Alexander A. Mikhailovsky, Ph.D.

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Education

Ph.D. in physics

1994-1998. Moscow State University, Dept. of Physics, Quantum Electronics Division, Moscow, Russia. **GPA (4.0/4.0)**

Thesis title: "Active spectroscopy of polaritons in homogeneous media and media with periodical distribution of the quadratic susceptibility."

Thesis advisor: Prof. A.N.Penin

M.S. in physics and electrical engineering *(Highest honors)*

1989-1994. Perm State University, Dept.of Physics, Experimental Physics Division, Perm, Russia. **GPA (4.0/4.0)**

Areas of expertise and research interests

- Femtosecond spectroscopy
- Organic light emitting and photovoltaic devices
- Optical characterization of materials
- Scanning probe microscopy
- Non-linear optics and spectroscopy
- Physics of nanostructures
- Solid state physics
- Laser physics
- Optical engineering

Technical skills

- Optical spectroscopy: time-resolved femtosecond techniques, non-linear optical spectroscopy, various "conventional" spectroscopic methods. Optical characterization of OLEDs and photovoltaic devices.
- Implementation of spectroscopic methods for studies and characterization of materials.
- Development of state-of-art research instruments: concept, design of optical, software, electronic, and mechanical components, their interfacing and integration. Projects include parametric down-conversion spectrometer, near-field single particle absorption spectrometer, time-resolved photoluminescence spectrometer, two-photon absorption spectrometer, femtosecond pump-probe spectrometer.
- Scanning probe microscopy (AFM, STM, NSOM) and single-molecule spectroscopy.
- Strong background in non-linear optics, solid state and semiconductor physics
- Design, application, maintenance, and troubleshooting of various laser systems .
- Computer skills: C/C++, Pascal and LabView programming, high-complexity numerical calculations, mathematical modeling of physical systems, device control programming, some CAD experience.
- Design of analog and digital electronic equipment.

Awards and Honors

2002 Los Alamos National Laboratory Postdoctoral Distinguished Performance Award for small research teams (together with Dr. J. A. Hollingsworth)
2001 Los Alamos Achievement Award for discovery of optical gain in quantum dot solids.
1997 Award of the Center for Science and Education at Russian Academy of Sciences for the best graduate research work.
1991-1992 Meshkov Fellowship, Perm State University, Russia.

Employment and research experience

2004-present *Optical Characterization Facility Manager (Sr. R&D engineer)*
2002-2004 *Optical Characterization Facility Manager (Assoc. R&D engineer)*
Department of Chemistry and Biochemistry, University of California – Santa Barbara

Responsible for the operation and support of the department of Chemistry and Biochemistry's Optical Characterization Facility.(http://www.chem.ucsb.edu/~ocf/)The new facility was built from scratch and provides campus researchers with an access to modern spectroscopic techniques. Designed and set up instruments for the femtosecond time-resolved spectroscopy, two-photon absorption, time-correlated photon counting, and other advanced techniques. Participate in equipment acquisitions and preparation of grant proposals.

Current research program is focused on the studies of surface plasmon interaction with light emitting materials. The latest advances include demonstration of radiative recombination acceleration in organometallic triplet emitters and enhancement of the organic light emitting devices performance using noble metal nanoparticles (patent pending). Fundamental physics of the surface plasmon enhancement of the radiative and energy transfer processes is investigated for development of novel bioassays. Significant research effort is focused on development of novel, highly efficient organic non-linear optical materials. The own research work is supported by DoE and DoD grants (see below).

1998-2002
Postdoctoral Research Associate, Los Alamos National Laboratory

Research of inorganic and organic nanomaterials, such as semiconductor nanocrystal quantum dots and conjugated polymers, respectively. These activities included studies of fundamental physics in nanoscale materials, spectroscopic characterization of novel compounds, and development of their possible applications. Studies of fundamental processes in colloidal CdSe quantum dots led to discovery of optical amplification and lasing in materials incorporating these nanocrystals. This makes them promising material for new generation of lasers and optical communication devices (patent pending). Developed two novel femtosecond spectroscopic techniques for studies of semiconductor materials. Performed mathematical modeling of energy relaxation in nanostructures and of dynamics of quantum dot-based optical amplifier.

Was responsible for development of the near-field optical pump-probe spectrometer with sub-picosecond temporal resolution and sub-100 nm spatial resolution (no analog exist in the world). Key experimentalist in studies of optical properties of single nanometer-scale objects.

Supported operation of the state-of-art spectroscopic lab including 4 experimental set-ups and 11 lasers.

1997-1998
Postdoctoral Research Associate, General Physics Institute of Russian Academy of Science, Moscow, Russia (http://surface.gpi.ru).

R&D of the variable temperature ultra-high vacuum scanning tunneling microscope. The instrument developed is capable of imaging of standalone atoms and is used for monitoring of chemical reactions involving only few of them. The work included design of mechanical and electronic parts, software development, manufacturing of prototype, and its testing. Modified version of this microscope is available commercially, 5 instruments have been ordered by the government of Russian Federation for the national Academy of Sciences.

Other experience

1994-1997
Graduate student, Moscow State University, Moscow, Russia

Built spectrometer for studies of coherent scattering of light by phonon polaritons: built YAG:Nd flash lamp-pumped actively Q-switched laser, set up optics, designed electronic equipment for signal detection (PD and PMT amplifiers, timing control electronics) and equipment control (step-motor controller and drivers, power supplies, etc), developed control software (Pascal).

Developed new spectroscopic technique for studies of optical properties of non-linear crystals in far IR range of spectrum. Studied quasi-phasematched non-linear processes in periodically poled media and influence of doping agents on optical properties of $LiNbO_3$.

Funding

1. Grant of Institute for Collaborative Biotechnologies (DoD and UCSB) for development of enhanced bioassays using hybrid metalloorganic nanostructures.
2. U.S. Department of Energy grant for development of novel solid state lighting technologies
3. Office of Naval Research grant for development of surface plasmon enhanced organic solar cells.

Publications in peer-reviewed magazines:	21 (5 papers are in progress)
Conference contributions:	33
Patents	3
Publications in news media highlighting research work	11

(See pages 4-7 for the list of publications, conference contributions, patents, *etc.*)

Letters of reference (available upon request)

1. Prof. Guillermo C. Bazan. Department of Chemistry and Biochemistry, UCSB, bazan@chem.ucsb.edu
2. Dr. Victor I. Klimov, Los Alamos National Laboratory, klimov@lanl.gov
3. Professor A. N.Penin, Moscow State University, postmast@qopt.phys.msu.ru

Publications

1. Q.H. Xu, S. Wang, D. Korystov, A. Mikhailovsky, G.C. Bazan, D. Moses, A.J. Heeger, "The fluorescence resonance energy transfer (FRET) gate: A time-resolved study", *PNAS* **102**, 530 (2005).
2. H.Y. Woo, J.W. Hong, B. Liu, A. Mikhailovsky, D. Korystov, G.C. Bazan, "Water-soluble [2.2]paracyclophane chrornophores with large two-photon action cross sections", *JACS* **127**, 820 (2005).
3. S. Weksler, A. Mikahilovsky, and P. Ford, "Photochemical Production of Nitric Oxide via Two Photon Excitation with NIR Light", *JACS* **126**, 13566 (2004).
4. A.A. Mikhailovsky, M.A. Petruska, Kiuri Li, M.I. Stockman, and V.I. Klimov, "Phase-sensitive spectroscopy of surface plasmons in individual metal nanostructures", *Phys.Rev. B* **69**, 085401 (2004).
5. Bin Liu, Shu Wang, G.C. Bazan, and A. Mikhailovsky, "Shape Adaptable Water-Soluble Conjucated Polymers", *JACS* **125**, 13306 (2003).
6. A.A. Mikhailovsky, M.A. Petruska, M.I. Stockman, and V.I. Klimov, "Broadband, Near-Field, Interference Spectroscopy of Metal Nanoparticles Using Femtosecond White-Light Continuum", Opt. Lett. **28**, 1686 (2003).
7. A.V. Malko, A.A. Mikhailovsky, M.A. Petruska, J.A. Hollingsworth, H. Htoon, M.G. Bawendi, and V.I. Klimov, "From amplified spontaneous emission to microring lasing using nanocrystal quantum dot solids", Appl. Phys. Lett. **81**, 1303 (2002)
8. A.A. Mikhailovsky, A.V. Malko, J.A. Hollingsworth, S. Xu, M.G. Bawendi, and V.I. Klimov, "Multiparticle interactions and stimulated emission in chemically-synthesized quantum dots", Appl. Phys. Lett. **80,** 2380 (2002).
9. S. Xu, A.A. Mikhailovsky, J.A. Hollingsworth, and V.I. Klimov, "Hole Intraband relaxation in strongly confined quantum dots: Revisiting the "phonon bottleneck" problem", Phys. Rev. B **6504**, 5319 (2002).
10. A.Mikhailovsky, S. Xu and V.Klimov. Femtosecond intraband modulation optical spectroscopy. Rev. Sci. Instr. **73**, 136 (2000)
11. V. Klimov, A. Mikhailovsky, S. Xu, A. Malko, J. Hollingsworth, D. McBranch, C. Leatherdale, H.-J. Eisler and M. Bawendi, "Optical gain and stimulated emission in nanocrystal quantum dot solids", Science **290**, 314 (2000).
12. V. Klimov, A. Mikhailovsky, D. McBranch, C. Leatherdale and M.Bawendi "Mechanisms of energy relaxation in semiconductor quantum dots: the role of electron-hole interactions", Phys.Rev.B **61**, R13349 (2000)
13. V. Klimov, A. Mikhailovsky, D. McBranch, C.Leatherdale and M.Bawendi, "Quantization of multi-particle Auger rates in semiconductor quantum dots", Science **287**, 1011 (2000)
14. G.Kh.Kitaeva, K.A.Kuznetsov, A.A. Mikhailovsky and A.N. Penin, Cascaded coherent Raman scattering by phonon polaritons, J. of Raman Spectroscopy, **31**, 767 (2000).
15. G.Kh. K. Kitaeva, K. A. Kuznetzov, A. A. Mikhailovsky, I. I. Naumova, A. N. Penin, "Four-wave scattering by coherently excited polaritons", Proc. of SPIE **3732**, 65 (1999)
16. G.Kh. Kitaeva, K.A. Kuznetsov, A.A. Mikhailovsky, I.I. Naumova and A.N. Penin, Four-wave scattering of light by coherently excited polaritons, Quantum electronics **29,** 89 (1999)
17. B. Kraabel, A. Mikhailovsky, H.-L. Wang, D. W. McBranch, Molecular control and energy transfer in self-assembled polymer films: towards improved ultrafast holographic materials, Proc. of SPIE **3976**, 43 (1999)
18. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky, I.I. Naumova and A.N. Penin, "Visible and infrared dispersion of the refractive indices in periodically poled and single domain Nd:Mg:$LiNbO_3$ crystals", Appl. Phys. B , **66**, 201 (1998).
19. G.Kh. Kitaeva, A.A. Mikhailovsky and A.N. Penin, "Non-linear diffraction in spontaneous three-wave and coherent four-wave light scattering by polaritons", Sov.JETP **85**, 1094 (1997).
20. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky and A.N. Penin, "Four-wave light scattering by polaritons in $LiNbO_3$". Opt. Comm. **138**, 242 (1997).
21. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky and A.N. Penin, " Four-wave polariton scattering of light in $LiNBO_3$", Sov. JETP, **85**, 241 (1997).

***** For publications 11-13 and 15-18 authors are listed in the alphabetical order.

Conference contributions

1. D. Bussian, A. Mikhailovsky, B. Liu, G. C. Bazan, and S.K. Buratto, " Ultrafast transient-absorption studies of spatially confined conjugated oligomers", 2005 APS March Meeting (Los Angeles 2005)
2. H. Woo, A. Mikhailovsky, D. Korystov, and G. Bazan, "Water-Soluble Paracyclophane Chromophores with Large Two-Photon Action Cross Sections", 2005 MRS Spring Meeting, San Francisco (March 2005).
3. D. Bussian, A. Mikhailovsky, B. Liu, G. C. Bazan, and S.K. Buratto, " Ultrafast transient-absorption studies of spatially confined conjugated oligomers", 229th National ACS meeting, San Diego (March 2005).
4. S.R. Weksler, A.A. Mikhailovsky, and P.C. Ford, "Photochemical production of nitric oxide via single and two photon excitation: Potential applications as photodynamic therapy (PDT) drugs", 229th National ACS meeting, San Diego (March 2005).
5. J. O. Osatrowski, A.A. Mikhailovsky, and G.C. Bazan, "Surface plasmon-enhanced emission of organometallic phosphors", SPIE Annual Meeting 2004, Denver CO (August, 2004).
6. Alexander Mikhailovsky, Jacek Ostrowski, Hadjar Benmansour, and Guillermo Bazan, "Surface plasmon enhanced light emitting devices", CLEO/QELS 2004, San Francisco CA (May 2004).
7. David Banach, Jerzy Kanicki, Alexander A. Mikhailovsky, Gui Bazan and Alan Heeger, "Opto-electronic properties of materials for organic polymer lasers", SPIE Annual meeting 2003, San Diego CA (July 2003)
8. A. Mikhailovsky, J. Ostrowski, M. Katiyar, G.Bazan. "Control of radiative processes using surface plasmon resonances in metal nanostructures", ESP 2003, Los Alamos NM (August 2003).
9. Liu Bin, G. Bazan, B. Koehler, H. Benmansour, A. Mikhailovsky, J. Hong, "Two-photon absorbing dyes", ESP 2003, Los Alamos NM (August 2003).
10. A. Bartko, A. Mikhailovsky, M. Achermann, M. Petruska, M. Stockman, V. Klimov, "Near-field interference spectroscopy of single metal nanoparticles", ESP 2003, Los Alamos NM (August 2003).
11. D. Banach, J. Kanicki, A. Mikhailovsky, G. Bazan, A. Heeger, S. Martin, "Opto-electronic properties of materials for organic polymer lasers", SPIE Annual Meeting 2003, (August 2003, San Diego).
12. V. Klimov, M. Achermann, A. Mikhailovsky, A. Bartko, M.Petruska, M. Stockman, "Near-field, phase-sensitive spectroscopy of metal nano-assmeblies", CLEO/QELS 2003 (June 2003, Baltimore).
13. A. Mikhailovsky, M. Petruska, A. Bartko, M. Achermann, M. Stockman, V.Klimov, "Near-field interference spectroscopy of individual metal nanostructures", APS March meeting 2003 (March 2003, Austin).
14. A.A. Mikhailovsky, A.P. Bartko, M.A. Petruska and V.I. Klimov, "Near-field optical spectroscopy of gold based nanostructures", 2002 MRS fall meeting (December 2002, Seattle).
15. A.A. Mikhailovsky and V.I. Klimov, "Single-particle, near-field extinction spectroscopy using a femtosecond, white-light continuum", 2002 SPIE Annual Meeting (July 2002, Seattle).
16. A. I. Malko, A. A. Mikhailovsky, J. Hollingsworth, M. Petruska and V. I. Klimov, "Photoinduced absorption and optical gain in CdSe quantum dots", 2002 SPIE Annual Meeting (July 2002, Seattle).
17. A. A. Mikhailovsky and V. I. Klimov, "Braod-Band Near-Field Extinction Spectroscopy of Single Gold Nanoparticles", CLEO/QELS 2002 (May 2002, Long Beach).
18. A. V. Malko, A. A. Mikhailovsky, J. A. Hollingsworth, and V. I. Klimov, "Multiparticle interactions and optical gain in chemically-synthesized quantum dots", CLEO/QELS'2002 (May 2002, Long Beach).
19. A. Mikhailovsky and V. Klimov, "Broadband, Near-Field Extinction Spectra of Single Gold Nanoparticles", APS March Meeting 2002 (March 2002, Indianapolis)
20. A.Malko, A. Mikhailovsky, J.Hollingsworth, M. Petruska, and V. Klimov, "Competition between optical gain and photoinduced absorption in chemically synthesized quantum dots", APS March Meeting 2002 (March 2002, Indianapolis)
21. V. Klimov, A. Mikhailovsky, S. Xu, A. Malko, and J. Hollingsworth, "Auger interactions and ultrafast carrier dynamics in nanocrystal quantum dots", HCIS-12 (August 2001, Santa Fe).

22. A. Mikhailovsky, S. Xu, J. Hollingsworth, and V. Klimov, "Electron and hole intraband dynamics in nanocrystal quantum dots", Conference on Excited States in Electronic and Bio-Materials (August 2001, Los Alamos).
23. V. Klimov, A. Mikhailovsky, S. Xu, A. Malko, J. Hollingsworth, C. Leatherdale, H.-J. Eisler and M. Bawendi, "Optical gain and lasing in colloidal quantum dots", CLEO/QELS'2001 (May 2001, Baltimore)
24. A. Mikhailovsky, S. Xu, D. McBranch and V.Klimov, "Carrier relaxation dynamics and photoluminescence efficiency in semiconductor quantum dots", CLEO/QELS 2000 (May 2000, San Francisco).
25. A. Mikhailovsky, S. Xu, V. Klimov, C. Leatherdale and M.Bawendi, "Carrier dynamics and photoluminescence efficiency in semiconductor quantum dots", APS March 2000 Meeting (March 2000, Minneapolis).
26. G.Kh. Kitaeva, K.A. Kuznetsov, A.A. Mikhailovsky, I.I. Naumova and A.N. Penin "Four-wave scattering by coherently excited polaritons", ICONO'98 (July 1998, Moscow, Russia).
27. G.Kh. Kitaeva, A.A. Mikhailovsky, and A.N. Penin, "Non-linear diffraction and under three-wave spontaneous and four-wave coherent scattering of light by polaritons". CLEO/IQEC'98 (May 1998, San Francisco).
28. A.A. Mikhailovsky, G.Kh. Kitaeva, P.S. Losevsky, and A.N. Penin, "Measurement of refractive index dispersion in Mg:LiNbO3 and Nd:Mg:LiNbO3 single crystals by means of coherent four-wave and spontaneous three-wave light scattering", LPHYS'97 (August 1997, Prague, Czech Republic).
29. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky, I.I. Naumova, and A.N. Penin, "Coherent four-wave and spontaneous three-wave light scattering in periodically poled $LiNbO_3$:Mg:Nd crystal", CLEO/Pacific Rim'97 (July 1997, Chiba, Japan).
30. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky, and A.N. Penin, "Coherent four-wave and spontaneous three-wave light scattering used for the precise measurement of refractive index IR dispersion of the doped and periodically poled $LiNbO_3$ crystals", CLEO/QELS'97 (May 1997, Baltimore)
31. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky, and A.N. Penin, "Four-wave light scattering by phonon polaritons", EQEC'96 (September 1996, Hamburg, Germany).
32. G.Kh. Kitaeva, P.S. Losevsky, A.A. Mikhailovsky, and A.N. Penin,"Four-wave mixing spectroscopy of phonon polaritons", ICORS XV(August 1996, Pittsburgh).
33. A.A. Mikhailovsky, A.G. Mikhailovsky, and A.A. Polozov, "Correlation spectrometer", 2nd USSR Conference "Optical methods in the Studies of Flows" (April 1992, Novosibirsk, USSR)

Patents

1. V. Klimov, A. Mikhailovsky, J. Hollingsworth, C. Leatherdale and M. Bawendi, Quantum dot optical amplifiers and lasers, *U.S. Patent 6,819,692*.
2. A.Mikhailovsky, J. Ostrowski, M. Katiyar, and, G. Bazan. Plasmon-assisted enhancement of optoelectronic devices. *Provisional application filed with USPTO.*
3. G. Bazan, B. Koehler, A. Mikhailovsky, H. Benmansour, B. Liu, and J. Hong, Water-soluble distyrylbenzene chromophores for applications in optoelectronic technologies. *Provisional application filed with USPTO.*

Publications highlighting research work

1. Nanoscale Flashlight, Today's Science News: Earth, Life and Space Science, September 2003
2. Shining A Nano Sized Flashlight On A New World, SpaceDaily, September 2003
3. Nanoscale spectrometry probes the nanoplasmonics of gold, LANL Press release, September 22, 2003
4. Building a "nanoscale flashlight" to explore the nanoscale world, LANL Press release, September 22, 2003.
5. Nanocrystal quantum-dot lasers show promise, OSA News, October 13, 2000
6. Put semiconductor lasers in quantum dots, Microelectronics Technology Alert, October 17, 2000
7. Nanoscale quantum dots produce light, Microelectronics Technology Alert, March 23, 2001
8. Peter Fairley, Innovation: Nanodot Lasers, Technology Review, April 2001
9. Quantum dot lasers coming soon, Chemistry and Engineering News, October 23, 2000, p.78

10. Los Alamos and MIT demonstrate uses of “Nanocrystal Quantum Dot lasers for new devices”, Los Alamos Monitor, October 15, 2000, p. A-8.
11. Quantum dots have ideal chemistry, Optics and Lasers Europe, November 2000, p.6