黄昆半导体科学技术论坛

**第324期讲座**

**报告题目:** **III-V Nanowires and Nanowire Devices Grown on Silicon Substrates**

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**Abstract**: The nanowire (NW) structure with a diameter in nanometer scale offers a way to integrate the lattice and the thermal expansion coefficient mismatched material systems by efficiently relaxing the strain with in a length of a few monolayers. Therefore, the integration of III–V materials on a Si platform can be achieved in the form of III-V NWs monolithically grown on silicon substrates. In addition, the NWs show superior optical and electronic properties, such as the enhanced light absorption and carrier correction. The lateral P-N junction formed by the core-shell structure provide an orthogonal pathway for the carriers to be extracted to the electrodes, which can significantly improve the carrier separation and hence the efficiency. GaAsP and AlGaAs NWs with a band gap which can cover the wavelength ranging from green (548 nm at 300 K) to near-infrared (864 nm at 300 K), is one of the most promising III-V compound semiconductor for photovoltaics and visible emitters. We have achieved the self-catalyzed GaAsP NW, AlGaAs NWs, and GaAs dot in GaAsP and AlGaAs NW growth on Si substrates with high uniformity. The GaAsP NW shows almost pure zinc-blende structure with very low defect density. The P composition of the NW can be tuned between 0 and 75%, which gives us more freedom in design NW device structures. The first water splitting device by using GaAsP p-i-n core-shell structure has been demonstrated. A power conversion efficiency over 10% has been achieved from a single GaAsP NW SC which sets a new world record for single NW solar cells, while room-temperature lasing is also demonstrated by GaAs/GaAsP nanowire quantum well strcucture. In addition, we developed the repeatable growth of self-catalyzed GaAsP nanowires (NWs) on SiO2 patterned Si (111) substrates, as shown the image, and makes us one step closer to the large-area NW SC fabrication. The realization of the pattern growth also helps us in controlling the NW position and hence photonic properties.

**Biography: Huiyun Liu** received his PhD in the Institute of Semiconductor, Chinese Academy of Sciences. After receiving his PhD, he joined the EPSRC National Centre for III-V Technologies at University of Sheffield in August 2001. He was responsible for the development of Molecular Beam Epitaxy growth of semiconductor materials for the UK academic and industrial research community. In 2007, he was awarded Royal Society University Research Fellow and started his academic career in the Department of Electronic and Electrical Engineering at UCL, where he is currently a Chair (Professor) of Semiconductor Photonics. He has co-authored over 300 papers and 4 patents in the area of semiconductor materials and devices. His general interest concentrates on the nanometre-scale engineering of low-dimensional semiconductor structures (such as quantum dots and nanowires) by using molecular beam epitaxy and the development of novel optoelectronic devices including lasers, detectors, and modulators by developing novel device process techniques.

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