Defect evolution and dopant activation in laser annealed Si and Ge - DTU Orbit (08/11/2017)

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Defect evolution and dopant activation are intimately related to the use of ion implantation and annealing, traditionally used to dope semiconductors during device fabrication. Ultra-fast laser thermal annealing (LTA) is one of the most promising solutions for the achievement of abrupt and highly doped junctions. In this paper, we report some recent investigations focused on this annealing method, with particular emphasis on the investigation of the formation and evolution of implant/anneal induced defects and their impact on dopant activation. In the case of laser annealed Silicon, we show that laser anneal favours the formation of "unconventional" (001) loops that, following non-melt anneals; act as carrier scattering centres, leading to carrier mobility degradation. In contrast, in the case of melt anneals, the molten region itself is of excellent crystalline quality, defect-free and with very high activation rates. As for laser annealed Germanium, we studied in detail the amorphous to crystalline Ge phase transition as a function of the increasing LTA energy density and we found that using LTA, very high carrier concentrations (above 10^{20} cm^{-3}) were achieved in As doped regions, which are unachievable with conventional rapid thermal annealing (RTA) processes.

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