STSM report – Vladimir Iakovlev

STSM Application number: COST-STSM-BM1205-19081.
STSM Grantee: Vladimir Iakovlev.
STSM title: Long wavelength wafer fused VCSELs for skin cancer diagnostics
Home Institution: EPFL, Lausanne, Switzerland;
Host Institution: INSA (FOTON Laboratory), Rennes, France
STSM period: 22/05/2014 – 28/05/2014

STSM purpose: Wafer fusion technology in fabrication of laser sources for skin cancer detection

Wafer fusion technology can propose generic laser structure suitable for 2 out three interconnected approaches for skin cancer identification and imaging:
***V**ertical-**C**avity **S**urface-**E**mitting **L**aser structures* , and its status, was presented in [1,2]. In more details Iakovlev have reported it at VCSEL day in his presentation on 22/05/2014. Wafer fused long wavelength VCSELs are very well positioned to enable low power consumption modules for future optical systems, especially those using advanced photonic technology. In particular, it is demonstrated that the wafer-fusion approach will contribute significantly to the progress of industrial fabrication of VCSELs emitting in the 1310 nm band for high speed WDM and other applications (for skin cancer diagnostic, for example). It is important to note that the concept of high accuracy and fast integration into silicon photonics integrated circuit have been demonstrated using wafer fused VCSELs [3,], one can expect the possibility to have the necessary electronic circuitry for extraction of the data on the same silicon "mother board".
***V**ertical-**E**xternal **C**avity **S**urface-**E**mitting Laser structures*
During STSM at INSA we have visited the lab demonstrator of a VECSEL emitting two wavelength that makes possible terahertz generation. .As demonstrated in ref [4] a continuous wave, single-frequency terahertz (THz) source emitting 1.9THz can be built based in such a structure. The THz source is based on parametric difference frequency generation within a nonlinear crystal located in an optical enhancement cavity.

Theoretical simulations [5] indicates the capability of the dual-wavelength VECSEL to efficiently generate the dual frequency far-infrared radiation by means of the intracavity nonlinear frequency conversion. Recently [6] we have reported results on the design, fabrication and characterization of electrically pumped vertical external cavity surface emitting lasers (EPVECSELs) emitting at 1470nm. We have also demonstrate 6.2mW of CW output power, which represents the highest power value reported so far for EPVECSELs in the 14XX nm and 15XX nm wavelength bands.

The key advantages of wafer fusion technology in fabrication of laser sources for skin cancer detection were exposed by Vladimir Iakovlev in his short presentation of BM1205 Action ion the last presentation of VCSEL day on May 23, as well as in his presentation on seminar at INSA on Monday, 26. As well as during lab tour and discussions on Tuesday, May 27.

Summary and future work
It was possible to identify mid- and long term "perspective" of the activities in this action with our expertise in (wafer fusion technology, that in fact at EPFL is at the state of the art level.
For VCSELs the motivation is promote the developed technology for biomedical applications. STSM in Rennes I have identified a mutual interest in exploring the potential of *VECSEL* technology for developing THz laser sources THz . It turns out that it may be a unique combination of our expertizes. In Switzerland, if a research subject identified within COST activity will be considered by the COST partners as essential for this particular cost action, one can get additional financial support, at the level of one person(mainly student) up to 2 years,

Altogether, we have the subjects for several STSM in the second year and we have initiated discussion on EU projects

[1] V.Iakovlev et all. Proc. SPIE 8639, Vertical-Cavity Surface-Emitting Lasers XVII, 863904 (March 13, 2013); doi:10.1117/12.2003759.
[2] Iakovlev , report at VCSEL day 2014
[3] http://www.fab2asm.eu/consortium/beamexpress-sa.html.
[4] Justin R. Paul et all. Narrow linewidth single-frequency terahertz source based on difference frequency generation of vertical-external-cavity source-emitting lasers in an external resonance cavity
[5] Yuri A. Morozov et all.. JST QE, VOL. 19, NO. 5,
[6] A. Caliman et all. 1OPTICS EXPRESS, June 2013 | Vol. 21, No. 11 | DOI:10.1364/OE.21.013668.