

Laser Techniques and Laser Physics in Polish Laboratories

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Abstract—The major part of the current issue of Photonics Letters of Poland and its next full edition are devoted to Lasers – their Physics and Technologies developed in Polish laboratories. There are a few groups in Poland working on different kinds of lasers. The aim of these two editions is to show their current results, advances and prospective. This issue contains 7 papers dealing mainly with quantum cascade lasers, semiconductor lasers and solid state and fiber lasers.

Laser technology as well as laser physics are strongly developing areas. The main stream of investigations was turned into semiconductor and fiber lasers. Lasers are still the basic and front objects of photonics. On the initiative of Professor Tomasz Woliński, the President of Photonics Society of Poland, we announced "the laser edition" of PLP and we have received more than 20 papers from different "laser groups", which seems to be quite a reasonable and representative number. This issue starts with the first seven papers. They cover four scientific areas: quantum cascade lasers, diode lasers (high power, VECSEL, VCSEL), and solid state and fiber lasers.

The first paper (*M. Bugajski et al.*) presents spectral properties of multimode mid-infrared quantum cascade lasers (QCL). A few year ago the group led by Professor Maciej Bugajski (the Institute of Electron Technology, Warsaw) joined the world "quantum cascade lasers" club. This paper deals with instabilities of multi-mode output of AlGaAs/GaAs QCLs around 9.5 μ m versus supply conditions.

The second paper (*G. Sobczak et al.*) is devoted to high power broad active stripe lasers. It is written by the group led by Dr. Andrzej Maciąg from the Institute of Electronic Materials Technology, Warsaw). This group also joined a few years ago the "world club of high power diode lasers".

The third paper (*A. Jasik et al.*) describes dual-wavelength vertical external-cavity surface emitting lasers (DW VECSEL) designed and manufactured in the Institute of Electron Technology and the Physics Faculty of Lodz University of Technology. The paper contains a basic technological description of the laser operating at 956nm and 1011nm and its main parameters.

The fourth paper deals with controlling the state of polarization of laser radiation in commercially available VCSEL operating at 780nm. It is written by specialists in

laser frequency stabilization (*G. Dudzik and J. Rzepka*) from Wrocław University of Technology. The sophisticated electronics and experimental set-up allowed measuring polarization fluctuation with quite high resolution.

The fifth paper is written by Polish scientist, Dr. Krzysztof Nowak working for Japanese company Gigaphoton Inc. The subject of the paper combines two different kinds of lasers – scientifically almost forgotten CO₂ and modern QCLs. These two lasers operate in the mid-infrared range. The special configuration proposed by the author combines these two lasers – an RF excited carbon dioxide laser with an array of short nanosecond pulses from quantum cascade seed lasers. The self-seeding effect gives multi-line high power nanosecond pulse operation of the CO₂ laser for plasma induced extreme ultraviolet (EUV) radiation (13.5nm) as a source for EUV lithography. The paper shows renewed interest in carbon dioxide lasers and its new attractive technology.

The sixth paper (*L. Gorajek*, Institute of Optoelectronics, Military University of Technology) describes the so called "eye safe" 2 μ m pulse operation of an end-pumped solid-state Tm:YLF laser in a Q-switching regime with the output power 5W, maximum 5.5mJ pulse energy and 11 ns pulse duration. The configuration and the main characteristics of the laser are presented.

The seventh paper (*J. Swiderski et al.* Institute of Optoelectronics, Military Academy of Technology) deals with a similar wavelength as the previous one, but in a different MOPA configuration – a Tm-doped fiber laser. The MOPA 4-stage pulse laser at the 1550nm (3.5W at 1550nm) forms a seed source for a thulium-doped fiber amplifier (0.9W at 2 μ m). This radiation is amplified in the fiber amplifier to the terminal double-clad Tm-doped fiber with an output power of 9 Watts with a pulse repetition frequency of 100kHz.

The next edition of PLP will continue an overview of Polish labs working on lasers.