

STSM REPORT

COST STSM Reference Number: COST-STSM-BM1205-33903

STSM Reference Code: COST-STSM-ECOST-STSM-BM1205-230416-075367

STSM Grantee: Dr. Andres Udal, Dept. of Computer Control, Tallinn Univ. of Technology, Tallinn (EE)

STSM title: Modeling of THz sources and detectors

Home Institution: Tallinn University of Technology, Tallinn (EE)

Host Institution: Prof. Gintaras Valušis, State research institute Center for Physical Sciences and Technology, Vilnius (LT)

STSM period: 23/04/2016 – 30/04/2016

STSM purpose:

The present short one week visit to Vilnius National Center of Physical Sciences and Technology was motivated by the following main goals:

- adjustment of trilateral Leeds-Vilnius-Tallinn cooperation research plan towards creating more effective THz detection systems for imaging and spectral analysis including biomedical applications;
- necessity to coordinate ongoing THz sources research efforts in Tallinn with the new technological opportunities offered by new technology center opened in Vilnius on March 15th 2016;
- need for agreement of the devices, material systems, frequency ranges that could be more reasonable for further joint research of THz compact sources and detectors taking into account the new Lithuanian national research project in Host laboratory;
- continuing work with joint manuscript on recent progress of resonant tunneling diodes as prospective THz compact sources.

Description of the work carried out during the STSM:

1. Getting acquainted with the new technology center in Sauletekio str. 3 (opened on March 15th 2016). Readjusting the ongoing joint research efforts in the fields of compact transmitters and detectors for THz and sub-THz frequency ranges considering the new possibilities offered by the new technology center (Terahertz Photonics Lab of Department of Optoelectronics, Prof. G.Valušis (BM1205 partner), Dr. I.Kašalynas (BM1205 partner)).
2. Analyzing with cooperation partners the recent world progress in the field of THz resonant tunneling diode THz sources, HEMT transistors, graphene transistors, semiconductor disk lasers and other sources.
3. Renewing contacts with the other laboratories of the Department of Optoelectronics of the Semiconductor Physics Institute (Dr. R.Adomavičius, Prof. A.Krotkus, Dr. R.Butkute et al.).
4. Discussing with cooperation partners the possible semiconductor heterostructure material systems (AlGaAs/GaAs, GaInAsP/Inp, AlGaN/GaN, Bi-containing compounds etc.) for further modeling efforts in Tallinn taking into account the technological facilities of new center and topics of the new projects in Vilnius.
5. Discussing work with joint publication (special Springer Series edition after TERA-MIR2015 in Izmir).
6. Adjustment of further action plan of the tripartite Vilnius-Leeds-Tallinn collaboration taking into account the possibilities and progress in RTD devices.
7. Establishing a new tripartite Tampere-Tallinn-Vilnius near neighbor information exchange for testing the possibility of a new powerful sub-THz source based on SDL lasers developed in Tampere Optoelectronics Center (Dr. E.Saarinen, Prof. M.Guina).

Description of the main results obtained:

1. The information on new possibilities of new Vilnius research center was exchanged and further activities for THz and sub-THz compact source devices R&D in cooperation between Vilnius, Tallinn, Leeds and Tampere were planned.
2. The recent world progress in development of resonant tunnel diode based RTD sources was analyzed (see Fig. 1 below).
3. The additional R&D connections were established with Tampere Optoelectronics Center for a new tripartite Vilnius-Tallinn-Tampere near neighbor cooperation team for testing the possibility of a creating a completely new powerful sub-THz source based on SDL lasers developed in Tampere.
4. The detailed actions plan of R&D of compact THz sources based on RTD and SDL structures was formulated for later usage in national project applications.
5. The work with the joint manuscript for special Springer Series edition was continued.

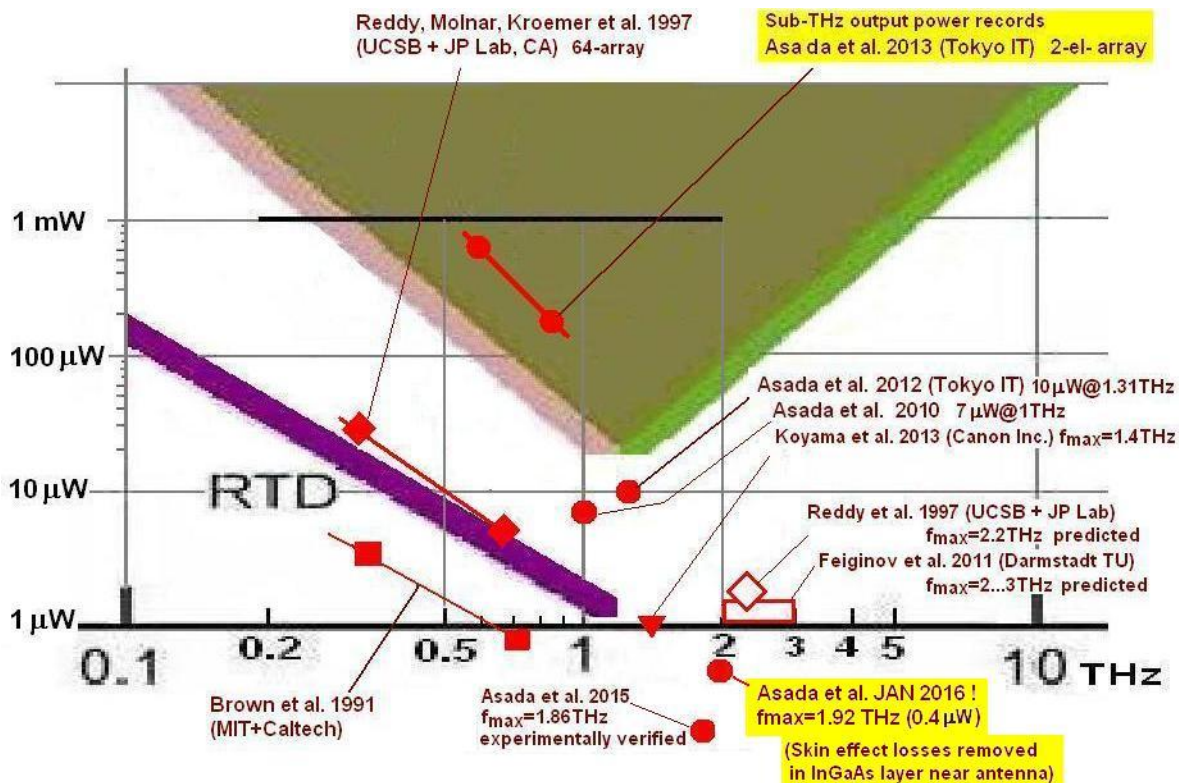


Fig.1 Overview of recent progress in development of resonant tunneling diode (RTD) based THz sources.

Mutual benefits for the Home and Host institutions: It may be estimated that this STSM improved remarkably the Home institution R&D level and somewhat also the Host institution R&D level due to intensive joint analysis and planning of new emerging solutions of compact source devices for sub-THz and THz regions. The agreed 3-year research plan prepared during the STSM may be used by Home institution for the preparation of the national project applications.

Future collaboration with the Host institution (if applicable): main goal of STSM was discussion and agreement of joint research issues of development of compact sources and/or amplification devices based on the RTD structures using as benefits the near neighbor location and new technological facilities of the new technology center in Vilnius. During the STSM the neighbor countries cooperation plans were extended to Finland Tampere University of Technology.

Foreseen journal publications or conference presentations expected to result from the STSM (if applicable): During the STSM was developed further the material presented in two last conference presentations:

- Udal A., Valusis G., Kasalynas I., Ikonic Z., & Indjin D.: The Resonant Tunneling Devices as the Promising Sources in the THz Gap Bottom for the Security Imaging and Detection. Materials of TERA-MIR 2015: NATO Advanced Research Workshop on THz Diagnostics of CBRN effects and Detection of Explosives & CBRN (Izmir, Turkey, Nov. 3-6, 2015), Book of Abstracts, 69 pages, 2015.
- Udal A., Jaanus M., Valusis G., Kasalynas I., Ikonic Z., & Indjin D.: Recent Progress in Development of the Resonant Tunneling Diode Sources for the Critical Part of THz Gap. Materials of 7th Int. Conf. on Semiconductor Mid-IR Materials and Optics SMMO2015 (Lisbon, Portugal, Mar. 21-24, 2016), Book of Abstracts, 70 pages, 2016.

It was decided that copyright issues with used graphical material need some work but then materials of those two presentations give solid basis to prepare a joint paper for “Springer Proceedings of the NATO ARW on Detection of Explosives and CBRN. NATO Science for Peace and Security. Series B: Physics and Biophysics”.

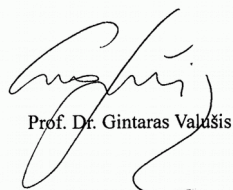
THE STSM OUTCOME FORM

STSM application number	Home institution & country	Host institution & country	BM1205 WG	Objective of the collaboration	Results of the collaboration
COST-STSM-BM1205-33903	Tallinn University of Technology, Tallinn (EE)	State research institute Center for Physical Sciences and Technology, Vilnius (LT)	WG3	Modeling of THz radiation compact sources and detectors	Formulating a joint R&D plan of new RTD and SDL based sources

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Hereby we confirm successful execution of the STSM

Director of the Center for Physical Sciences and
Technology, Vilnius, Lithuania



Prof. Dr. Gintaras Valdisis