第５回結晶談話会のご案内

【日時】平成２９年４月６日（木） 13:30～14:30
【会場】東北大学金属材料研究所 ２号館講堂
【主催】東北大学 金属材料研究所 電子材料物性学部門

＜談話会プログラム＞

13:30－14:30 Zlatko Sitar, Kobe Steel Distinguished Professor

Department of Materials Science and Engineering,
North Carolina State University

“Control of surface kinetics during the growth of III-nitrides on native substrates”

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Control of surface kinetics during the growth of III-nitrides on native substrates

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AlGaN alloys are the building blocks of deep UV optoelectronics and high-power devices. Metal polar, Al-rich AlGaN films were grown on both single crystalline AlN and sapphire substrates. The role of dislocation density on surface kinetics and morphology of these thin films will be presented.

With the reduced dislocation density of the films grown on AlN substrates, atomically smooth bilayer stepped surfaces are achieved with RMS roughness of less than 50 pm. By controlling the surface supersaturation during MOCVD growth, a transition from 2D nucleation to step flow was achieved. Depending on growth conditions, a critical substrate misorientation angle for onset of step-bunching was observed. In order to predict and control the surface morphology, an all-inclusive surface kinetic framework was developed that connects vapor supersaturation, surface supersaturation, surface diffusion length, and substrate misorientation angle. In general, transitioning from a surface with 2D nuclei to one with bilayer steps required a decrease in supersaturation or an increase in miscut, whereas the suppression of step-bunching required the two parameters to change in the opposite direction. The composition of bilayer stepped AlGaN was found to strongly depend on substrate misorientation angle. Step-bunching resulted in compositional inhomogeneity as observed by photoluminescence and scanning transmission electron microscopy studies.

The talk will discuss MOCVD processes for control of AlGaN composition and heteroepitaxy, approaches to control strain, point defects, and doping in this material, and implications of this technology for further development of UV optoelectronic and electronic devices.

Zlatko Sitar is a Kobe Steel Distinguished Professor of Materials Science and Engineering at NCSU. His research is concerned with bulk and thin film growth, characterization, and device development in wide bandgap semiconductors: GaN, AlN, and diamond. He has pioneered the nitride MBE process through the design of a unique ECR plasma source (later commercialized by Astex, Inc.), developed, patented, and commercialized a process for growth of AlN crystals, which is currently the only commercial high-quality AlN crystal growth process in the world (commercialized by HexaTech, Inc.), developed, patented, and commercialized polishing and device layer growth processes on AlN wafers, which is the basis for high-efficiency deep-UV lasers and light emitting diodes, invented and patented a process for growth of III-nitride lateral polar structures via MOCVD and proposed and demonstrated novel devices based on this invention, which include lateral pn diodes, low-contact resistance field effect transistors, and quasi phase matched structures for optical frequency doubling. He has developed silicon-on-diamond wafer technology and increased power handling capability of devices fabricated on these hybrid wafers by a factor of fifty. His research has been instrumental in understanding and explaining electron field emission form diamond, carbon nanotubes and other carbon materials. Among other research programs, he has directed a Multidisciplinary University Research Initiative on Bulk III-Nitride Growth, which involved five US universities and two DoD laboratories. Based on his research, he founded HexaTech, Inc., an NCSU spin-out focusing on AlN-based technology, which currently employs 25 researchers and business professionals, and Adroit Materials, Inc., focusing on devices on native GaN substrates.