Enhanced Dopant Activation in Strained-Si/$Si_{1-x}Ge_x$ Substrate using Non-melt Laser Annealing

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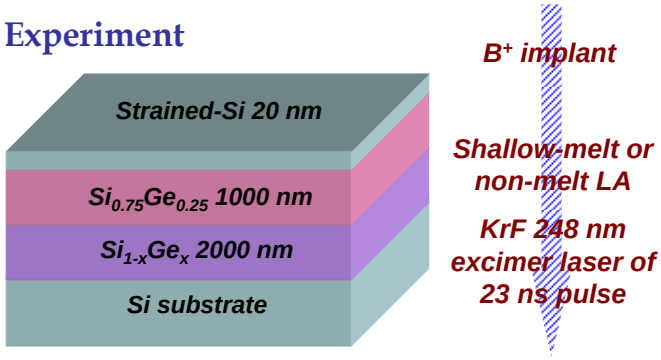
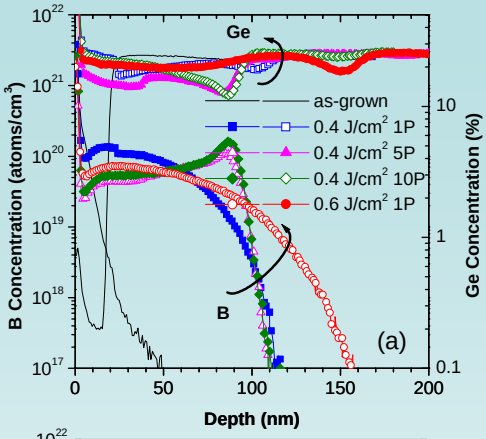
Introduction

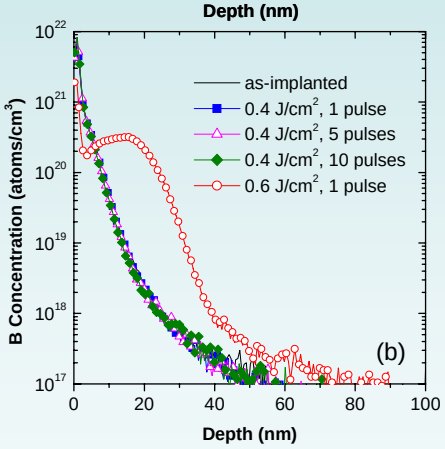
Strained-Si/SiGe substrate comprises a thermally insulating layer, which deprives a good thermal dissipation pathway. This gives rise to a highly non-equilibrium laser process and can vary significantly to that in normal bulk silicon substrate. In this work, we compare the formation of ultra-shallow p^+/n junctions in bulk silicon and strained-Si/SiGe substrates using laser annealing (LA) in shallow-melt and non-melt regimes.

Experiment

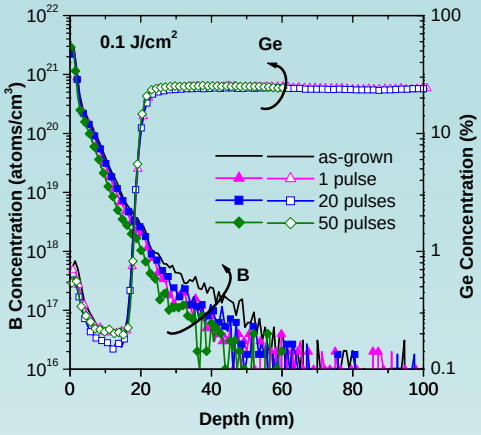


Results

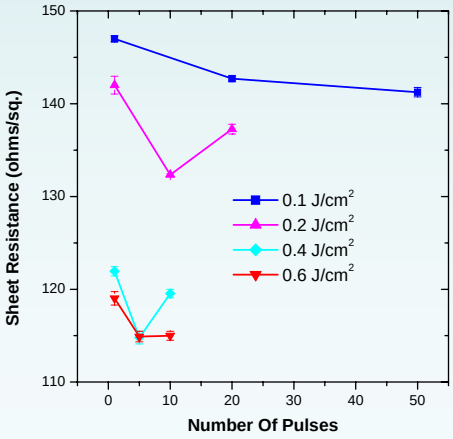




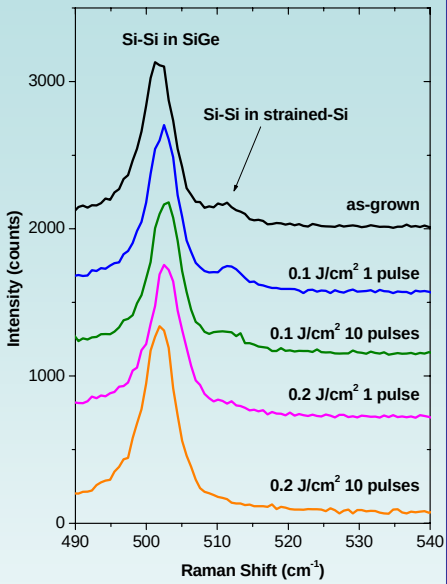
Boron distribution in (a) strained-Si/SiGe substrate is always deeper and more abrupt than that in the (b) bulk silicon substrate.



In non-melt regime, laser annealing produces dopant profiles of negligible diffusion (above) and improved activation in the strained-Si/SiGe substrates with laser pulses (below).



No degradation in the strain in the strained-Si layer was induced after non-melt laser annealing.



Conclusion

- Thermal insulation of SiGe layer enhances heating and melting of strained-Si/SiGe substrate during LA.
- Non-melt LA formed diffusionless highly activated p^+/n junctions in strained-Si without degradation in strain.

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