Doping and stability of 3C-SiC: from thinfilm to bulk growth

Jokubavicius, V.; Sun, J.; Linnarsson, M. K.; Liljedahl, R.; Kaiser, M.; Wellmann, P.; Ou, Yiyu; Ou, Haiyan; Yakimova, R.; Syväjärvi, M.

Publication date:
2013

Doping and stability of 3C-SiC: from thinfilm to bulk growth

V. Jokubavicius[a], J. Sun[b], M. K. Linnarsson[c], R. Liljedahl[d], M. Kaiser[e], P. Wellmann[f], Y. Ou[g] , H. Ou[h], R. Yakimova[j] and M. Syväjärvi[k]

Email: valjo@ifm.liu.se

[a,b,d,j,k]Department of Physics, Chemistry and Biology, Linkoping University, S581 83 Linkoping, Sweden
[c]School of Information and Communication Technology, KTH Royal Institute of Technology, SE-16440 Kista, Sweden
[g, h]Department of Photonics Engineering, Technical University of Denmark, DK-2800 Lyngby, Denmark
[e,f] Department of Material Science – Electrical Engineering Materials (WW6), University of Erlangen-Nuremberg, Martensstr. 7, 91058 Erlangen, Germany

Cubic silicon carbide (3C-SiC) could pave the way for development of advanced electronic and optoelectronic devices. It could be an excellent substrate for growth of nitride and epitaxial graphene layers. Boron doped 3C-SiC films could reach up to 60% efficiency and pave the way for a new solar cell technology. Nitrogen and boron doped 3C-SiC layers can depict a new infrared LED.
Hexagonal SiC is an excellent substrate for heteropeitaxial growth of 3C-SiC due to excellent compatibility in lattice constant and thermal expansion coefficient. However, the growth of 3C-SiC on such substrates is still being followed by a number of obstacles like polytype stabilization and high density of double positioning boundaries in the grown material. The polytype stability during epitaxial growth of doped 3C-SiC has not been explored. Consequently, the polytype stability during bulk growth of doped 3C-SiC is not known.
In this study we explore the growth of low and medium doped bulk-like 3C-SiC layers on off-oriented 6H-SiC substrates using a sublimation epitaxy technique. We compare SIMS, XRD and PL data obtained from 3C-SiC material grown using polycrystalline SiC sources prepared by CVD with a low (~10^{16}cm^{-3}) boron concentration and by PVT with a medium (~10^{18}cm^{-3}) nitrogen and boron concentrations. The effects of impurities on polytype stability and crystal quality of low and medium doped bulk-like 3C-SiC layers with thickness up to 0.5 mm are analysed. Moreover, the remaining challenges in growth of 3C-SiC for optoelectronic applications are discussed.