SOROKIN

3rd International Conference on

Middle Infrared Coherent Sources

organized by
Centre de Recherche sur les Ions, les Matériaux et la Photonique
CIMAP « Matériaux et Instrumentation Laser »
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Région Basse-Normandie, Mairie de Trouville sur Mer,
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Tu6 11:40 – 12:05 ***I.T. Sorokina, E. Sorokin***
Mid-infrared femtosecond frequency comb generation and application: advances and perspectives

Tu7 12:05 – 12:30 ***R. K. Shori, O. M. Stafsudd***
2.6 – 2.94 μm Multi-wavelength Emission from Co-doped Er-based Laser

Lunch 12:30 – 14:00

Session 6 ***Advanced materials and waveguide structures***
(Chair: I. Sorokina) **(14:00 – 16:00)**

Tu8 14:00 – 14:30 ***J.-L. Adam, V. Nazabal, J. Trolès, L. Brilland, P. Houizot, J.-L. Doualan, R. Moncorgé, T. Chartier, G. Canat, F. Smektala (30)***
Chalcogenide Glasses and Fibers for Mid-Infrared Sources

Tu9 14:30 – 15:00 ***A.K. Kar (30)***
Laser written optical waveguides and devices

Tu10 15:00 – 15:20 ***L. N. Butvina, O. V. Sereda, A. G. Okhrimchuk, A. L. Butvina, E. M. Dianov, N. V. Lichkova, V.r N. Zagorodnev, (20)***
Singlemode low loss crystalline fibers for the middle infrared

Tu11 15:20 – 15:40 ***A. Okhrimchuck (20)***
The waveguide architecture of Mid-IR lasers based on rare-earth doped crystals

Tu12 15:40 – 16:00 ***L.I. Isaenko, A.M. Tkachuk, A.P. Yelisseyev, S.E. Ivanova, A.A. Merkulov, A.Yu. Tarasova, V.M. Pashkov (20)***
New laser $K_xRb_{1-x}Pb_2Br_5$ crystals doped with RE ions

Coffee Break 16:00 – 16:15

Local excursion 16:15 – 20:00

Wednesday 10 june

Session 7: ***Quantum Cascade lasers II*** **(Mercure Hotel)**
(Chair: H. Ito) **(09:00 – 10:00)**

We1 09:00 -09:30 ***D. Botez***
Deep-Well Quantum-Cascade Laser Structures: An Effective Way for Suppressing Carrier Leakage in Quantum Cascade Lasers

We2 09:30 -10:00 ***J. Faist, A. Wittmann, A. Hugi, A. Bismuto, M. Beck***
High temperature single mode and broadband tunable quantum cascade lasers

Poster session /Table-top exhibit and Coffee Break **(10:15 – 12:45)**
(Casino of Trouville, Salon des Gouverneurs)

Lunch 12:45 – 14:15

Mid-infrared femtosecond frequency comb generation and applications: advances and perspectives

Irina T. Sorokina[1] and Evgeni Sorokin[2]

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3.

The talk reviews the latest advances in generation and applications of mid-infrared frequency combs directly from the solid-state oscillators based on Cr^{2+}ZnSe laser, and highlights the radical efficiency and sensitivity increase when applied to high-resolution molecular spectroscopy and gas sensing. The most recent breaking-through development in the ultrashort pulse generation in the mid-IR has been the first truly Kerr-lens modelocked regime of operation of Cr^{2+}:ZnSe laser, which will be for the first time presented at this conference. Finally, we discuss the new perspectives, which are opening for these as well as for other ultrashort pulsed mid-IR fiber based sources like e.g. Tm^{3+} fiber laser.

An ultrabroadband Cr^{2+}-doped ZnSe laser operates between 2 and 3 μm, and has been shown to operate as high-power tunable continuous-wave laser, tunable single-frequency source, in Q-switched and gain-switched regimes, as well as in actively and passively mode-locked regimes. The mode-locked Cr^{2+}:ZnSe laser is especially interesting, because the exceptionally broad gain band of the material allows few-cycle operation in an important for various applications mid-infrared range. The first ultrashort-pulse femtosecond operation has been reported already three years ago [1] and utilized a SESAM with a semiconductor Bragg mirror for achieving passive modelocking. Pulse duration could be shortened down to 80 fs using chirped mirrors, but output power stayed around 100 mW, limited mostly by absorption in the SESAM. Even more importantly, the pulse spectrum width was already at the limit of SESAM reflection band. In this configuration, the laser proved to be suitable for sensitive spectroscopic measurements [2]. Another novel and exciting observation has been made on the KLM regime in Cr^{2+}:ZnSe laser. Namely, the laser has operated in two distinct regimes: high-power soliton regime with ~300 mW of output power and 100 fs duration, and chirped pulse regime with 170 mW of output power and ~1 ps pulse duration. The mode-locked operation in the positive chirped regime was particularly long-term stable and self-starting, promising new ways of generation of frequency combs in this wavelength region.

We believe that the demonstration of a KLM Cr^{2+}:ZnSe laser opens a way to utilizing the 800-nm broad bandwidth of the material and reach ultrabroadband single-cycle operation. Most importantly, it was shown that it is possible to start and operate the modelocked laser in an open air. This simplifies setting up and adjustment of the laser significantly. At the same time, ultrabroadband operation should obviously require a purged or evacuated enclosure.

Summarizing, the recent availability of ultrabroadband coherent frequency comb sources, based on solid-

state lasers, enables novel approaches which allow achieving simultaneously high resolution and record sensitivity at very short recording times, using multichannel and multiplex techniques. Most importantly, these sources are now available in the mid-infrared region around 2-3 microns, where molecular spectral lines are located, and are ready for introducing them into practice.

[1] I. T. Sorokina , E. Sorokin, T. Carrig, "Femtosecond Pulse Generation from a SESAM Mode-Locked Cr:ZnSe Laser", CLEO/QELS May 21-26, Long Beach, CA, USA, Technical Digest on CD, paper CMQ2 (2006).

[2] E. Sorokin, I. T. Sorokina, J. Mandon, G. Guelachvili, N. Picqué, "Sensitive multiplex spectroscopy in the molecular fingerprint 2.4 μm region with a Cr2+:ZnSe femtosecond laser", Opt. Expr. 15, 16540-16545 (2007).