SU2P Entrepreneurial Fellows

Case Study:- Weisheng Lu

Title: MIXSELs

Introduction

Dr Weisheng Lu's project was to develop 1.3 µm modelocked integrated-external-cavity surface emitting lasers (MIXSELs). VECSELs have advantages such as (i) mode-conversion, producing symmetric fundamental-mode output beams at high average powers, (ii) wavelength conversion, offering very wide spectral coverage, and (iii) flexibility of operation. As one of the VECSELs' family, ultrafast VECSELs have received substantial attention. Their potential applications could cover metrology, optical clocking and sampling for telecommunications, or biophotonics.

Project

Conventional ultrafast VECSELs have at least three cavity elements, the gain structure, the output coupler and a SEmiconductor Saturable Absorber Mirror (SESAM) for the generation of ultrashort pulses. The project proposition was that a semiconductor saturable absorber could be integrated into the gain structure, because both are semiconductors and this concept would finally make wafer-scale mass production technology accessible for passively mode-locked VECSELs. This class of devices is referred to as MIXSELs. The basic obstacle which has prevented the realisation of such a device has been the lack of a suitable absorber material which has a sufficiently low saturation fluence with equal mode sizes on the gain element and absorber. However, the recent development of low saturation fluence SESAMs based on a quantum-dot absorber material has made it realistic to move toward this goal. Thus there was an opportunity to fabricate 1.3 µm GaInNAs-based MIXSELs.

The project provided useful information for producing 1.3 µm GaInNAs-based MIXSELs. The development of the QW SESAM and QW gain structure shows that the design and growth of the devices reached the project's requirements. The QD analysis indicated that a novel design of the QD structure is required. In terms of the device design, the low dispersion of the QD SESAM provides the necessary high growth tolerances, which suggests an antiresonant design should be used in the MIXSEL structure. As a conclusion, it is highly possible to produce 1.3 µm GaInNAs-based MIXSELs for the market.

Benefit

After the fellowship a collaboration was developed between IoP and Compound Semiconductor Technology Global Ltd (CST) in which Dr Lu used his experience and knowledge in nitride materials to contribute to new processes and product technology in the company. Experience was gained in how to transfer novel process techniques and device concepts that have the potential to accelerate commercialisation. With the entrepreneurial experience and relationship developed in this fellowship, Dr Lu now has an ambition to become an entrepreneur.