Advanced Ultra-Shallow Junctions (USJ) Formation via Co-implantation for Nano-CMOS Devices

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Introduction
As CMOS devices evolve into sub-nanometer, formation of ultra-shallow junction (USJ) in the source/drain (S/D) extension poses one of the major challenges. The S/D extension regions are generally formed by introducing dopants using ion-implantation and electrically activated by annealing process. Unfortunately, during the annealing, dopants exhibit anomalous transient enhanced diffusion (TED) which increases the dimension of devices. In addition, dopant clustering induced by implant damages/defects will degrade device electrical performances.

Aims
- Study the impact of Carbon(C) / Fluorine(F) co-implantation on the USJ formation.
- Demonstrate USJ optimization in devices coupled with novel co-implant process, based on physical understanding, modeling and simulation.

Results and Discussion
- Co-implant scheme has great potential for USJ formation in nano-CMOS. (Suppression of TED and dopant de-activation)
- Better understanding has been gained on the interactions of implant damages/defects with dopants coupled with C/F co-implantation.
- USJ optimization with novel co-implant process can be achieved via simulation to improve the device performance.

Conclusions
- Co-implant scheme has great potential for USJ formation in nano-CMOS. (Suppression of TED and dopant de-activation)
- Better understanding has been gained on the interactions of implant damages/defects with dopants coupled with C/F co-implantation.
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