MODELISATION AND EXPERIMENTAL RESULTS ON LASER THERMAL PROCESSING FOR ULTRA-SHALLOW JUNCTION FORMATION

J. Venturini,[1] M. Hernandez,[1] D. Zahorski,[1] G. Kerrien,[2] T. Sarnet,[2] D. Débarre,[2] J. Boulmer,[2] C. Laviron,[3] M.N. Semeria,[3] J.L. Santailler[4] and D Camel[4]

[1]SOPRA
26, rue Pierre Joigneaux
92270 Bois Colombes
France

[2]Institut d'Electronique Fondamentale (IEF)
Université Paris-Sud - Bat. 220
91405 Orsay
France

[3]CEA-DRT - LETI/DTS - CEA/GRE
17, avenue des Martyrs
38 054 GRENOBLE CEDEX 9
France

[4]CEA-DRT - DTEN/LESA - CEA/GRE
17, avenue des Martyrs
38 054 GRENOBLE CEDEX 9
France

According to the International Technology Roadmap for Semiconductors (ITRS), the doping technology requirements for the MOSFET source and drain (S/D) regions of the future CMOS generations lead to a major challenge. A critical point of this evolution is the formation of ultra-shallow junctions(USJ) for which present technologies, based on ion implantation and rapid thermal annealing, will hardly meet the ITRS specifications. Laser based technologies, known as Laser Thermal Processing (LTP) and Gas Immersion Laser Doping, (GILD) have been shown to be potential candidates to solve this fundamental problem. In the present paper, LTP experiments have been performed with two different XeCl excimer lasers (= 308 nm) with different pulse characteristics. The first laser (Lambda Physics, Compex 102) delivers 200 mJ laser pulses with a duration of 25 ns. The second laser is an industrial tool (SOPRA, VEL 15) that delivers 16 J laser pulses with a duration of 200 ns and allows to anneal a few cm die in a single laser shot. Here we examine the influence of the pulse duration on LTP of B+ (with and without Ge+ pre-amorphization) and BF2+ implanted silicon samples on the basis of real-time optical monitoring of the laser induced melting / recrystallisation process, four-point probe resistivity measurements, secondary ion mass spectroscopy (SIMS) depth profiles. Experimental results are compared to model calculations developed in the framework of an industrial software (FIDAP) with pulse characteristics of both laser pulses. The activated dopant dose, junction depth and sheet resistance, as a function of the laser fluence and shot number for both lasers, confirm the efficiency of laser processing to realize ultra-shallow and highly doped junctions required for the future CMOS generations.

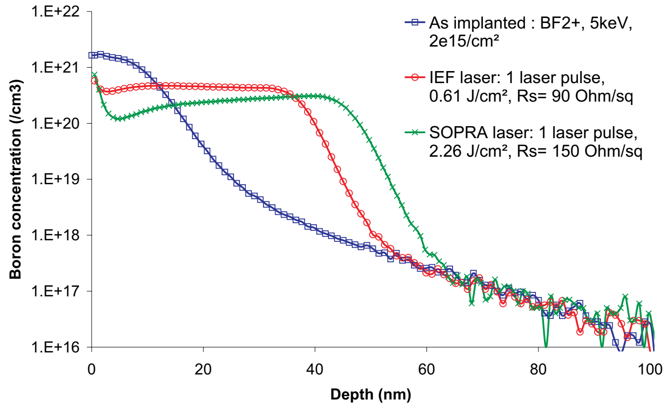

Figure 1

SIMS depth profiles.

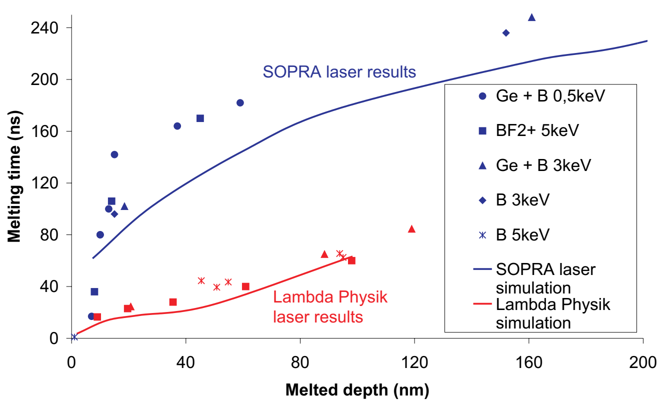

Figure 2

Numerical simulation compared to the experimental results.