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INSTITUTE OF APPLIED PHYSICS AND MATERIALS ENGINEERING

# LAPME Seminar

## Quantum-dot laser technology: the key for Si-based lasers for Si photonics



**8 November 2024**

Prof. Huiyun LIU

University College London, UK

Venue: N23-4018

Time: 10:30 - 11:30

Hosted by: Prof. Handong SUN

### Abstract

Si is one of the most important semiconductor materials as it has been the mainstays for modern electronics. However, it is not widely used for light emitting sources because Si is an inefficient emitter, a result of indirect bandgap. Direct epitaxial growth of III-V nanostructures on silicon substrates is one of the most promising candidates for realizing photonic devices on a silicon platform. The major issue of monolithic integration of III-V on Si is the formation of high-density threading dislocations. The propagation of TDs will cause high ratio of non-radiative recombination centre in III-V epitaxial active region. To stop the TD propagation, different epitaxial strategies, such as InGa(Al)As strain layer, Ge buffer layers and patterned substrates have been applied and compared in this presentation. As a zero-dimensional material, quantum dots (QDs) have three-dimensional quantum confinements, which create delta-function like density of states. Therefore, III-V QD lasers have low threshold currents, temperature insensitive operation, and less sensitivity to threading dislocations, which are the ideal candidate to form active region in III-V lasers grown on group IV substrates. 1300-nm InAs/GaAs QD lasers grown on Si and Ge substrates have been proposed and developed since 2011 at UCL with long lifetime and high power. In this presentation, the development milestones of InAs/GaAs QD lasers monolithically grown on a Si platform will be summarised, and the potential trend in next few years will also be predicted.

### Biography

Prof. Huiyun LIU received his PhD from Institute of Semiconductor, Chinese Academy of Sciences in 2001. After receiving his PhD, he joined the EPSRC National Centre for III-V Technologies at Sheffield University. In 2007, he was awarded Royal Society University Research Fellow, and started his academic career by taking Senior Lecturer position in the Department of Electronic and Electrical Engineering at University College London with commissioning the first new Molecular Beam Epitaxy reactor in London, and creating a new group. In 2012, he was promoted as Chair Professor of Semiconductor Photonics at University College London. His current research interest concentrates on the nanometre-scale engineering of low-dimensional semiconductor structures by using Molecular Beam Epitaxy and the development of novel optoelectronic devices including lasers, detectors, solar cells, and modulators on Si platform. He co-authored more than 500 papers and hold on several patents on silicon photonics and quantum dot technology.

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