Semiconductor physics at Wrocław University of Science and Technology: historical perspective

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The beginning of semiconductor research at WUST dates back to the end of '60s when Witold Żdanowicz and Janusz Pawlikowski established a semiconductor physics group and started fabrication and investigation of II-V family materials. They performed very pioneering studies on electrical properties of these compounds later extended also into optical properties and investigation of the band structure details of zinc arsenide (Zn3As2) and zinc phosphide (Zn3P2). The latter was especially explored in view of its application potential for solar energy converters. Piotr Becla and Janusz Pawlikowski developed the growth and investigation of graded gap HgCdTe towards high efficiency infrared detectors

In 1992, the Laboratory for Optical Spectroscopy of Nanostructures (LOSN) was established and new kind of experiments were initialized, like photoreflectance, which combined with other optical techniques appeared to be a very efficient tool to study semiconductor heterostructures and the quantum confinement driven effects in lowdimensional systems. At this stage the lab activity was based on collaboration with technological laboratories locally at WUST (MOCVD growth facility) but also in Warsaw (Warsaw University, Institute of Physics PAS, Institute of Electron Technology) and with several foreign institutions: University of Nottingham, DTU in Copenhagen, TU Berlin, University of Würzburg. The latter (the labs led by Alfred Forchel) became especially important and have continued successfully till now, summarized in about 100 joint publications and 6 projects of the UE programmes (mainly in the in the fields of quantum well and quantum dot - QD lasers for telecom, or mid infrared lasers for optical gas sensing.

In parallel to the experimental efforts, intensive theoretical works concerning semiconductor physics also started. Currently it is conducted in two main groups. One, led by Arkadiusz Wójs, has worldwide recognized achievements in investigation of electronic structure, excitonic properties and magneto-optics of QDs, fundamentals of the fractional quantum Hall effect and theory of composite fermions. Second, led by Paweł Machnikowski, is known of their studies on carrier, exciton and spin dynamics, decoherence and other phonon-assisted phenomena in 0D systems towards quantum optics and quantum computing with semiconductor QDs. Both teams collaborate efficiently with experimentalist. For instance, the A. Wójs group was involved in the studies of the properties of two dimensional hole gas in high magnetic fields, in collaboration with High Magnetic Field Laboratory in Grenoble. Whereas, the kinetics of excitations in nanostructures which is investigated experimentally by ultrafast spectroscopy in LOSN is analysed theoretically by the team of P. Machnikowski.

More recently, many other new fields of activity have been developed: fabrication and functionalization technologies and optical studies of colloidal nanostructures for the biomedical and optoelectronic applications, probing defects in semiconducting materials by DLTS spectroscopy, studies of new multicomponent compound materials mainly for photonic devices from infrared to ultraviolet, investigation of photon correlations and quantum-dotbased non-classical light emitters for quantum communications, physics of exciton-polariton condensates, properties and applications of two-dimensional crystals and perovskites.