NEW YORK STATE PHOTONICS BOARD OF OFFICERS

MEETING AGENDA

June 22, 2016
2:00 – 3:00 PM
Eastman Business Park
200 Ridge Road West
Rochester, NY 14615

PUBLIC SESSION

2:00 PM	**Chair Welcome and Introductions** John Maggiore, New York State Director of Policy Board Officers
2:10 PM	**Item No. 1 for Approval- Approval of Minutes** Chair
2:15 PM	**AIM Photonics Funding Request (Presentation)** Dr. Michael Liehr, SUNY Polytechnic Institute
2:30 PM	**Item No. 2 for Approval – Approval of AIM Photonics Expense Budget** Chair
2:40 PM	**General Discussion** Board Officers
2:50 PM	**Next Steps** Chair
3:00 PM	**Adjourn**

Next Meeting: TBD

Item No. 1

NYS Photonics Board of Officers Meeting Minutes
January 20, 2016, 11:00 AM to Noon
Eastman Business Park
200 West Ridge Road
Rochester, NY 14615

Board Members Present: Andrew Kennedy, Anne Kress, Ryne Raffaele, Rob Clark, Paul Tolley, Alexander Cartwright and Ronald Goldblatt (via Conference Call)

Andrew Kennedy welcomed everyone and gave introductions of the NYS Photonics Board Officers.

Mr. Kennedy then gave a short history on AIM Photonics and the $250M award for Rochester.

Mr. Kennedy then acknowledged Congresswoman Louise Slaughter, County Executive Cheryl Dinolfo, Ex-Lt. Governor Bob Duffy, President of University of Rochester Joel Seligman, the Head of Integrated Photonics Michael Liehr, Neil Supola from the Department of Defense.

The Board Members introduced themselves and Mr. Kennedy thanked Dolores Kruchten of Eastman Business Park for hosting this meeting.

The first order of business for the Board has been to develop a Charge for the Board. NYS Photonics mission:

"*The New York State Photonics Board of Officers will oversee and implement the investment of State funds committed to support the efforts of the American Institute for Manufacturing Integrated Photonics (AIM Photonics).*

> *State funds will be administered in accordance with the terms identified in AIM Photonics application, which was submitted by a consortium of organizations and selected by the Department of Defense to be the Integrated Photonics Institute for Manufacturing Innovation (IP-IMI), and should be focused on the economic development of the photonics industry, particularly in Rochester as identified by Governor Cuomo."*

Anne Kress made a motion to approve the charge. Ryne Raffaelle seconded the motion. A vote was taken and the motion was passed with a full consensus.

Mark Peterson gave an update on the Finger Lakes Regional Economic Development Council's Strategic Plan. Mr. Peterson recognized the work of the Regional Economic Development Council in this region is the result of the work of the entire community. There were 20 work groups with 450 volunteers spent countless hours helping to develop this plan. He also recognized the dedicated leadership of our co-chairs, Danny Wegman and Joel Seligman.

The URI goals given to every Regional Council:

1. Grow jobs.
2. Increase regional wealth.
3. Drive private investment.

We chose to add a fourth goal for our region: 4. Reduce poverty.

Mr. Peterson also gave a brief overview of the URI Strategic Framework and pillars.

Mr. Peterson then gave a brief history of why Optics, Photonics and Imaging (OPI) and why it is important to our region and why it was chosen as part of our framework. 10% of jobs in our region are in the OPI industry. And we feel this will lead us to prosperity in our region.

URI application process is open and we are already looking at the projects being submitted.

Mr. Kennedy introduced Dr. Michael Liehr who gave an update on AIM Photonics. Dr. Liehr explained what integrated photonics is about. This is a DOD award and it is for the national center and will be used to build an infrastructure throughout the US so we will be able to support the US industry. We are actually behind as there are facilities in Japan and Singapore that are ahead of us.

Second point, we were challenged to get this together in 6 months when it usually takes about 14 months to put this together. We do have a contract that people can sign. We did have to rush a few steps and we are going forward and we are going to put more effort into where we are going. We took the first set of projects and we are in the process of awarding the first round of projects.

Mr. Kennedy gave a review of NYS funding commitments. NYS has committed $250 million to support AIM Photonics, leveraging the $110 million DOD award and $250 million in private support for a total investment of more than $600 million. The funds will be focused on economic development, workforce development and academic research.

$50 million over 5 years to support operations, staff and research & development.
$200 million to investment here in the Rochester area to build and equip the facilities, and business operations at the Legacy tower, Research and Development in the Sibley Building, investments in our academic facilities in the region in SUNY Poly Canal Ponds, University of Rochester, Rochester Institute of Technology.

In the next four to six weeks a more formalized budget will be presented at the next Board meeting and made public on how the $250 million will be spent.

Mr. Kennedy then stated that a designation of a fiscal agent for the NYS funds for integrated photonics. As the Regional Council, URI funds go through Empire State Development; he would recommend that Empire State Development be the designated fiscal agent.

Ms. Kress made a motion to make Empire State Development the Fiscal Agent for the NYS funds. Mr. Tolley seconded the motion. The motion was voted on and passed with a full consensus.

A motion to adjourn this meeting was made by Dr. Kress and Mr. Raffeale seconded the motion. The motion was voted on and passed with a full consensus.

Meeting Adjourned.

Item No. 2

AIM Photonics Expense Budget
Integrated Photonics Institute for Manufacturing Innovation
June 22, 2016

Attached is the expense budget for consideration by the New York State Photonics Board of Officers ("State Board") along with two attachments.

The expense budget proposes certain expenses under the American Institute for Manufacturing Integrated Photonics ("AIM Photonics") program centered in Rochester, New York. This budget covers a period that will end on or about April 1, 2017. It proposes the first tranche of state expenditure of $106 million of the $250 million that New York State committed to the project. The total budget is $612,877,000 with the federal government committing $110 million and the state and other parties including private sector companies providing the balance of $502,877,000.

This budget displays how New York State's $106 million will be spent. The budget calls for $11 million to be spent on operating and maintenance costs and $95 million to be spent on capital. Overall, the capital budget is front end loaded to allow for the purchase and installation of equipment and tools that will be used for many years.

Also attached as Attachment 1 is a Description of the Semiconductor/ Photonics Industry and as Attachment 2 a description of the AIM Photonics Operations in Rochester including a description of equipment needs and planned education and workforce development support.

AIM Photonics Expense Budget
June 22, 2016

Expense Budget for AIM Photonics Operations

The overall commitment of the State of New York is for $250M over 5 years, with $50M for operation ($10M / year) and $200M for capital investments. The capital investments are front-end loaded to allow the establishment of the Institute's Testing, Assembly and Packaging ("TAP") facility early in the life cycle to enable sustainability of AIM through industry relationship and commercial engagement with enough lead time to revenue generation.

Funding Request Item	[$M]	
Capital		
Rochester Photonics Assembly Equipment and Install:	$	7
Rochester High Speed Optical Test Equipment and Install:	$	13
Facility Upgrades for above:	$	11
Facility Upgrades for Optical and Fiber Package:	$	17
Optical and Fiber Package equipment	$	32
Suggest license for Rochester process to be installed:	$	10
Wafer Test and Laser Attach Equipment	$	5
TOTAL CAPITAL	**$**	**95**
Operations and Maintenance		
Education and Workforce Development (UR, RIT, MCC):	$	1
R&D Project State Match for RIT/UR:	$	2
AIM Operating Wafer, Test Package, Assembly Budget	$	7
AIM Start-up Fund (2015)	$	1
TOTAL O&M	**$**	**11**

AIM Photonics Expense Budget
Attachment 1
Description of Semiconductor/ Photonics Industry
June 22, 2016

AIM Photonics – Building Tomorrow's Technology to Attract Industry

Semiconductors have changed the way we work, interact and play over the course of the last 40 years. The shrinking of the features that make up the individual elements at the core of a semiconductor device or chip – switches called transistors, and tiny wires connecting the switches – have led to ever increasing complexity of the tasks a semiconductor can perform at rapidly decreasing cost. The semiconductor industry has enjoyed decades of ever increasing levels of integration and miniaturization, often referred to as "Moore's Law", which now implies an unrelenting pace of cost reduction. In the process, the semiconductor industry has developed business models that substantially contributed to productivity, such as the fab-less companies, the dedicated foundries, independent electronic design automation (EDA) companies that offer design libraries and pre-qualified blocks of intellectual property, and equipment and material suppliers – a large disaggregated but mutually interdependent fabric of enterprises. Moore's Law has allowed the emergence of the internet, the PC and the laptop, as well as the cell phone and myriads of other ubiquitous products that have transformed our world. . The semiconductor industry is a $300B+ industry employing almost 400,000 in the U.S. alone, with almost 200,000 of these jobs in the manufacturing sector [ref. SIA 2015].

The use of semiconductor elements that make up a semiconductor chip, transistors and wires, require the use of electrical currents to operate these devices. Increasing speed and complexity led to increasing power consumption which limits the further miniaturization of these devices. In contrast to electrical current that creates heat, light propagates through fibers with much less loss due to heat, and allows signals to be transmitted at higher speed. Fibers weigh much less than copper cables, a significant advantage in weight constrained applications (e.g., jets). In the past decade, engineers and scientists have started to merge the elements of optical systems with the tools and techniques enabled by the semiconductor revolution. Integrated photonics attempts to replicate the semiconductor business model in the optical space, miniaturizing optical elements and fabricate them with standard wafer-level processing tools for cost reduction.

The remaining assembly steps to build a finished product, such as fiber attach to a packaged part, need to involve dramatic redesign to leverage microelectronics assembly tools rather than custom robotics that just emulate what a person does. Packaging and assembly costs today are the most significant contributors (about 70%) to an integrated photonic product. The high cost of test, assembly and packaging (TAP) is the viewed as the single most impactful obstacle to making integrated photonic products ubiquitous.

At present, there exists no central integrated photonics TAP facility in the U.S. in support of industry or federal entities. The American Institute for Manufacturing of integrated Photonics (AIM Photonics) proposes to establish such a central, open access facility in Rochester, NY, as part of the NY State investment.

After completion of the TAP facility, AIM Photonics will rest on two key pillars – semiconductor fabrication capability and know-how in Albany, and test, assembly and photonics packaging in Rochester – for a complete manufacturing ecosystem solution based in NY. It is imperative that the two facilities cooperate closely, as they constitute two key stages of an integrated supply chain.

The presence of a TAP facility in Rochester, NY, is expected to be a magnet for industry, attracting a host of industry segment players:

- Corporate end users (examples: General Electric, Corning, Hewlett Packard Enterprise, Cisco) to explore prototype development using the state of the art tool set.
- Equipment suppliers (examples: Keysight, Ficontec) who are welcome to establish equipment evaluation programs and take advantage of the supply of state of the art prototypes to fine tune their offering. These companies are encouraged to establish a production base and/or application lab in the area.
- Foundries (examples: Globalfoundries, ON Semi, IBM Packaging) wishing to establish joint development programs with AIM to explore high risk, high reward offerings.
- Packaging service providers (examples: Promex, Samtec) are encouraged to evaluate equipment for suitability to procure for their manufacturing operation and to collectively investigate standards that facility industry growth.
- Component providers (examples: Corning, Lasermax) to have industry users evaluate their component in the context of a state of the art integrated photonic assembly.
- Start-ups who can access a very capital intensive infrastructure via low entry barrier vehicles, such as multi-project wafers and incubator space.

Core Application Spaces

Applications of integrated photonics will start with the current emerging use in data centers, where communication between server racks already has migrated to fiber transmission. This transition will proceed to shorter and shorter distances, replacing copper cables with fibers. In addition, the scope of AIM Photonics will span several additional industry segments with the most prominent and near term commercial segment of analog/RF, array, and sensor applications that are expected to mature at a later time.

The impact of integrated photonics over the next 20 years will reach across all spectrums from defense, space, and Datacom, to automotive driverless vehicles, advanced drone applications, to consumer applications in home and user. Lidar for automotive and body sensing, to holographic user interfaces are all current disruptive photonic technologies which will change the way people commute, interface, and communicate in the near futures.

The greatest challenge of all these technologies, is taking these technologies from proof of concept to commercialization. The institute will focus majority of its resources to develop infrastructure in electronic-photonic design automation, multi project wafer platform offering, as well as test, assembly, and packaging. This will allow a maturation of manufacturing around the key technologies to enable quick turn photonic development through proof of concept, validation, qualification, and commercialization under one national institute, ensuring manufacturing readiness for years to come.

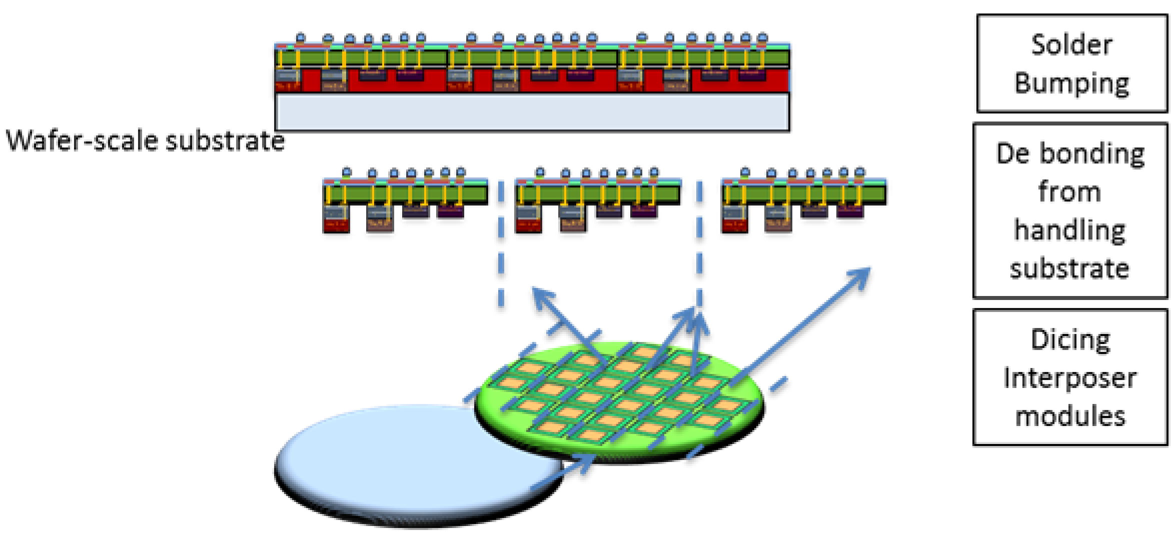
AIM Photonics Expense Budget
Attachment 2
AIM Photonics Operations in Rochester including Description of Equipment Needs and Education and Workforce Development Support
June 22, 2016

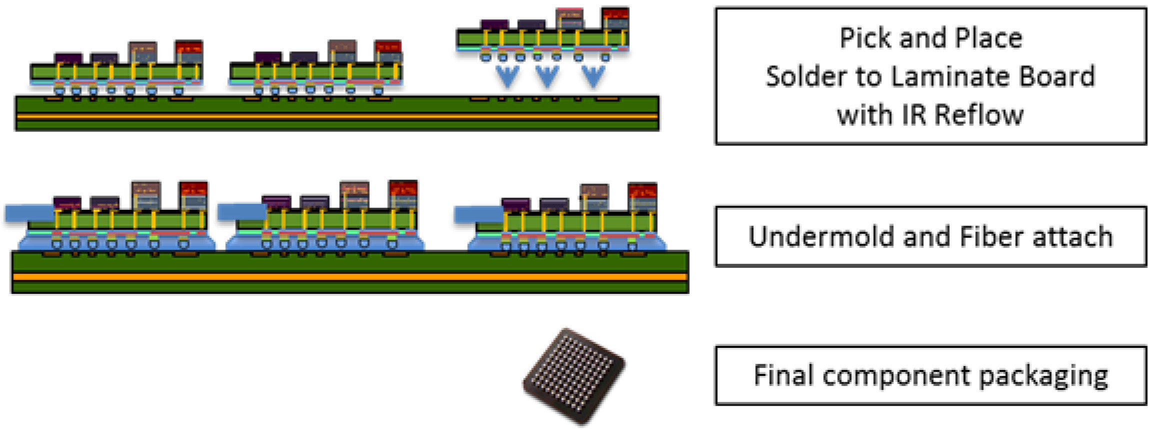
Planned Rochester TAP Equipment Needs and Capabilities

To establish the Rochester TAP facility, AIM Photonics requests a FY 2016/2017 budget of $106M, of which $11M is for operational expenses and $95M are for capital projects.

Specific investments will go to establish the elements of TAP: High-speed Optical Test, Optical die-based Assembly and packaging of high-speed components. A brief description of the technical capabilities and required infrastructure follows:

Once having completed wafer processing in the Albany line, wafers will be sent to Rochester. The technical capabilities planned for Rochester involve backside metallization (a.k.a. chip bumping) to connect to an organic substrate; interposers (carriers involving stacked wafers) will be detached from their carrier; wafers will be diced into chips and soldered to the substrate. In addition to the process equipment, metrology equipment will be purchased to characterize the quality of the solder and the joints and to properly clean the parts. These tools require a cleanroom environment.





The Optical Packaging and Assembly equipment allows to provide protective material in between the chip and the substrate, attach a fiber reliably and cheaply and to complete the package with a plastic or metallic housing with electrical leads and a fiber connection. Fast and inexpensive fiber attach to a die is a key focus area of equipment and process development under AIM. A number of high-accuracy die handling stages are proposed to develop such schemes. Some, but not all of the equipment requires a cleanroom wherever dust contamination might interfere with high accuracy placement or requires the joining of clean, smooth surfaces. A significant amount of metrology equipment, including failure analysis equipment is required at this stage, as it involves the joining of expensive subassemblies that have taken months to manufacture.

The final stage involves testing of the finished product, but the equipment can and will also be used to test at any stage in the assembly process to assure material and product quality during the manufacturing process. The parts on which we intend to perform research and development are very high speed parts (400 Gb/s transceivers) that require very sensitive electrical test equipment, as well as commercial-grade optical test benches. The environment for these tools can be a lab environment to contain cost of facilities.

To operate the combination of package, assembly and test requires a floor control system for parts logistics and customer IP protection, plus die marking equipment for traceability.

To effectively operate the facility requires the development of a base process which involves engineering resource and a minimum of 2-3 years' time. AIM Photonics proposes to invest in licensing an existing process for optical assembly and packing which would accelerate the bring-up of the TAP facility to full operation by 2 years or more.

Support of Industry, and an Education and Workforce Focus

In addition to ensuring a solid manufacturing platform and center, the institute has also established AIM Academy, an organization under AIM that fosters education and workforce development. This also is significant to ensure not only the manufacturing readiness to build the technology, but also the work force to support it. Efforts at local universities, such as RIT and the University of Rochester, will provide the educational material (courses, MOOCs) not only in the care areas of manufacturing, but also for another critical element of the integrated supply chain: electronic design automation. Given strength at the U of R in this field, we expect a strong demand for training of industry personnel in the use of design aides optimized for the AIM Photonics manufacturing and process base. The Rochester Community College (MCC) will play a significant role in training additional members of the workforce. We have also established connections with local industry (e.g., ON Semi) that promise to provide highly skilled personnel for On the Job Training (OJT) programs and internships.

Investments in the local university infrastructure will be focused on the most conducive learning environment, also to assure that, e.g., equipment training program do not negatively interfere with the operation of the central R&D facility. In the interest of optimized the benefits of co-location, AIM intends to move all non-educational project equipment into the central facility.

Generic TAP Tool List

Equipment Set Name - Test
Chip Inspection System
Electronic Chip Tester
3-axis motorized translational stages 12mm
3-axis motorized translational stages 25mm
3-axis motorized translational stages 50mm
Active Fiber Attach
Analog Signal Generator
Aqueous Board Cleaner
Arbitrary Waveform Generator
Atmospheric Plasma
Booster Amplifier
Characterization and Alignment
Chassis for Arbitrary Waveform Generator
Confocal Scanning Acoustic Microscope
Device Parameter Analyzer
Digital Microscope
Drying oven
High accuracy Comparator
High-Definition Oscilloscope
High-Performance BERT
In-line amplifier
In-Line Tester
Inspection Microscope
Interferometer
IR Microscope
Lightwave Component Analyzer
Lightwave Multimeter
Lightwave Probe LWP
Microscope for Epi-Fluorescence XY Platform
Motorized Micromanipulator Assembly
Motorized Physiology Stage
Optical Attenuator
Optical Backscatter Reflectometer
Optical modulators - multiple
Optical Preamplifier
Optical Spectrum Analyzer
Oscilloscope
Photodetector 50 GHz
Photodetector   70 GHz
Photodetector   100 GHz
Pick & Place
Reflectance Spectrometer

Refrigerator
RFIC & Wedge Probes
Scientific camera
Signal Analyzer
Spectroscopic Ellipsometer
Stereo Microscope
Tunable Laser - multiple
Tunable Laser with power meter
Vacuum Tips
X-ray Fluorescence System
Scanning Electron Microscope
Ultrasonic Bath
Automated Die and Bond Testing
Datacom and Telecom Receivers
Digital Image Correlation
Digital Scanning Calorimetry
Extender Modules 12
Extender Modules 8
LN Modulator
Microwave Network Analyzer
Multi-Port Data Generator/Data Analyzer
Optical Amplifier
Optical Modulation Analyzer
Optical Modulation Analyzer MCS
Optical Modulation Analyzer QAM
Optical Transmitter
Optical Vector Analyzer
Oscilloscope
Photodetector
PLC Connections
Power and Energy Meter Console
Precise Motion Systems
RF Signal Generator
Shear & Pull Tester
Shear Tester
Solderability Bond Test
Stereo Microscope
Stress Screening System
Synchronization Hub - multiple
Tunable Laser
UV-VIS Spectrometer
Waveform Generator (AWG)
X-ray Scanning Tomography System

Equipment Set Name - Assembly
Cure Oven
Desiccant Dry Cabinets
ESD Stations
Fiber Cleavers - Laser
Freezers
Passive Fiber Attach
Sub-zero freezer
Hand soldering stations
3D Inspection
Adhesive / Underfill Dispense
Bake Oven
Ball Attach Tool
Coat/Dev Track
Flip Chip Bonder
Pick & Place
Molded Underfill
Post-mold Cleaner
Silicon Thickness Measurement
Wafer Bonder
Wafer Debonder
Wire Bonder - Precision
Overmold
Dispensing, Assembling, Marking and Packaging
Probe Station
Wire Bonder - Au, Al

Equipment Set Name - Packaging
SMT Line (loader, solder stencil printer, solder AOI, P&P, reflow oven, AOI, unloader, installation)
Electrochemical Deposition - (ECD or Plating) with Analysis, Sn, Au, SnAg, Cu, Ni, AuSn
Exposure
Flux Cleaner
Ionograph
Laser Die Bonder
Laser Scribe
Overlay
Package Saw
Photoresist Stripper
Physical Vapor Deposition (PVD or Sputtering)
Plasma surface treatment machine
Plasma-Enhanced Chemical Vapor Deposition (PECVD)
Reflow Oven
Wafer Saw
Wet Etch
Dicing Saw 300mm
Floor Management Software
UV Exposure System
Wafer Dicing Tape Frame Applicator
Wafer Ink System

June 22, 2016

NEW YORK STATE PHOTONICS BOARD OF OFFICERS – Approval of AIM Photonics Expense Budget

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BE IT RESOLVED, that upon the basis of the materials presented at this meeting, the New York State Photonics Board of Officers (the “Board”) hereby approves the AIM Photonics expense budget; and be it further

RESOLVED, that the Board recommends and approves that copies of the approved AIM Photonics expense budget be provided to the AIM Photonics Leadership Council and all other interested parties.

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