Preface

The 7th International Conference on Atomic and Molecular Pulsed Lasers (AMPL-05) is a biennial scientific forum traditionally held in the academic campus of Tomsk, the old Siberian town. Traditionally, the program of the AMPL-2005 involved the following topics:

– gas and plasma lasers (session A);
– metal vapor lasers (B);
– dye lasers and photoprocesses in complex organic molecules (C);
– physical processes in gas lasers (D);
– laser systems and new laser and optical technologies, laser applications (E);
– noncoherent UV and VUV sources (F);
– laser output conversion. optoelectronic devices (G).

The conference gathered about 150 scientists from Russia, Belarus, the USA, Germany, France, Yugoslavia, Iran, China, Armenia, Kazakhstan, and Estonia, who have presented 90 oral and 111 poster presentations. The students from Tomsk universities (about 50 persons) took part in the conference as listeners.

In 2006, we are planning to publish a part of the conference proceedings in the SPIE issue, namely, those that were prepared in English. The Russian part has been published in the current issue of the *Atmospheric and Oceanic Optics* journal.

Overview of the conference presentations

The plenary session held on September 12, 2005 involved the reports covering the most urgent problems in pulsed lasers, gas discharge physics, UV and VUV radiation sources, interactions between laser radiation and matter, and the use of laser systems in micro- and nanotechnologies. The session was launched with the presentation by A.K. Dmitriev (The Institute of Laser Physics SB RAS, Novosibirsk) in which he considered the problems in building up high-power chemical SF_6 lasers and the mechanisms of the electric discharge development in them.

A. Ulrich (The University of Technology, Munich, Germany) reported a new combined method of exciting an active medium with a high-frequency discharge and electron beam. He presented data on the effect of high-frequency discharge on the emission spectrum of an active medium.

A.B. Treshchalov (Tartu University, Tartu, Estonia) made a presentation "VUV and visible spectroscopic diagnostics of high-current pulsed volume discharge in argon".

There were several reports considering excilamps as sources of noncoherent narrow-band UV and VUV radiation (V.F. Tarasenko, Institute of High-Current Electronics SB RAS, Tomsk), the methods of spectral diagnostics of their emission (G.N. Gerasimov, State Optical Institute, St. Petersburg), and their practical application (M. Krishnan, Alameda Co. USA).

Keen interest was aroused by the reports devoted to practical laser application. M. Trtica (The Institute of Nuclear Sciences, Belgrad, Serbia and Monte Negro) presented an overview of the investigations into the interactions between laser and matter.

B. Lacour from the South-Paris University (France) reported on amplification of short HF-laser pulses with an amplifier in a chain discharge-initiated reaction. He concentrated his attention on the HF-laser parameters that suit its use in the experiments on radiation–matter interaction. A.N. Soldatov (Tomsk State University, Russia) presented a new IR system for laser micro- and nanotechnologies.

Session A. Gas and Plasma Lasers

This session was opened with the presentation by A.M. Razhev (Institute of Laser Physics SB RAS, Novosibirsk), in which he discussed atomic F, He, Ne, Ar, and molecular XeCl and XeF laser generation at excitation by an inductive transverse discharge. The highest pulse power of 6 kW was achieved in the mixture of $He–NF_3$ at the pulse length of 20 ns (FWHM).

V.F. Losev (Institute of High-Current Electronics SB RAS, Tomsk) presented a 300-J excimer laser system intended for use in the studies of radiation–matter interactions.

Some predictions of the development of a supersonic overtone CO laser were presented by A.A. Ionin (The Institute of Physics RAS, Moscow).

A. Behjat reported the data of the investigations of a TEA CO_2 laser with a surface corona pre-ionization performed at the Tehran Laser Research Center (Iran).

B.V. Lazhintsev (the Federal Nuclear Center, Sarov), M.U. Khasenov (TOO "Nauka," Kazakhstan), A.A. Zhupikov (the Institute of Laser Physics, Novosibirsk), and V.M. Mkhitaryan (the Institute of Physical

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Research, Armenia) have addressed the issues in KrF, XeCl, ArF excimer lasers with different pumping techniques. A.N. Panchenko (the Institute of High-Current Electronics, Tomsk) discussed creation of the electric-discharge exciplex lasers pumped with inductive generators on semiconductor switching devices.

Altogether, this session included 20 oral presentations and posters. This allows us to arrive at the following conclusion: the investigations into gas and plasma lasers show a good progress, which is especially obvious from the success in physics and technology of short-wave UV and VUV lasers. In these ranges, other laser types cannot yet compete with the gas lasers.

Session B. Metal Vapor Lasers

It is traditional for our conference to pay much attention (over 30 presentations this time) to metal vapor lasers and their applications. Most reports were still devoted to the CuBr laser, but we must note a considerable growth of the number of studies on the control of the discharge properties via injection of impurities into an active medium, solution of the problems of salt-based vapor injection, stabilization of physical and chemical composition of a medium, and the physics of a longitudinal energy-intensive pulse-periodic discharge.

G.G. Petrash (the Institute of Physics RAS, Moscow) opened the plenary session with the report "Continuous-wave collisional lasers: problems and prospects," in which he considered the reasons for insignificant progress in finding conditions for continuous-wave generation in r–m-transitions in metal atoms. One of these reasons was found to be the lack of knowledge of the properties of plasma of stationary and quasistationary discharges in mixtures of metals with buffer gases. According to G.G. Petrash, our knowledge of the energy transfer processes in interatomic and atomic-molecular collisions is insufficient either.

E.L. Latush (Rostov State University, Rostov-on-Don) has analyzed a numerical model of a discharge in a typical recombination laser in order to ascertain the processes and phenomena that govern the break of contraction of high-energy pulse-periodic discharge in lasers of this type.

N.A. Yudin (The Institute of Semiconductor Physics SB RAS, Novosibirsk) has addressed the processes determining the excitation intensity of r–m-transitions in the plasma of pulse-periodic discharges.

V.A. Gerasimov with co-authors (The Institute of Atmospheric Optics SB RAS, Tomsk) focused on the correlations between spectroscopic (the energies of configurations) and thermodynamic (the density of saturated vapor) properties of the elements with f-shells that can be occupied. They have formulated the criteria for the selection of chemical elements with thermal atomic emission of neutral atoms in the excited states. They have also considered the problems in creating conditions for lasing on optical transitions in atoms of rare earth metals to the ground state by producing the population inversion at emission of atoms from surface.

A.N. Soldatov et al. (Tomsk State University) presented several reports on the development of a strontium vapor laser with the average spectral power exceeding 10 W in the IR spectral region. It is a specific feature of these studies the use of three-component gas mixtures for laser optimization. They have presented results on the spatiotemporal discharge characteristics.

V.V. Tatur with colleagues (The Institute of Monitoring of Climatic and Ecological Systems SB RAS, Tomsk) analyzed a five-year performance of a CuBr laser with a unipolar transistor–transformer system of switching an 800-W discharge. Unipolar and bipolar discharge switching circuits were compared.

G.S. Evtushenko with colleagues (The Institute of Atmospheric Optics SB RAS, Tomsk) reported on the effects of H_2 and HBr admixtures on a CuBr laser performance. An active scheme of regulating the density of admixtures was used as well as the regulation of tube temperature by an external furnace.

V.G. Sokovikov (The Institute of Atmospheric Optics SB RAS, Tomsk) presented the results on the spectroscopic search (with a dye laser in a two-photon optical excitation) of shifted states of the europium atom that are autoionized to the resonance states of the first ion. V.G. Sokovikov has found such atomic states, which, if autoionized, yield superluminescence due to r–m-transitions in the ion spectrum.

Hamid Ghomi (Shahid Beheshti University, Tehran) presented his investigations of a CuBr laser with a part of a discharge placed into the magnetic field. He noticed a positive influence of the magnetic field on the near-cathode part of the discharge.

H. Saghafifar (The University of Technology, Isfahan, Iran) considered the features of operation of a sealed off CuBr laser at a pulse repetition frequency of 10 to 30 kHz.

Session C. Dye Lasers and Photoprocesses in Complex Organic Molecules

At this session, there were 29 presentations, including 12 oral ones. The participants have presented their finished studies concerning the development and production of different organic molecules, thermally stable and emitting in the solid state at optical excitation and at excitation by the electric current: complex molecular systems with electronic excitation energy transfer, luminescent polymers, and solid solutions of organic molecules in various matrices.

For example, V.A. Svetlichnyi (Siberian Physical-Technical Institute, Tomsk) considered special properties of generation by organic dyes of dicyanomethylene–pyran series under two-photon excitation with a Nd:YAG laser radiation of 15 ns pulse duration.

Quite urgent are studies of the properties of organic molecules in thin polymer films (L.G. Samsonova with co-authors, Siberian Physical-Technical Institute, Tomsk).

Complex molecular systems, such as bifluorophores, are promising for new applications, and the presentations by G.V. Maier, V.Ya. Artyukhov, L.G. Narozhnaya, and Yu.P. Meshalkin (Tomsk State University) have aroused much interest of the audience.

Many presentations at this session, have dealt with the photoprocesses in complex organic molecules studied using the quantum-chemical methods (the presentations by V.Ya. Artyukhov, N.Yu. Vasilyeva, V.A. Pomogaeva et al., Siberian Physical Technical Institute, Tomsk).

Session D. Physical Processes in Gas Lasers

This session counted 13 oral and 26 poster presentations. The most active discussion was raised in the presentations by V.F. Tarasenko (Institute of High-Current Electronics SB RAS, Tomsk) "The properties of volume nanosecond high-pressure discharge formed in non-uniform electric field and of supershort electron beams" and by S.I. Yakovenko (The General Physics Institute RAS, Moscow) "Runaway electrons and powerful subnanosecond beams at atmospheric pressure," where the authors presented data of experimental and theoretical studies into the formation of high-power subnanosecond electronic beams.

Yanchen Qu (Harbin, China) reported the results on mathematical modeling of five temperatures in TEA CO_2 laser.

V.M. Klimkin (The Institute of Atmospheric Optics SB RAS, Tomsk) considered the problems of continuous lasing in He–Eu mixture in the wavelength region from 1.07 to 1.47 μm.

K. Silakhori (Tehran, Iran) in his presentation "High repetition rate PIN-array UV pre-ionized CO_2 laser" presented the design and construction of a CO_2 laser with a pulse energy more than 65 mJ at the repetition rate higher than 2 kHz.

The presentations by A.G. Yastremsky (Institute of High-Current Electronics SB RAS, Tomsk), G.N. Zvereva (The State Optical Institute, St. Petersburg), A.M. Razhev (The Institute of Laser Physics, Novosibirsk), Yu.N. Panchenko (Institute of High-Current Electronics SB RAS, Tomsk) focused on the computer simulations of the way the XeCl-laser pumping parameters affect the radiation pulse. The authors also discussed the results of theoretical research into the amplification properties of a krypton gas-discharge plasma. Experimental observations of the effect the parameters of pumping as well as the pressure and active media parameters produce on the output energy of the KrCl and XeCl excimer lasers were also considered.

Session E. Laser Systems and New Laser and Optical Technologies, Laser Applications

This session included 10 oral and 21 poster presentations covering the whole scope of the problems of using laser systems in different sectors of the national economy.

The plenary session was opened with the presentation by M.A. Kazaryan (Physical Institute RAS, Moscow) "Microprocessing with the help of a copper vapor laser system", which he prepared with co-authors from the State Research and Production Corporation "Istok" (Fryazino, Moscow Region), Yerevan Physical Institute, and the General Physics Institute RAS (Moscow). The presentation was well illustrated with photographs of microprocessed ceramics, plastics, etc.

Many presentations at this section were reviews. For example, the report "High power laser equipment and applications for laser technology" by A.G. Ignatov ("Laser Infrom-Service" Joint-Stock Private Co., St. Petersburg) and "Application of pulsed laser welding in industry. Review of the works of Samara Branch of the P.N. Lebedev Institute of Physics in the field of laser technology" by S.V. Kayukov. Kayukov's presentation was dedicated to the 25th anniversary of Samara Branch of the P.N. Lebedev Institute of Physics known for its developments in new laser systems and commercialization of many advanced laser technologies.

A.V. Vasilieva (Tomsk State University) reported in her presentation "Research laser system for resonance ablation of materials" a new laboratory setup for experimental research of resonance ablation of biological tissues and polymers in the middle IR spectral region. The setup may be useful in fundamental and applied research in laser physics, biology, materials science, and nanotechnologies.

Likewise, the session discussed the problems in laser separation of isotopes, development of new laser systems for medicine and industry as well as improvement of the existing ones. Several presentations dealt with the studies of the new effects in interactions between laser radiation and matter. It is important to note that the interest in this problem revives again: this year, the percentage of works devoted to laser ablation and its by-effects has doubled.

Particularly we would like to note the poster presentation "The problem of development of laser-plasma microjet for micro- and nanosputniks" by A.N. Panchenko (Institute of High-Current Electronics SB RAS, Tomsk). He focused on a new laser application that has found extensive development only in recent time, though for the first time the idea of using laser ablation to move space objects, as an alternative to jet thrust generation fostered by a chemical reaction, was suggested by Kantrovich yet in 1972. Following this technique, with the driving laser positioned on the Earth, the space vehicle is free from heavy engines or fuel reserves.

This time the conference had a modest number of reports devoted to medical applications of laser, which was uncommon. Among these few works we would mention the "Laser systems with acousto-optical control of output parameters for medical applications" by E.A. Morozova et al. (Munich Technical University, France) and "Optimization of an optical unit for a versatile laser system" by I.V. Reimer et al. (Tomsk State University). In the latter report, the authors discussed creation of a new laser complex for treatment of oncological and dermatological diseases.

Generally, the results reported at this session promise a reasonable chance of success in further development of applied research in the fields of science and technology related to pulsed lasers and laser physics.

Session F. Noncoherent UV and VUV Sources

This session included 25 presentations. V.M. Tsvetkov (The Federal Nuclear Center of the Research Institute of Experimental Physics, Sarov) reported interesting facts on the luminescence characteristics of inert gases and their binary mixtures excited by fission fragments of U^{235}.

J. Wieser (Munich Technical University, Germany) in his paper "Compact electron beam-excited light sources and lasers" discussed the characteristics of a light source emitting in vacuum UV spectral region and considered its possible application to mass-spectrometry of organic molecules.

It is also worthy to note a series of studies into the new developments and applications of excilamps reported by researchers from Institute of High-Current Electronics (Tomsk). For example, D.V. Schitz presented generalized data on configurations and operation of 5 to 100 W power excilamps (emitting at 172, 206, 222, 282, 289, and 308 nm wavelengths) pumped by barrier and capacitive discharges.

Session G. Laser Output Conversion. Optoelectronic Devices

This session comprised 28 reports. S.G. Grechin (Moscow State University) has thoroughly analyzed the frequency conversion in nonlinear crystals. Yu.M. Andreev (Institute of Monitoring of Climatic and Ecological Systems SB RAS, Tomsk) reported the results on frequency conversion of femtosecond radiation pulses in mixed biaxial crystals and considerations of admissible variations in crystal mixtures for the second harmonic generator and parametric light oscillators. A very interesting report was presented by V.A. Gerasimov (IAO SB RAS, Tomsk), in which he considered conversion of laser radiation into a shorter wavelength region in vapor of rare earth metals.

V.O. Troitskii (Institute of Atmospheric Optics SB RAS, Tomsk) announced a successful solution to the problem of focusing laser beam into a crystal using two crossed cylindrical lenses. He also presented an optimization of this problem relative to some initial parameters and proved the advantage of cylindrical focusing.

A new insight into the nature of electron emission from metal electrodes inside the pulse electron field was a topic of report by V.N. Kukharev (IAO SB RAS), which publication in this issue is open to discussion.

The closing session of the AMPL-05 on September 16, 2005, summarized the conference results. Special time was let for acknowledgement of young authors of the best oral and poster presentations. Both Russian and foreign participants expressed their high regard for the organizational and scientific level of the event, approved the conferencing enthusiasm of young scientists and post-graduate students, and supported the idea of arranging the next regular AMPL conference in September 2007 in Tomsk.

Further information on the AMPL conference can be found on the website of the Institute of Atmospheric Optics SB RAS under http://symp.iao.ru.

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