Investigation of High-Performance Germaniunm-on-Insulator (GeOI) GAAFETs Fabricated through Wafer Bonding

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Abstract

Since germanium provide higher electron and hole mobility than silicon, it is considered one of the most promising channel materials to replace silicon transistors. However, due to the severe short channel effect (SCE) caused by the high dielectric constant, the short channel control capability has become a major problem in the manufacturing of Ge CMOS. To overcome this problem, GAAFET is the ultimate solution because of its better gate control capability to suppress SCE. In addition, Ge has a lower bandgap, which causes higher interband tunneling and junction leakage. To reduce power consumption, in this article, a Ge film is directly epitaxy on a thin SOI substrate through epitaxy, and a channel release process is performed through TMAH wet etching. As a comparison, high crystal quality GeOI substrates are also achieved through direct wafer bonding and chemical mechanical polishing (CMP) technology, which retains the topmost film of epitaxial germanium, thus maintaining a similar quality to bulk Ge wafers. In addition, since only hydrofluoric acid is used to remove the bonding oxide under the germanium channel, the GAA channel can be obtained losslessly. The transistor characteristics after the process are better than those of GeSOI. Its on/off ratio, SS, and Ion have been improved to varying degrees compared to GeSOI. In this article, the prepared Fin/GAA of GeSOI and GeOI FETs will be systematically studied using Raman, XRD, IDVG characteristics.

Keywords - GeSOI, GeOI, FinFET, GAAFET, SCE