NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

PAP Seminar Announcement

Nanostructures for Green Photonics

By

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Time: 11.00 am - 12.00 pm
Venue: MAS Executive Classroom 1 (SPMS-MAS-03-06)
Host: Assoc Prof. Cesare Soci

Abstract

Universal self-organization and self-ordering effects at surfaces of semiconductors lead to the formation of coherent zero-dimensional clusters, quantum dots (QDs). The electronic and optical properties of QDs, being smaller than the de-Broglie-wavelength in all three directions of space are close to those of atoms in a dielectric cage than of solids. Their delta-function-like energy eigenstates are only twofold (spin) degenerate. All few particle excitonic states are strongly Coulomb correlated due to the strong carrier localisation. Their energies depend on shape and size of the dots, such that positive, zero or negative biexciton binding energies and fine-structure splitting (caused by exchange interaction) appear.

Consequently, single QDs present the most practical possible basis of emitters of single polarized photons (Q-bit emitters) on demand or entangled photons via the biexciton-exciton cascade for future quantum cryptography, repeaters and communication systems. Embedding them in electrically pumped resonant cavity structures, they can emit single photons at rates beyond 1 Gbit/s. Using GaN-based structures room temperature operation is possible.

Multiple QD layers, as active materials for nano-optoelectronic devices like edge and surface emitting lasers, or semiconductor optical amplifiers, are extremely promising. Their properties, in particular their energy efficiency, are outperforming those of photonic devices based on higher dimensional systems.

Semiconductor nanotechnologies transform presently to enabling technologies for new economies. The commercialization of nano-devices and systems has started. High bit rate and secure quantum cryptographic systems, nano-flash memories, ultra-high speed nano-photonic devices for metropolitan area networks, the 400 Gbit/s ethernet, etc. present some of the first fields of applications of nano-devices.

Short Biography

Dieter H. Bimberg received the Diploma in physics and the Ph.D. degree from Goethe University, Frankfurt, in 1968 and 1971, respectively. From 1972 to 1979 he held a Principal Scientist position at the Max Planck-Institute for Solid State Research in Grenoble/France and Stuttgart. In 1979 he was appointed as Professor of Electrical Engineering, Technical University of Aachen. Since 1981 he holds the Chair of Applied Solid State Physics at Technical University of Berlin. He was elected in 1990 Excecutive Director of the Solid State Physics Institute at TU Berlin, a position he hold until 2011. In 2004 he founded the Center of Nanophotonics at TU Berlin, which he directed until 2015. From 2006 -2011 he was the chairman of the board of the German Federal Government Centers of Excellence in Nanotechnologies. Since 2018 he is the director of the Center of Green Phtonics of the Chinese Academy of Sciences at CIOMP. He has authored more than 1500 papers, 36 patents, and 7 books resulting in more than 56,000 citations worldwide.

His research interests include the growth and physics of nanostructures and nanophotonic devices, ultrahigh speed and energy efficient photonic devices for information systems, single/entangled photon emitters for quantum cryptography and ultimate nanoflash memories based on quantum dots.

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