**III-V RACETRACK MICROLASERS WITH InAs/InGaAs QUANTUM DOT ACTIVE REGION**

Ildar Nabiullin1, Eduard Moiseev1, Natalia Kryzhanovskaya1,3, Yulia Polubavkina1,   
Mikhail Maximov1,2, Alexey Nadtochiy1, Andrey Lipovskii1,3, Sergey Troshkov2,   
Marina Kulagina2, Yuri Zadiranov2, Alexey Zhukov1,3

1 St Petersburg Academic University, St Petersburg, Russia

2 Ioffe Physical-Techical Institute, St Petersburg, Russia

3 St.Petersburg State Polytechnical University, St Petersburg, Russia

nabildar@yandex.ru

***Aim***: poster

Semiconductor microring lasers were proposed for a large variety of applications including all-optical switching and signal processing. To use them in latter functions, they are mounted in one integrated optical circuit and usually connected to other parts of the circuit by bus-waveguides. To achieve an acceptable level of outcoupled power with low perturbation of the optical mode structure, an evanescent point coupler with a gap as small as 100 nm is required [1]. To improve the coupling between the microring resonator and the output waveguide, insertion of a straight section in the coupling region is suggested (the so-called racetrack geometry, see Fig. 1).



Fig. 1. Lasing threshold (Pth) versus the straight part length of the racetrack (L). In the insertion: design of the racetrack laser with its geometric parameters definition (R – outer radius, r – inner radius, L – length of the racetrack)

Racetrack microlasers with the radii less than 3.5 µm based on InAs/InGaAs quantum dot active region are fabricated by molecular beam epitaxy and studied under optical pumping by microphotoluminescence method. The influence of the racetrack geometry (outer and inner radii and length of the straight part) on emission spectra and lasing characteristics at room temperature are studied.

As follows from our previous studies [2],the threshold power (absolute value) of the microring lasers decreases by approximately 30-40% as the inner bend radius (r) increases from 0 (the microdisk case) to 0.75 of the outer radius (R). Further waveguide width thinning results in rapid growth of the threshold. Our observations coincide with the calculated dynamics of the lasing thresholds in the microrings [3]. Taking this into account, in the present work we study resonators with the outer and inner bend radii of 3.5 and 2.7 μm, respectively and a width of 0.8 μm. We have found that FSR decreases with the increase of the straight part of the racetrack. That is in agreement with our previous results [2] and theoretical equation:

FSR ~ λ2/(neff(2πR + 2L))

The mode spacing can be widely detuned from 26 to 104 nm by varying the ring diameter and the straight section of the resonator. A slight increase of the resonator’s width from 0.4 to 0.6 μm results in an increase of the mode spacing due to the different effect of the inner boundary on modes with different order. The threshold power increases with the straight section length (L) and it is shown in Fig. 1, but it remains quite comparable with microlasers with L=0. Thus, high-quality microlasers with small foot-print and low threshold currents optimized for coupling to bus-waveguides are demonstrated.

**Acknowledgements.** The work is supported in different parts by the Russian Foundation for Basic Research (15-02-03624, 16-29-03111).

[1] M.Sorel, G.Mezősi, M. J. Strain, Proc. SPIE **7230**, Novel In-Plane Semiconductor Lasers VIII, 72300I (2009).

[2] A. E. Zhukov, N.V. Kryzhanovskaya, A.V. Savelyev, A.M. Nadtochiy, E.M. Arakcheeva, F.I. Zubov, V.V. Korenev, M.V. Maximov, Yu.M. Shernyakov, M.M. Kulagina, I.A. Slovinskiy, D.A. Livshits, A. Kapsalis, C.Mesaritakis, D. Syvridis, A. Mintairov , Proc. SPIE **8552**, Semiconductor Lasers and Applications V, 855202 (2012).

[3] A. S. Zolotukhina, A.O. Spiridonov, E.M. Karchevskii, A.I. Nosich, Opt. Quant. Electron, **47**, 3883 (2015).