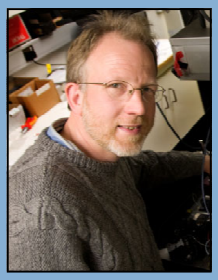

SU2P Staff Exchange
Case Study:- Thorsten Ackemann

The visit was part of a portfolio of exchanges which started with the visit of Konstantin Vodopyanov and his student Alireza Marandi to Scotland in February/March 2011. The main objective was to discuss the collaboration between Strathclyde and Vodopyanov's group at Stanford on high-power intra-cavity difference frequency generation of Terahertz radiation in a two-frequency vertical-cavity surface-emitting laser (VECSEL). A secondary objective was to establish closer links and to explore the potential of further collaboration with the other Stanford groups.

Project

Generation of THz radiation

Intense discussions with the Vodopyanov group centred on the generation of MIR and THz waves by difference frequency generation (DFG) and parametric oscillation (OPO) using quasi-phase matched (QPM) GaAs and the selection of an appropriate material for DFG in a vertical-external-cavity surface-emitting laser (VECSEL). Orientation-patterned (OP) GaAs has low losses but yields only limited apertures (< 1 mm). In addition, due to the very complex growth process its availability is still very limited. Diffusion-bonded (DB) GaAs wafer stacks seems to be too lossy for intra-cavity applications in spite of the rather high gain of the VECSEL. Dr Ackemann took a GaAs sample from Vodopyanov to Strathclyde which was used in a VECSEL experiment in collaboration with the Institute of Photonics for a demonstration experiment. No THz radiation was detected though. Recently, Dr Vodopyanov sent a modified sample, which will be tried in the VECSEL group of the newly founded Fraunhofer Centre for Applied Photonics. The aim is a long-term collaboration with the prospect of Konstantin Vodopyanov being a visiting researcher in a future EPSRC project. Carsten Langrock from the Feyer group provided an overview on growth issues of OP-GaAs and recent progress. Further discussion was on the comparison of figures of merit of random number generation using OPO's at Stanford with semiconductor lasers with feedback.

All-optical switching

Fruitful and interesting discussions were going on with the Miller, Vuckovic and Marbuchi groups on fundamentals and implementation of all-optical switching and processing applications. Armand Niederberger, the entrepreneurial fellow from Strathclyde in the Marbuchi group, is developing theory and code for describing networks of open quantum systems with the long-term aim of achieving a circuit-level description like in electrical engineering. Following this route of coupling nodes, which operate in the few photon quantum regime, by classical means might be a more feasible way of harnessing all-optical functionalities than challenging full quantum information protocols. The experimental implementation of the nodes in the Marbuchi group is currently based on atomic systems allowing switching with a few photons. Moving these ideas to a material platform compatible with micro-fabrication and integration matches Dr. Ackemann's interest in all-optical semiconductor photonics and the general interest of the Photonics group in quantum optical phenomena.

Benefit

In conclusion, Dr. (now Prof.) Ackemann considered this to be a very fruitful visit with the short-term benefit of sample exchange and the prospect for a long-term collaboration in THz generation. The visit opened new views and possibilities for all-optical switching, which are explored. Dr. Vodopyanov and other Stanford researchers were participating already as potential training providers or members of the advisory board in a submission for an EU Initial Training Network "Control of light in semiconductor photonics" in 2012 coordinated by Dr Ackemann.

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