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| 14. ABSTRACT |
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RPPR Final Report

as of 25-Apr-2022

Agency Code: 21XD

Proposal Number: 77409ELRIP

Agreement Number: W911NF-21-1-0019

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Final Report for Period Beginning 15-Dec-2020 and Ending 14-Dec-2021

Title: Acquisition of Vertex 70V FTIR System for Ultra-Broad Range Infrared Spectroscopy

Begin Performance Period: 15-Dec-2020

End Performance Period: 14-Dec-2021

Report Term: 0-Other

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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees:

STEM Participants:

Major Goals: The goal of the proposal is acquisition of Vertex 70v FTIR spectroscopic system. The system is a key equipment component for the following experiments, directly related to the ongoing research projects of the Optoelectronic group. The system is used for the following experimental tasks:

- Evaluation of the energy gap of semiconductor optoelectronic materials.
- Analysis of the refractive index dispersion
- Measurements of the responsivity spectra
- Spectral measurements of terahertz (THz) emission.

Accomplishments: Vertex V70 system was purchased and installed on August 2021. The system is actively used for the long- and mid-wave infrared spectroscopy. The detailed system configuration and the related experimental work is given in the uploaded report.

Training Opportunities: Vertex V70 system enhanced The new FTIR spectroscopy system is actively used for undergraduate and graduate student training. Graduate students of the Optoelectronics Group Jhair Alzamora, Wonjae Lee, Ruiyan Liu, Jinghe Liu and Kevin Kucharczyk will actively use the system for research. The operation principles and experimental results obtained on Vertex 70V are shared with a large group of students in graduate-level courses taught by the PIs at the State University of New York at Stony Brook and on-line: ESE 519 "Semiconductor Lasers and Detectors", ESE 514 "MOS Transistor modeling" and ESE 525 "Modern Sensors". One of the PIs (Sergey Suchalkin) is actively working with K12 students in the frame of the Stony Brook University affiliated enrichment program School Nova at Stony Brook and Regeneron science competition.

Results Dissemination: The experimental data obtained with Vertex 70V system were summarized in the research paper "Semiconductor interferometer for long wavelength light modulation" by S.Suchalkin, B. Laykhtman, G. Belenky, S. P. Svensson, G. Kipshidze, J. Alzamora, which is currently under review in "Micro- and Nanostructures".

Honors and Awards: Nothing to Report

RPPR Final Report
as of 25-Apr-2022

Protocol Activity Status:

Technology Transfer: Nothing to Report

Partners

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I certify that the information in the report is complete and accurate:

Signature: Sergey Suchalkin

Signature Date: 4/19/22 2:31PM

**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
STATE UNIVERSITY OF NEW YORK AT STONY BROOK**

**ACQUISITION OF VERTEX 70V FTIR SYSTEM FOR ULTRA-BROAD
RANGE INFRARED SPECTROSCOPY.**

Report

Sergey Suchalkin and Gregory Belenky

Department of Electrical and Computer Engineering, State University of New York at Stony Brook

The goal of the proposal is acquisition of Vertex 70v FTIR spectroscopic system. The system is a key equipment component for the following experiments, directly related to the ongoing research projects of the Optoelectronic group. The system is used for the following experimental tasks:

- **Evaluation of the energy gap of semiconductor optoelectronic materials.**
- **Analysis of the refractive index dispersion**
- **Measurements of the responsivity spectra**
- **Spectral measurements of terahertz (THz) emission.**

The system was purchased and installed on August 2021 (Figure 1a). The detailed system configuration is given below:

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|---|---------------|
| 1. Infrared Fourier Vacuum Spectrometer VERTEX 70v, 1PC | \$ 100,807.20 |
| 2. External Measurement Channels: | |
| 2a. A171/8V-R adaptor, 1PC | \$ 3,281.85 |
| 2b. W162/8V flange, 3 PC | \$ 789.75 |
| 3. Spectral Range Extension: | |
| 3a. W201/ZV-3, 1 PC | \$ 9,396.00 |
| 4. Detectors | |
| 4a. D316/B, MCT, liquid N2 cooled, 1 PC | \$ 10,762.20 |
| 4b. E550/A, electronic adaptation, 1 PC | \$ 1,143.45 |
| 4c. E556/AU, addition for an analog signal output, 1 PC | \$ 1,318.95 |
| 4d. D211/Z, Si-bolometer, liquid He cooled, 1 PC | \$ 34,484.40 |
| 5. Beamsplitters | |

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| 5a. S239V, 1 PC | \$ 3,215.70 |
| 6. Alternative Detector Positions | |
| 6a. W105/Z2, unit for selecting external detector, 1 PC | \$ 3,712.50 |
| 6b. W211/8V, external detector mount | \$ 1,668.60 |
| 7. Step/Scan Options | |
| 7a. S510/Z, Step-scan option for step- and slow scanner movement, 1 PC | \$, 6,991.65 |
| 8. Emission Ports | |
| 8a. W121/Z-EP, changer for external parallel radiation, 1 PC | \$ 4,630.50 |
| 9. Windows | |
| 9a. F131-5, KBr window, 1 PC | \$ 284.85 |
| 9b. F131-9, Polyethylene window, 2 PC | \$ 210.60 |
| 10. OPUS Spectroscopy Software | |
| 10a. O/IR8+, integrated spectroscopy software package, 1 PC | |
| 10b. O/3D-N, OPUS 3D software package, 1 PC | \$1,738.80 |
| 11. Data Systems | |
| 11a. CS81/27+, high-performance data system, 1 PC | \$ 2,683.80 |
| 12. Additional components | |
| 12a. I24217, Connecting Signal Cable for ext. /B-Detector, 1 PC | \$ 241.65 |
| 12b. I27757, CABLE FLK 25P85 DDC-ID, 1 PC | \$ 82.35 |
| Net price | \$ 187,444.80 |
| Educational discount, 10% | -\$ 18,744.48 |
| Net price incl. discount | \$ 168,700.32 |

Vertex 70V spectroscopic system was used for experimental work related to U.S. Army Research Office grant no. W911NF2010109. The effect of electric field on the transmission of multi quantum well structure has been studied. Vertex 70V system made it possible to measure optical transmission in a wide spectral range with a fraction of percent accuracy. An example of the experimental data is shown in Figure 1b.

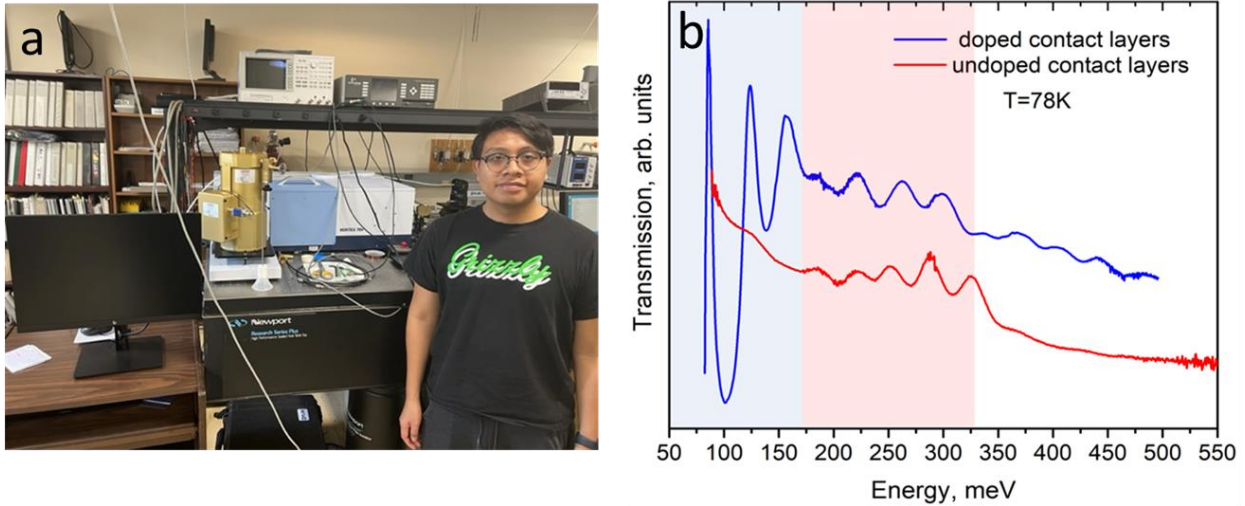


Figure 1. Graduate student Jhair Alzamora with Vertex 70V system installed in the Optoelectronics Lab of Stony Brook University (a). Optical transmission of multi quantum well structures with doped and undoped contact layers. (b).

The experimental data obtained with Vertex 70V system were summarized in the research paper “Semiconductor interferometer for long wavelength light modulation” by S.Suchalkin, B. Laykhtman, G. Belenky, S. P. Svensson, G. Kipshidze, J. Alzamora, which is currently under review in “Micro- and Nanostructures”. Besides U.S. Army Research Office grant no. W911NF2010109, the system was used for projects sponsored by NSF and Center of Semiconductor Materials and Device Modeling.

IMPACT ON RESEARCH AND TEACHING

Vertex V70 system enhanced The new FTIR spectroscopy system is actively used for undergraduate and graduate student training. Graduate students of the Optoelectronics Group Jhair Alzamora, Wonjae Lee, Ruiyan Liu, Jinghe Liu and Kevin Kucharczyk will actively use the system for research. The operation principles and experimental results obtained on Vertex 70V are shared with a large group of students in graduate-level courses taught by the PIs at the State University of New York at Stony Brook and on-line: ESE 519 “Semiconductor Lasers and Detectors”, ESE 514 “MOS Transistor modeling” and ESE 525 “Modern Sensors”. One of the PIs (Sergey Suchalkin) is actively working with K12 students in the frame of the Stony Brook University affiliated enrichment program School Nova at Stony Brook and Regeneron science competition.