Full low temperature microwave processed Ge CMOS achieving diffusion-less junction and Ultrathin 7.5nm Ni mono-germanide

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Abstract

For the first time, Ge CMOS with all thermal processes performed by microwave annealing (MWA) has been realized. The full MWA process is under 390 oC. It significantly outperforms conventional rapid thermal annealing (RTA) process in 3 aspects: (1) Diffusion-less junction: for easily diffused n-type dopant, phosphorous (P), the ion implantation dopant profile after the MWA activation process remains unchanged. (2) Increased Cox and lower gate leakage: the low temperature activation process leads to less Ge out-diffusion during MWA than RTA, suppressing the degradation of gate dielectric/ Ge channel interface. (3) Ultrathin 7.5nm Ni mono-germanide with low sheet resistance (Rs) and contact resistivity: after two-step MWA, a thin mono-NiGe layer was obtained which has larger crystallite size to lower Rs. Ge n- and p-MOSFET were also demonstrated. Compared to conventional RTA, the MWA gives 50% and 24% drive current enhancement for p- and n-MOSFET, respectively. These data show that the low temperature MWA is a very promising thermal process technology for Ge CMOS manufacturing.

Keyword：Ge CMOS , microwave annealing