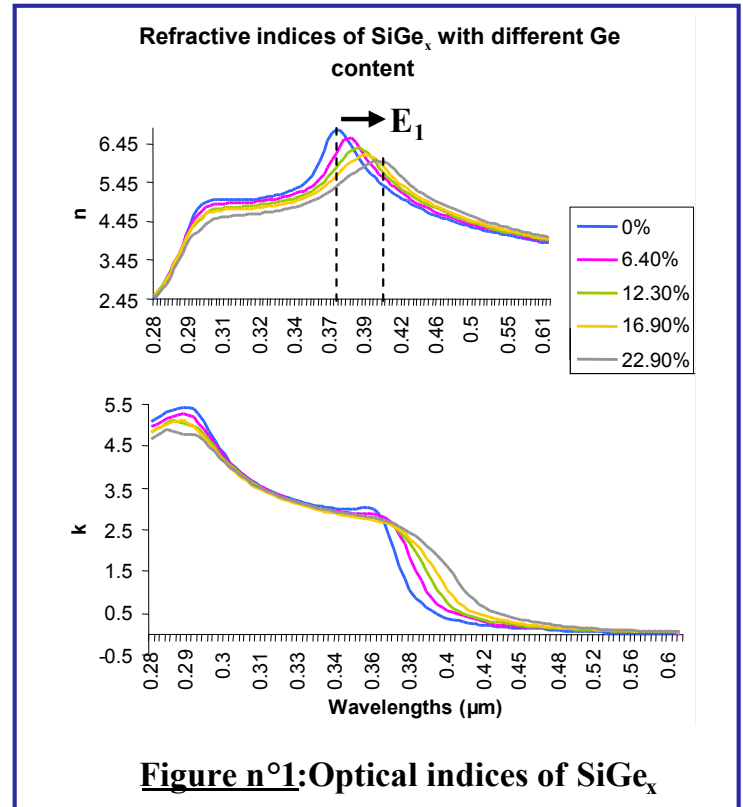


Figure n°1: Optical indices of SiGe_x

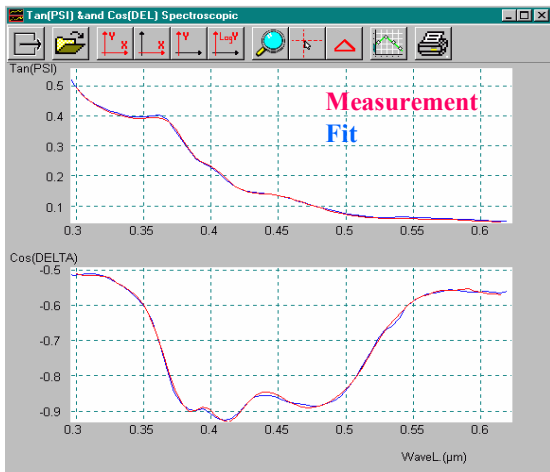


Figure n°2-a : SiGe measurement

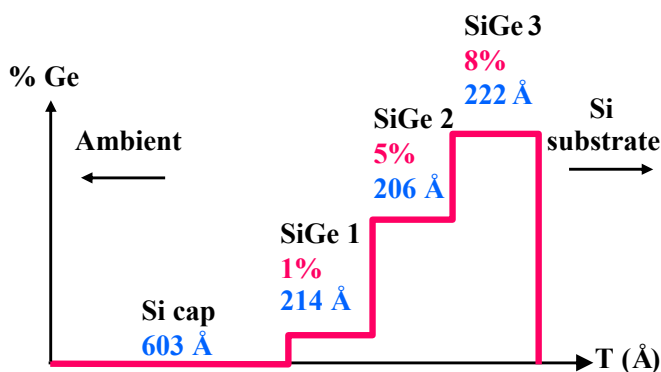


Figure n°2-b : Typical SiGe_x graded structure with cap

Figure 2-a shows the measurement, taken in scanning mode, of typical SiGe_x structure (Si cap / SiGe_x graded / Si).

After running SOPRA's regression the best fit and the experimental curves are presented. The excellent agreement between the measurement and the model is to be seen.

Figure 2-b presents the structure of the sample and the results obtained.

From the measurement of two parameters ($\text{Tan}\Psi$ and $\text{Cos}\Delta$), **Spectroscopic Ellipsometry(*)** can easily determine **at the same time and independently the thicknesses of each layer within the stack as well as the Ge content of the three SiGe_x layers and so, to characterise the shape of the graded layer.**

(*)Refer to SOPRA web page (www.SOPRA-SA.com) for tutorial on ellipsometry principles, terminology and products.

