

Abstract

# Advanced Diffusion Strategies for Junction Formation in Germanium <sup>†</sup>

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The investigation of innovative dynamical processes for the fabrication of highly doped and high quality Ge layers is currently a hot topic in many applicative fields such as nanoelectronics, photonics and radiation detectors. Challenges that require a deep physical and material science investigation are: (i) the high electrical activation in narrow region that can be obtained by out of equilibrium processes but has not to introduce lattice damage that may deteriorate the electrical properties. High concentration of the active dopant may transform germanium in a plasmonic material for sensor applications, or in an optical active material thanks to the direct gap transition that occurs at high doping and high strain. (ii) The control of the amount of doping at nanoscale (deterministic doping) is fundamental to meet the request of nanodevices production. Traditional methods as ion implantation are difficult to manage due to statistical fluctuations. In particular, this task has to be solved in germanium to exploit such material as a high mobility material in nanoelectronic. (iii) The preservation of the material purity during doping processes is a relevant problem especially when high purity germanium (HPGe) is used for gamma detector for nuclear spectroscopy and gamma imaging applications.

In this talk we will present some example of our recent research on germanium to contribute to the above challenges. Molecular doping process i.e., the production of monolayer self- assembled source of dopants on the devices surface is a promising way toward deterministic doping. We recently investigate the use of both P and Sb monolayer to this aim [1,2]. The effectiveness of such monolayers as diffusion sources is investigated. A very promising way to obtain very high doping is pulsed laser melting (PLM), this is a highly out equilibrium process that melts the extreme surface of the crystal and allows for dopant diffusion into the melt and its incorporation during fast regrowth. The application of this method to Ge allows for record activation of the dopants. Finally, we investigated the contamination induced by this laser process in the bulk of the material and we understood that it is a very promising method for doping of HPGe making possible fast and cheap processing for next generation gamma detectors [3,4].

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