Crystal growth and characterization of fluorescent SiC

Wellmann, P.; Kaiser, M.; Hupfer, T.; Sun, J. W.; Jokubavicius, V.; Hens, P.; Liljedahl, R.; Syväjärvi, M.; Ou, Yiyu; Ou, Haiyan; Linnarsson, M. K.

Publication date:
2012

Crystal Growth and Characterization of Fluorescent SiC

P. Wellmann[1], M. Kaiser[1], T. Hupfer[1], J.W. Sun[2], V. Jokubavicius[2], P. Hens[2], R. Liljedahl[2], M. Syväjärvi[2], Y. Ou[3], H. Ou[3] and M.K. Linnarsson[4]
[1]University of Erlangen, Germany. [2]Linköping University, Sweden. [3]Technical University of Denmark. [4]KTH Royal Institute of Technology, Kista-Stockholm, Sweden.

Silicon carbide (SiC) is widely used as substrate for nitride based light emitting diodes (LEDs). For today's white LEDs mainly a sandwich structure of a blue or ultra violet LED and a yellowish phosphorus is used. In the frame of European project we study a concept to implement the functionality of the phosphorous into the SiC substrate to make an all semiconductor white LED. In recent years, due to the improvement of the crystalline quality of SiC by the so called fast sublimation growth process (FSGP), high room temperature internal quantum efficiencies of the yellow donor acceptor pair luminescence of 6H-SiC co-doped with nitrogen and boron has been achieved [1][2].
The source is the rate determining step, and is expected to be determining the fluorescent properties by introducing dopants to the layer from the source. The optimization process of the polycrystalline, co-doped SiC:B,N source material and its impact on the FSPG epitaxial process, in particular the influence on the brightness of the is presented. In particular, the doping properties of the poly-SiC source material influence on the brightness of the fluorescent 6H-SiC. In addition we have investigated how the grain orientation of the poly-SiC source material changes the growth rate during the fast epitaxial growth process. Using shadow masks we have isolated sublimation from selected SiC grains with varying crystallographic orientation and measured the average growth rate (Fig. 1). The growth rate increases with increasing off-angle from (0001) crystallographic orientation which is attributed to surface kinetics during sublimation.

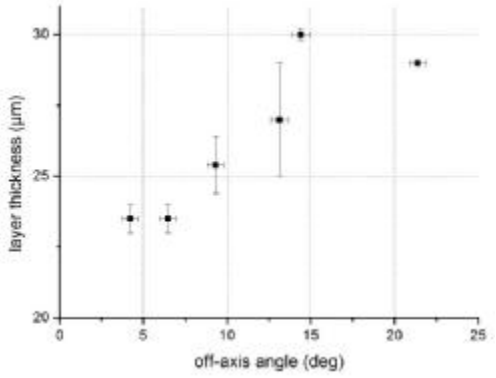

Fig.1. Impact of off-axis (0001)-SiC-grain orientation of the poly-SiC source material on FSGP growth rate.

[1] S. Kamiyama et al.; J.Appl.Phys. 99, 093108 (2006).
[2] M. Syväjärvi et al.; Phys. Scr. T 148 (2012) 014002.