

TEIMURAZ MTCHEDLIDZE (MCHEDLIDZE), Ph.D.

Semiconductors/Materials Researcher

Short summary

- More than 30 years of experience in research of semiconductor materials: fabrication, characterization, and development of related technologies.
- Wide range of scientific interests with an emphasis on the investigation, engineering, and employment of various defects and nanostructures in semiconductors.
- Ability to improve existing material characterization methods and invent new ones.
- More than 120 publications in leading refereed international scientific journals.
- Guest-editor and reviewer for Scientific Journals.
- Contributed more than 75 papers to international conferences on topics related to materials science and physics of semiconductors.
- Organized and chaired international conferences.
- Possess several patents.

WebPage: <http://www.teimuraz.net>



Employment history and scientific activity topics

- Institut Angewandte Physik, Technical University Bergakademie Freiberg, Freiberg, GERMANY

Researcher

01.01.2021 – present

- Characterization of interface traps in fully depleted HKMG SOI FET structures using subthreshold swing measurement method;
- Characterization of carrier mobility in fully depleted HKMG SOI FET structures using subthreshold swing measurement method.

Project:01.01.2021-31.12.2021: In the frame of “IPCEI on Microelectronics” (IPCEI - “Important Projects of Common European Interest” launched by EU Commission), a subproject of GLOBALFOUNDRIES: “Development and industrialization of innovative FDSOI-technology”, Dresden, Germany

- Semiconductor Laboratory, Technical University Dresden, Dresden, GERMANY

Researcher

16.01.2012 –31.12.2020

- Characterization of fully depleted HKMG SOI FET structures using capacitance transient and subthreshold swing measurement methods;

- Capacitance transient spectroscopy measurements on high-k metal gate field effect transistors fabricated using 28nm technology node;
- Solar cell degradation induced by light and elevated temperatures;
- Light- and current-induced degradation of solar cells;
- Near-Junction volume defects in Si solar cells;
- Capability of deep level transient spectroscopy for characterizing multi-crystalline silicon;
- Iron-related defects in solar cells;
- Simulation of PV-cell fabrication processes and thermal budget;
- Characterization of mono- and multi-crystalline Si wafers after PV-cell fabrication processes;
- Development and perfection of PV-material characterization technique.

Project(s): 01.06.2018-31.12.2020: In the frame of “IPCEI on Microelectronics” (IPCEI - “Important Projects of Common European Interest” launched by EU Commission), a subproject of GLOBALFOUNDRIES: “Development and industrialization of innovative FDSOI-technology”, Dresden, Germany

2014-2018: GLOBALFOUNDRIES Project “Zeus”, HKMG FET 28nm Stacks, Germany.

2012- 2013: BMBF project No. 03SF0398E: “xμ- Materials”, Germany.

Publications in international refereed journals: 18 manuscripts.

Supervision: 6 M.S. works, 4 B.S. work, 4 Practicum.

Teaching: Practicum in DLTS spectroscopy; Summer school on Physics (Batumi, Georgia, 2014).

PV practicum in TU Dresden (2015-2017).

- Joint Laboratory IHP/BTU, Brandenburg Technical University, Cottbus, GERMANY

Researcher

01.05.2005 –31.12.2011

- Light-induced Solid Phase Crystallization of thin Si films and nano-structures;
- Characterization of CuInSe thin films for photovoltaic (PV) applications;
- Properties of Crystal Silicon on Glass films for PV and development of related technology;
- Characterization and development of Si PV materials (mc-Si, thin films, 3rd generation materials);
- Si based light – emitting devices, Si photonics;
- Si wafer direct bonding, regular dislocation networks;
- Defect control and defect engineering for photonic and PV applications;
- Band structure engineering in Si for photonic and PV applications;
- Properties of agglomerates of intrinsic defects in silicon;
- Iron-phosphorus complexes in Si and gettering mechanisms for PV applications.

Project(s): 2009-2010: BMBF project No. 13N9734: “SiliconLight, Germany.

2010-2011: The European FP7 project “HIGHEF”, contract number 213303, EU.

2008-2012: BMBF project No. 03SF0352: “SINOVA”, Germany.

2005-2008: BMBF project No. 03SF0308: “Band structure design”, Germany.

Publications in international refereed journals: 36 manuscripts.

Supervision: 2 Ph.D. works, 3 M.S. works, 5 B.S. works, 3 Practicum.

Teaching: Lecture courses: “Spectroscopic methods in Semiconductors” and “Spin-resonance spectroscopy”.

Patents: Three patents filed

- **Institute for Physics and Measurement Technology, Linköping University, SWEDEN**

Visiting Researcher

2004 -2005

- Investigation of defects and band structure in dilute nitrides by means of optically detected spin resonance, cyclotron resonance and optical spectroscopy methods.

Supervision: Ph.D. works, M.S. works

Publications in international refereed journals: 5 manuscripts.

- **Institute for Materials Research, Tohoku University, Sendai, JAPAN**

Research Associate

2000 -2004

- Clusters of self-interstitials in silicon, nanostructures;
- Investigation of defects in silicon samples, which represent a model for the contemporary "device area" of silicon wafers;
- Investigation of interaction between platinum and hydrogen in silicon crystals Investigation of hydrogen-related defects in silicon;
- Investigation of iron-related complexes in silicon crystals;
- Spin resonance methods in materials studies.

Publications in international refereed journals: 22 manuscripts.

Supervision: 2 Ph.D. works, 1M.S. works, 1 B.S. works, 5 Practicum.

Teaching: Lecture courses: "Spectroscopic methods in Semiconductors"

- **Komatsu Electronic Metals Co., Ltd., Silicon wafer producer, Hiratsuka, JAPAN**

Engineer of R&D Centre, Device Group Manager

1995-2000

- Developed new measurement sequence (hardware and software) for gate oxide integrity (GOI) evaluation in the time-zero dielectric breakdown mode;
- Developed new measurement sequences for the GOI evaluation of silicon wafers in the TZDB and TDDB modes;
- Developed software for classification of wafering process damage;
- Investigated and developed new methods for evaluation of defects and their properties in silicon wafers using leakage current of simple device structures (patent received);
- Investigated and developed new methods for characterization of gate oxide degradation process under current stress, including low electrical field behaviour characterization, repeated scan characterization, carrier trap creation analysis, etc;
- Developed new method for investigation of iron gettering processes in Si wafers (patent obtained);
- Investigated electrical activity of oxide precipitates;
- Improved quality of buried oxide layer for silicon-on-insulator (SIMOX) wafer fabrication (patent received).
- Investigated electrical properties of Cz-grown SiGe systems.

Publications in international refereed journals: 11 manuscripts.

Supervision: Practicum for group members.

Patents: Four patents filed

- **Institute for Materials Research, Tohoku University, Sendai, JAPAN**

Post-Doctoral Research Associate

1994-1995

- Investigated electrical activity of rod-like defects in Cz-Si;
- Detected and investigated electric-dipole resonance signal from rod-like defects in Cz-Si;
- Investigated influence of metallic impurities on oxygen precipitation in Cz-grown silicon crystals.

Ph.D. Fellow of Japanese Society for Promotion of Science

1991-1992

- Investigated growth process, infrared, electrical and mechanical properties of SiGe systems;
- Investigated hydrogen-related defects in Si crystals;
- Investigated surface and subsurface damage of Si wafers polished with diamond tool in ductile mode.

Publications in international refereed journals: 7 manuscripts.

- **Institute for Solid State Physics, Chernogolovka, Moscow District, Russia**

Trainee Researcher, Ph.D. student, Researcher

1985-1994

- Investigated properties of heavily deformed silicon crystals;
- Investigated physics of one-dimensional electric-dipole spin-resonance (EDSR) in semiconductors;
- Investigated properties of various types of dislocations in silicon;
- Investigated microwave absorption peculiarities in high TC superconductors;
- Investigated electric-dipole spin resonance (EDSR or combined resonance) in one-dimensional systems.

Publications in international refereed journals: 13 manuscripts.

- **Tbilisi State University, Physics Department, Tbilisi, Republic of Georgia**

Engineer

1980-1985

- Performed comparison of different ion sources for mass-spectrometric analyses;
- Improved mass-spectrometric method with laser-ion source for elemental analysis.

Publications in international refereed journals: 5 manuscripts.

Education

Institute for Solid State Physics, Chernogolovka, Moscow District, Russia

Trainee Researcher, Ph.D. Physics

1985-1988

Ph.D. in Physics and Mathematics (1989)

Ph.D. thesis title: "Electric Dipole Spin Resonance on Dislocations in Silicon."

Tbilisi State University, Department of Physics, Tbilisi, Republic of Georgia

Diploma in Physics

1975-1980

Diploma thesis (1980): "Laser and Spark Ion Source Mass-Spectrometry."

Invited talks at international scientific conferences and meetings:

1. **20th International Conference on Defects in Semiconductors, ICDS-20**, July 1999, Boston, USA. Title: "Dependence of electrically detected magnetic resonance signal shape from iron contaminated silicon wafers on the thermal treatment of the samples."

2. **2nd Forum on "Silicon Materials and Technology"**, November 1999, Kizarazu, Japan. Title: "Iron gettering in Cz-Si: can spin-dependent recombination give new information?"

3. **1st International Symposium on Point Defects and Nonstoichiometry, ISPN-2003**, March 2003, Sendai, Japan. Title: "ESR signature of tetra-interstitial defect in silicon."

4. **Forum on the Science and Technology of Silicon Materials 2003, November 2003, Shonan Village Center, Kanagawa, Japan. Title: "Iron vacancy pair in Si: an ESR study."**

5. **13th meeting on Extended Defects in Semiconductors (EDS-2006)**, September 2006, Halle, Germany. Title: "Rod-like defects in Silicon: signatures of distinct RLD structures detected by various measurement methods."

6. **14th International meeting on "Gettering and Defect Engineering in Semiconductors", GADEST-2011, September 2011, Loipersdorf, Austria.** Title: "Fast light-induced solid phase crystallization of nanometer thick silicon layers on quartz".

7. **27th International Conference on Defects in Semiconductors, ICDS-27**, July 2013, Bologna, Italy. Title: "PL and DLTS measurements on PV materials and solar cells".

8. **16th International meeting on "Gettering and Defect Engineering in Semiconductors", GADEST-2015, September 2015, Bad Staffelstein, Germany.** Title: "Transient spectroscopy measurements on fabricated device structures".

Organizing and chairing of conferences:

17th international conference on Gettering and Defect Engineering in Semiconductor Technology – GADEST 2017, Lopota resort, Georgia, 01-06 October 2017.

Key publications

At present the full publication list contains more than 110 items. The list of publications with titles and abstracts could be downloaded at <https://www.teimuraz.net> from the “Resume” page.

Mchedlidze T., et al., “Electric-dipole spin-resonance study on extended defects in Czochralski-grown silicon developed by thermal-treatment”, Phys. Rev. B, Vol. 50, 1511 (1994).

Mchedlidze T. and Matsumoto K., “Electrically Detected Magnetic Resonance Signal from Iron Contaminated Czochralski Silicon Crystal”, J. Appl. Phys., Vol. 83, 4042 (1998).

Mchedlidze T., Matsumoto K., and Asano E., „Electrical Activity of Defects Induced by Oxygen Precipitation in Czochralski-grown Silicon Wafers”, Jpn. J. Appl. Phys., Part 1, Vol. 38, 3426 (1999).

Mchedlidze T. and Suezawa M., “Properties of an Iron-vacancy Pair in Silicon”, Jpn. J. Appl. Phys., Part 1, 41, 7288 (2002).

Mchedlidze T. and Suesawa M., “Properties and formation mechanism of tetrainterstitial agglomerates in hydrogen-doped silicon”, Phys. Rev. B, Vol. 70, 205203 (2004).

Mchedlidze T., et al., “Electric-dipole Spin-resonance Signals Related To Extended Interstitial Agglomerates In Silicon”, J. Appl. Phys, Vol. 98, 043507 (2005).

Mchedlidze T., et al., “Influence of Electric Field on Spectral Positions of Dislocation-related Luminescence Peaks in Silicon: Stark Effect”, Appl. Phys. Lett., Vol. 91, 201113 (2007).

Mchedlidze T., et al. “Light-induced solid-to-solid phase transformation in Si nanolayers of Si-SiO₂ multiple quantum wells”, Phys. Rev. B, Vol. 77, 161304 (2008).

Mchedlidze T., et al., “Electroluminescence From P-i-n Structure Fabricated Using Crystalline Silicon on Glass Technology”, J. Appl. Phys., Vol.105, 093107 (2009).

Mchedlidze T., et al., “Light Induced Solid-phase Crystallization of Si Nanolayers In Si/SiO₂ Multiple Quantum Wells”, J. Appl. Phys., Vol. 107, 124302 (2010).

Mchedlidze T. and Kittler M., “Investigation of defect states in heavily dislocated thin silicon films”, J. Appl. Phys., Vol. 111, 053706 (2012).

Mchedlidze T., et al., “Capability of photoluminescence for characterization of multi-crystalline Silicon”, J. Appl. Phys., Vol. 111, 073504 (2012).

Mchedlidze T., et al., “Local detection of deep carrier traps in the pn-junction of silicon solar cells”, Appl. Phys. Lett., Vol. 103, 013901 (2013).

Mchedlidze T. et al., “On the capability of deep level transient spectroscopy for characterizing multi-crystalline silicon”, J. Appl. Phys., Vol. 115, 012006 (2014).

Mchedlidze T. and Weber J., “Radial distribution of iron in silicon crystals grown by Czochralski method from contaminated feedstock”, Phys. Status Solidi RRL 8, 228 (2014).

Mchedlidze T. et al., “Evolution of iron-containing defects during processing of Si solar cells”, J. Appl. Phys. Vol. 116, 245701 (2014).

Mchedlidze T. and Weber J., “Direct detection of carrier traps in Si solar cells after light-induced degradation”, Phys. Status Solidi RRL Vol. 9, 108 (2015).

Mchedlidze T. and Weber J., “Location and properties of carrier traps in mc-Si solar cells subjected to degradation at elevated temperatures”, Phys. Status Solidi A, Vol. 216, 19000142 (2019).

Mchedlidze T. and Erben E., “Characterization of Ultrathin Fully Depleted Silicon-on-Insulator Devices Using Subthreshold Slope Method,” Phys. Stat. Sol A Vol. 217, 2000625 (2020).

Guest editor for Scientific Journals:

1. Physica Status Solidi A, Vol. 214, Issue 7. Version of Record online: 6 JUL 2017 | DOI: 10.1002/pssa.201770137.
2. Physica Status Solidi C, Vol. 14, Issue 7. Special Issue: GADEST 2017 - Gettering and Defect Engineering in Semiconductor Technology: October 1st to 6th, 2017, Lopota resort, Georgia. Version of Record online: 3 JUL 2017 | DOI: 10.1002/pssc.201770107.

Expert/referee for manuscripts submitted to international journals:

- Journal of Electronic Materials (from 2017)
- Journal of Materials science (from 2013)
- Crystal Research and Technology (from 2012)
- Journal of Materials Engineering and Performance (from 2012)
- Thin Solid Films (from 2010)
- Solid State Phenomena (from 2008)
- Materials Science & Engineering B (from 2006)
- Physica Status Solidi (from 2005)
- Physical Review Letters (from 2003)
- Physical Review B (from 2000)
- Journal of Applied Physics (from 2000)

Experimental skills:

• Magneto-resonance methods:

Electron Spin Resonance (ESR), Electrically detected magnetic resonance (EDMR),
Optically detected spin resonance (ODMR), Electric-dipole spin resonance (EDSR),
Optically detected cyclotron resonance (ODCR).

• Electrical methods:

Deep Level Transient Spectroscopy (DLTS, LDLTS, ODLTS), Hall Effect, Gate oxide
integrity evaluation (TZDB, TDDB, etc.), Surface Photo Voltage (SPV), Methods for
characterization of FETs fabricated in FD SOI HKMG technology by subthreshold swing
analyses.

• Infrared and optical methods:

Fourier transform infrared spectroscopy (FTIR), Raman Spectroscopy (RS) ,
Photoluminescence (PL), Photoluminescence excitation (PLE).

• Microscopy

Transmission electron microscopy (TEM), High resolution electron microscopy (HREM),
Scanning probe microscopy (AFM), Electron beam methods (EBIC, SEM, CL).

• Mass Spectrometric methods

Spark-source mass-spectrometry, Laser-source mass-spectrometry, Secondary-ion-source
mass-spectrometry.

• Semiconductor materials treatment/handling

Deformation, irradiation, doping, annealing, Slicing, polishing, etching, Specimen
preparation for all the above analytical methods.

Computer skills:

• *Operation systems:* MSDOS, MS Windows (all), Windows NT

• *Basic research Software:* Wolfram Mathematica, Origin©, Maple™, LabView©, etc.

• *Programming languages:* BASIC, QBASIC, Visual BASIC, HP VEE, HTML

• *Experience in programming* (please visit www.teimuraz.net/soft/ for details):

Experiment management software, Data-processing software, Simulation software, Software
for calculations and graphics, image digitalization software, Software for databases, Internet
applications, web pages.

Pages in the professional social networks:

Researcher Gate: https://www.researchgate.net/profile/Teimuraz_Mchedlidze

LinkedIn : <https://www.linkedin.com/in/teimuraz-mtchedlidze-5913a396/>