

*Bring Changes in
Full Spectrum*

Webinar with
SEMI MSIG

February 21, 2024

A person in a dark suit and tie is shown from the chest down, holding a glowing blue sphere with both hands. The sphere has a golden border and the text "SPU SYSTEM" in bold, orange and green letters. The background is a dark, blue-tinted image of a city skyline at night, with lights reflecting on water in the foreground.

**SpectroChip: an Optical System-on-Chip
Enabling Ultra-Portable Devices for Broad
Industrial Sensing Applications**

Safe Harbor Statement

This presentation contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, encompassing information related to the company's groundbreaking SpectroChip technology, strategic goals, priorities, potential applications, current pipelines, development milestones, new product launches and innovations, estimated product development costs, potential partnerships, market opportunities, anticipated revenue and financial outlook, competitive analysis, financial condition, and considerations, as well as intentions and expectations concerning future plans and trends. These statements are based on the current beliefs of the Company's management, along with assumptions made by, and information available to, management. Terms such as "anticipate," "plan," "estimate," "expect," "intend," "may," "will," "should," "would," "forecast," "project," "likely," "believe," "guidance," "outlook," and similar expressions, as they relate to the company, are employed to identify forward-looking statements.

Forward-looking statements involve inherent risks and uncertainties and are not guarantees of future performance. Actual results, performance, or achievements of the Company may materially differ from those anticipated or implied in any forward-looking statement due to various factors, including, but not limited to: the Company's ability to safeguard its intellectual property rights; anticipated capital requirements, including cash runway and plans for future equity financings; dependence on additional financing for operations and product development, with potential risks of restricting operations or relinquishing rights to technologies or product candidates; limited operating history making it challenging to evaluate prospects, business plans, or the likelihood of successful plan implementation; uncertainties and challenges in achieving financial projections and goals; potential inability to increase product adoption through direct sales efforts or partnerships; incurred losses since inception with anticipated continued losses; inaccurate market opportunity estimates; competition challenges; cybersecurity threats affecting data security and customer privacy; dependencies on key partners; talent acquisition and retention challenges; potential disruptions and impacts from geopolitical uncertainties, currency exchange rates, and natural disasters.

Forward-looking statements are made as of this presentation's date, and the Company, except as required by applicable law, undertakes no obligation to revise or update any forward-looking statement or make any other forward-looking statements, whether due to new information, future events, or otherwise.

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Information provided by SPU System, Inc. is not intended as financial, investment, or legal advice. Investment decisions based on this information should be made after careful consideration and consultation with professional advisors.



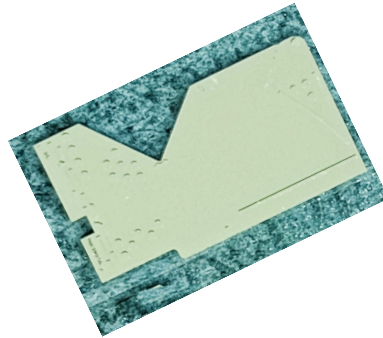
Brief Bio of Dr. Kevin Cheng-Hao Ko

Professor at National Taiwan University of Science and Technology

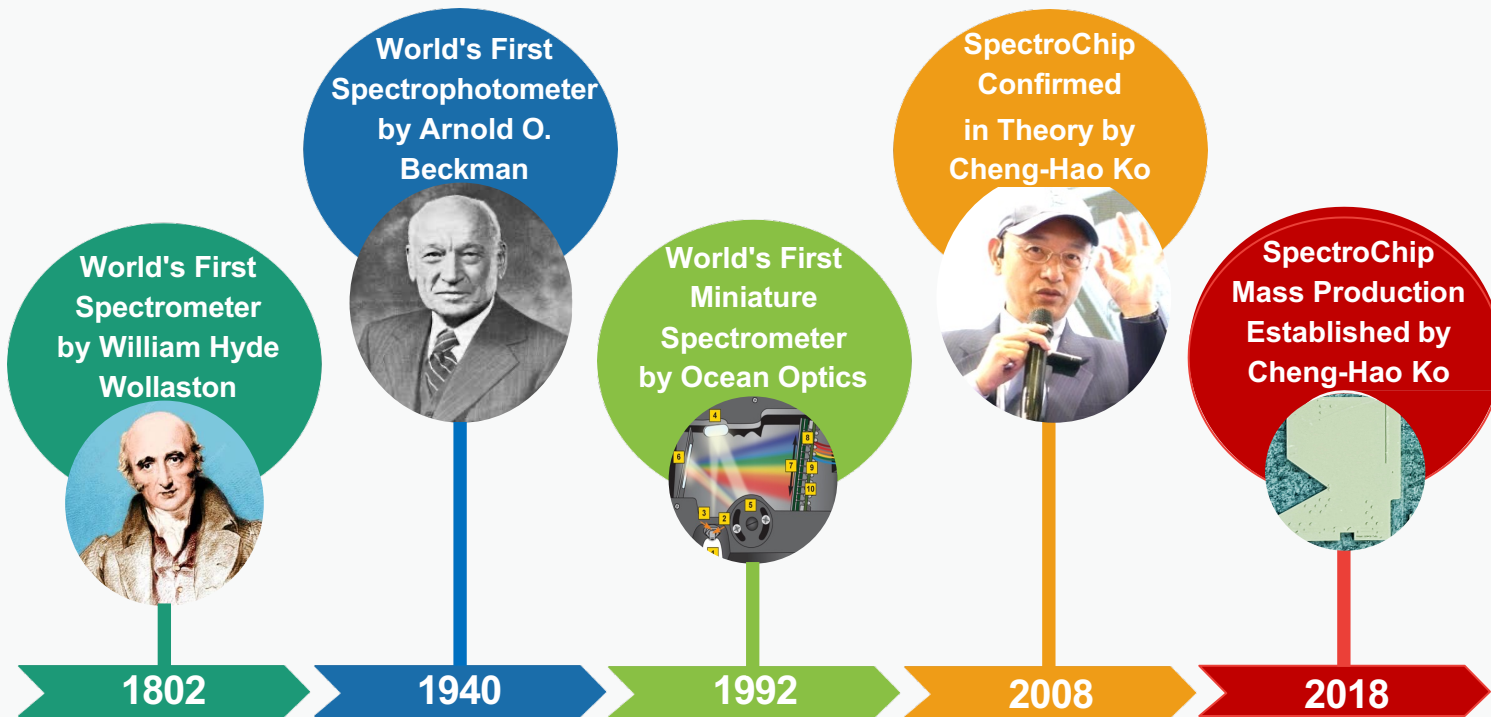
- Chairman of SpectroChip Inc. and SPU System Inc.
- SpectroChip fabrication technology development and production (2002-current)
- Involved in the development of Nanometer Resolution X-ray Tomography Project in NSRRC (2003-2007)
- Project leader, Scanning Photoemission Electron Microscope End-Station using U5 Undulator Beamline in NSRRC (1995-1999)
- Physics PhD, SUNY at Stony Brook, advisor: Janos Kirz
Development of a Scanning Photoemission Electron Microscope (SPEM) in the National Synchrotron Light Source (NSLS) in Brookhaven National Laboratory (BNL). (1991-1995)



Introduction to SpectroChip Core Technology



SpectroChip Technology - A Historical Breakthrough



Problems in Miniaturizing Spectrometers/Spectral Sensors



Performance Reduction in Miniaturization

- Sacrifice Sensitivity
- Sacrifice Resolution
- No chip-based Spectrometer in UV/Vis range

Scaling Difficulty and Cost Barriers

- Higher resolution translated into high cost
- No wafer-based mass production

Compromised long-term Stability & Reliability

- Alignment & Maintenance required.
- Sensitive to other environmental factors

Complexity in Integration & Expanding Applications

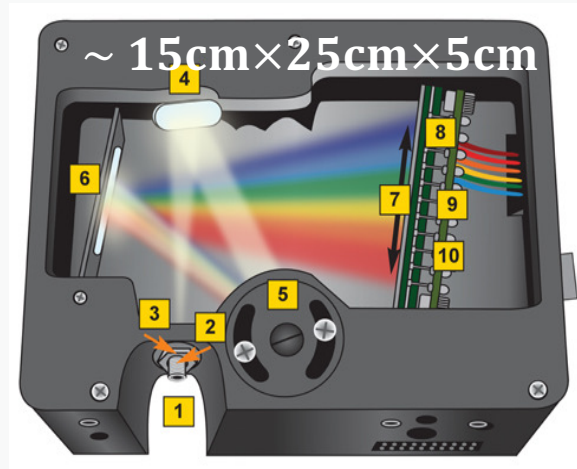
- Compatibility and integration challenge among optical sensors with other sensors
- Challenges in large spectral data collection and analysis

Long Time Challenge in Science and Technology:

Can Embedded-Spectrometer be Achieved?

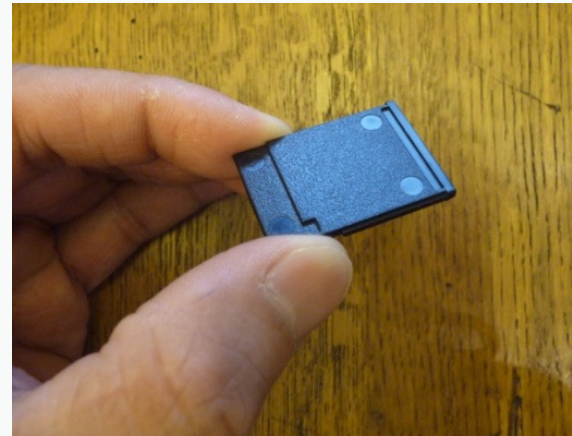
Current Spectrometer

Laboratory Usage



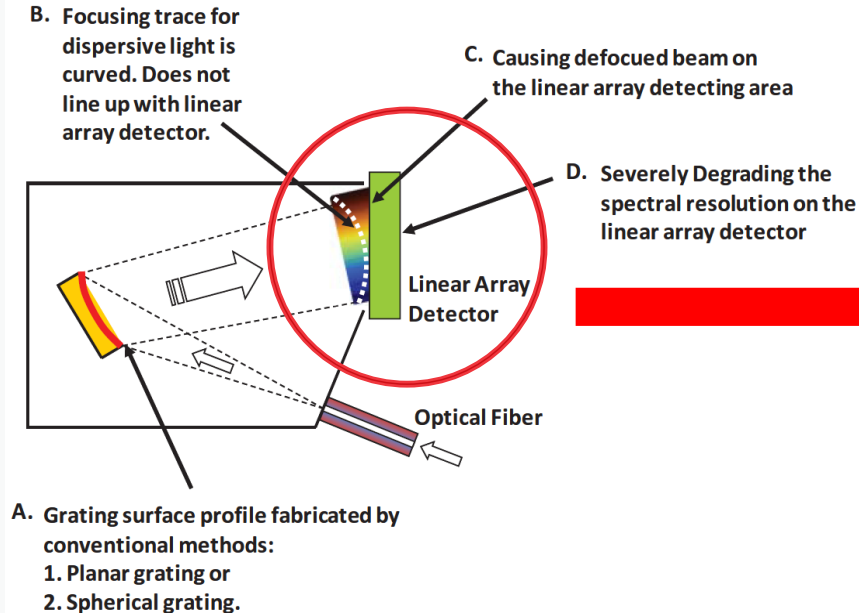
A Spectrometer-on-Chip

in SD card size

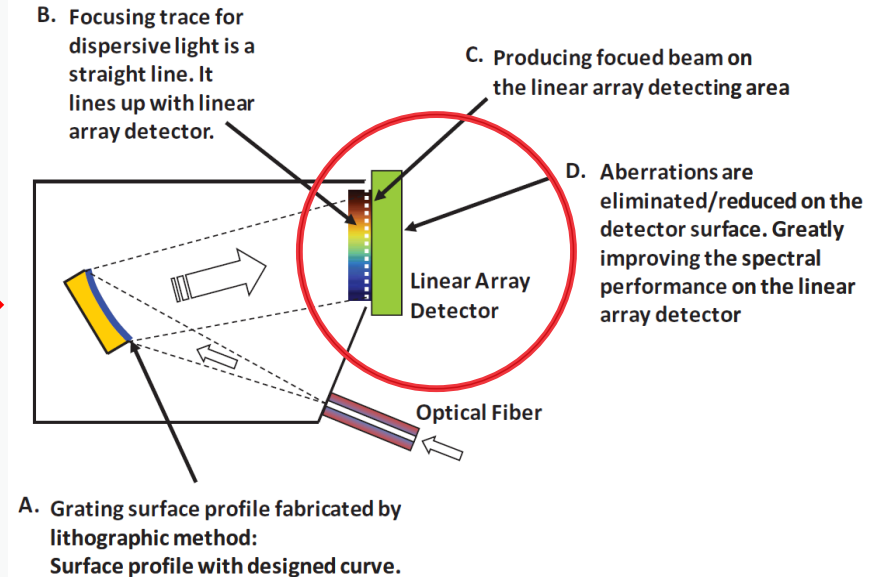


Optical Path Needs to be Simplified

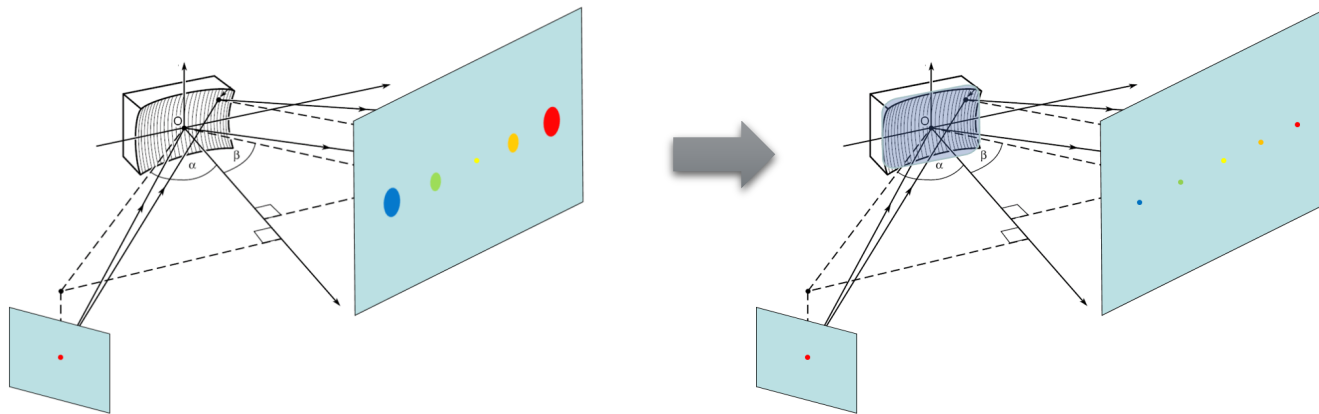
De-focused



Flat Field Focusing

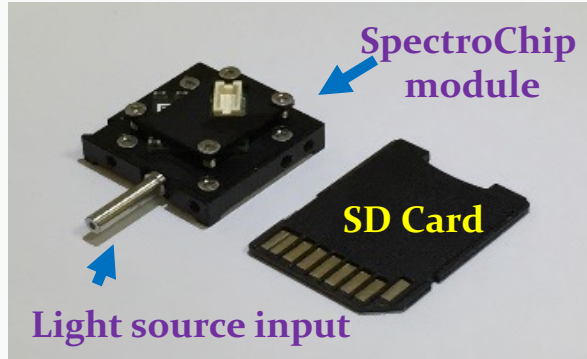


Flat Field Focusing Aberration Reduction Procedure (FF-ARP)



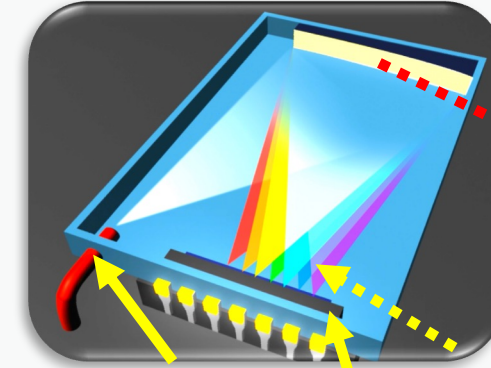
SpectroChip established flat field focusing

Fabrication Requirements



Optical System-on-Chip

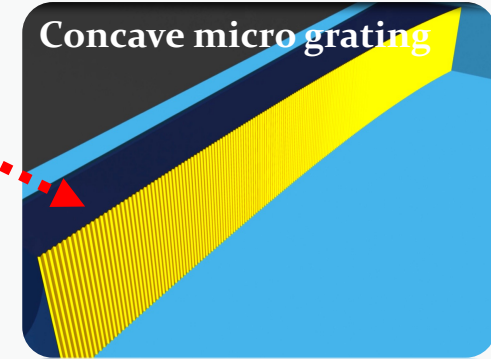
- Monolithic MEMS
→ Mass manufacturing



Light source input
Image sensor

Enhances diffraction efficiency

- Variable blazed angle

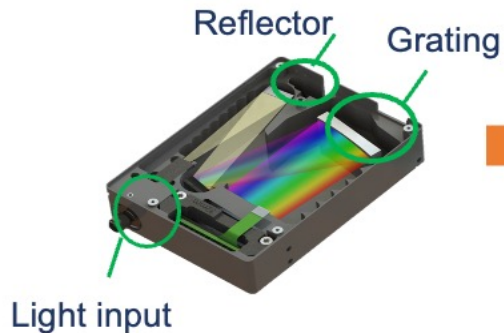


Flat field focusing on image sensor

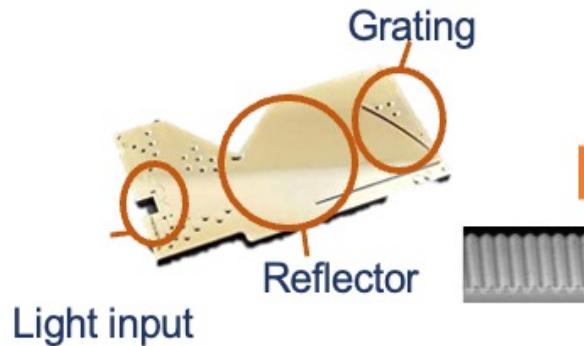
- Free-form grating profile
- Variable line spacing

SpectroChip is Manufactured with X-Ray Lithography, and then Coupled with Image Sensor to Obtain SPU Module

Mechanical structure spectrometer

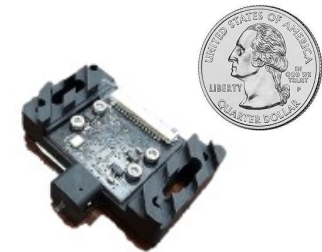


Micro spectrometer on Spectrochip



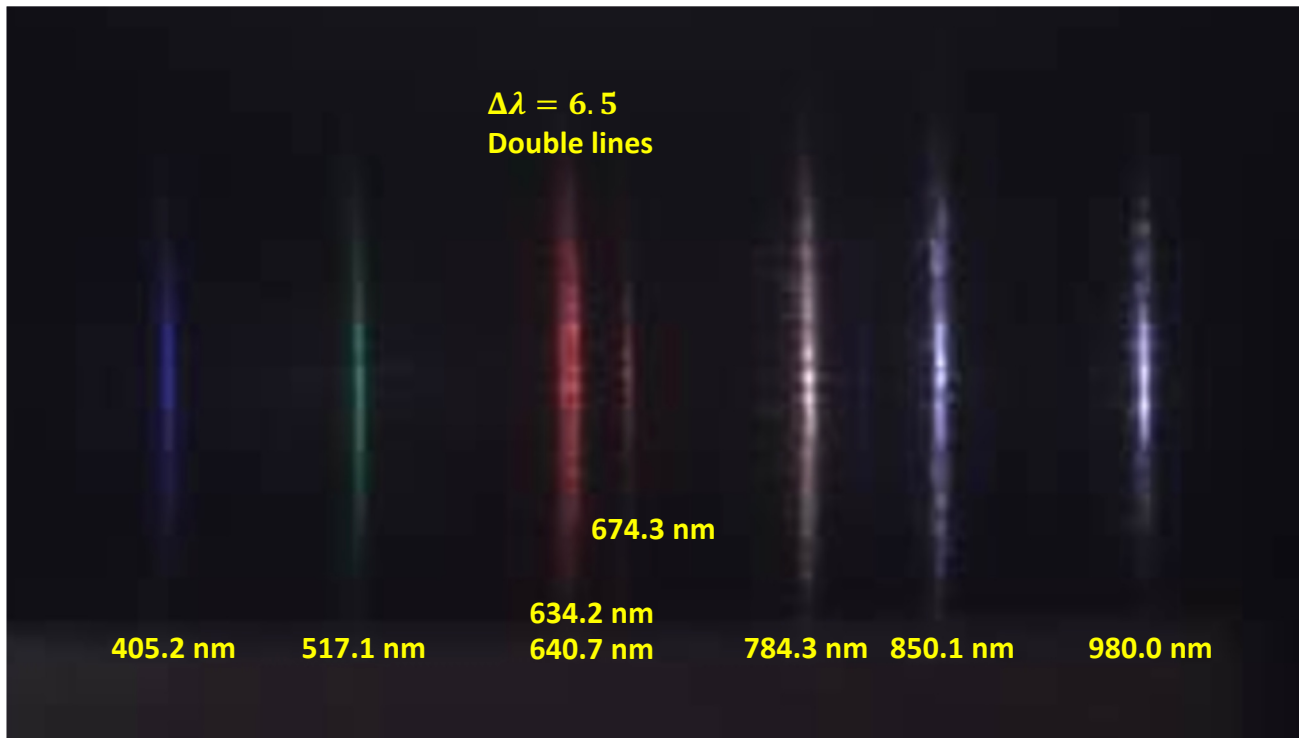
1.7 x 0.9 cm

SPU module – Spectrochip+image sensor



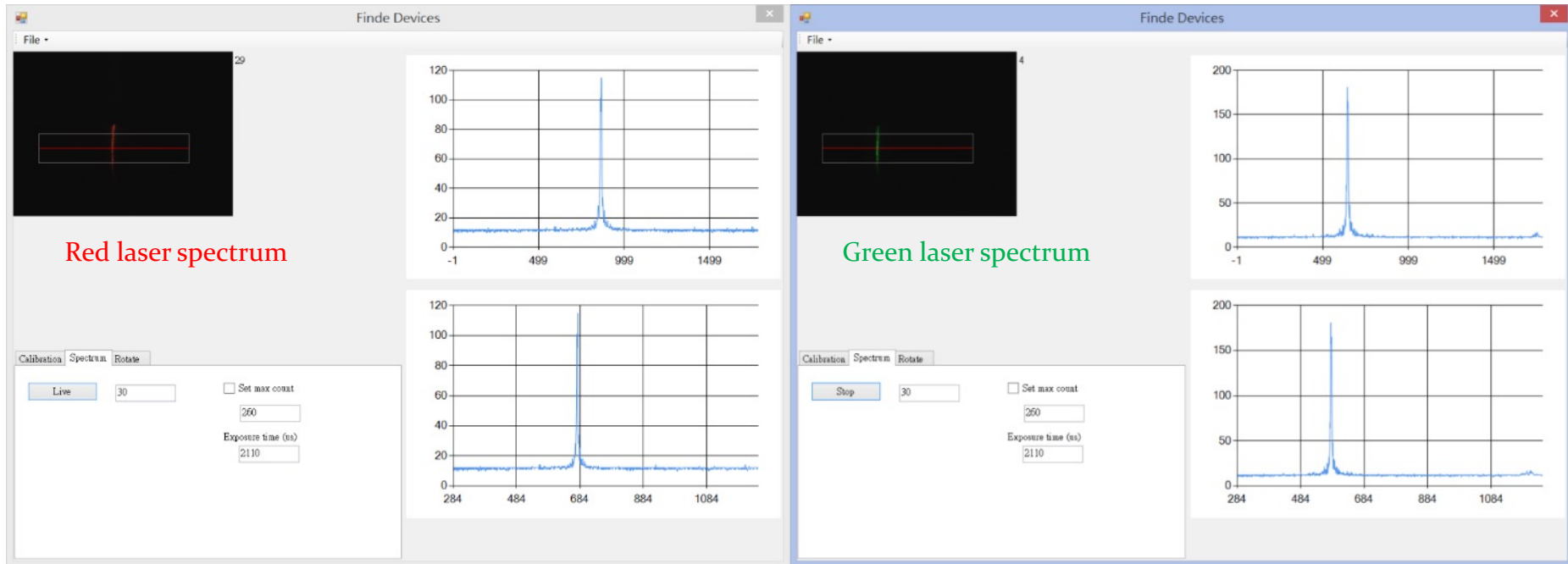
2.5 x 4.5 cm

Flat-Field Focusing Achieved!

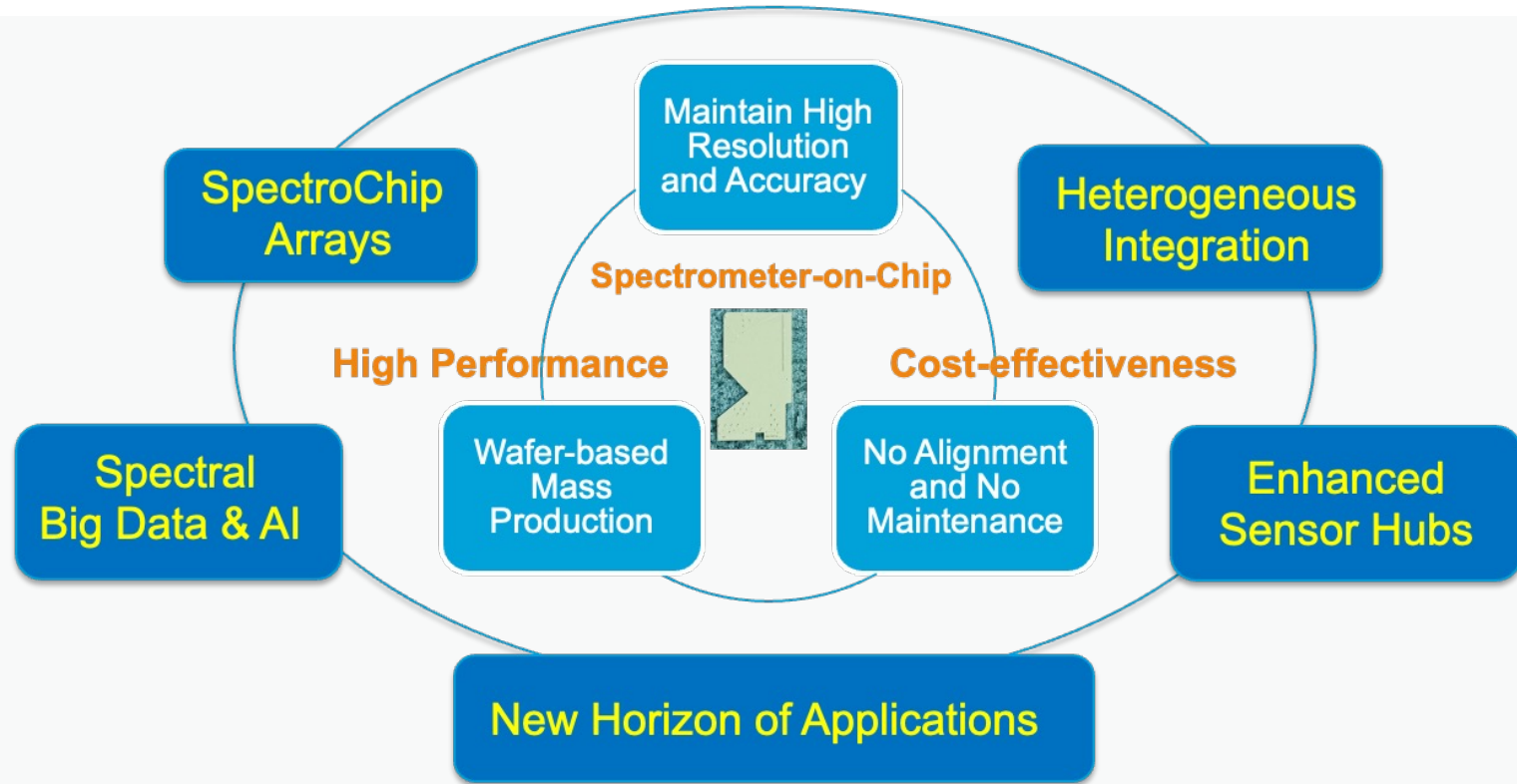


SpectroChip Module Testing Results

Spectral resolution: **3~5 nm**; Current Spectral Range: **300-1000nm**



Our Solution with Breakthrough SpectroChip Technologies



➤ SpectroChip technology resulted from 2 decades' efforts and protected by many patents

Competitive Advantages of Spectro-Chip Based Modules/Products



SPU
Prototype

Key Features	Lab spectrophotometer	Mini-spectrometer	SpectroChip modules
Performance (Resolution, Accuracy)	Medium-High ✓	Low - High	Medium-High ✓
Miniaturization (size and weight)	No	Yes ✓	Yes ✓
Cost-effective (Wafer-based mass production)	No	No	Yes ✓

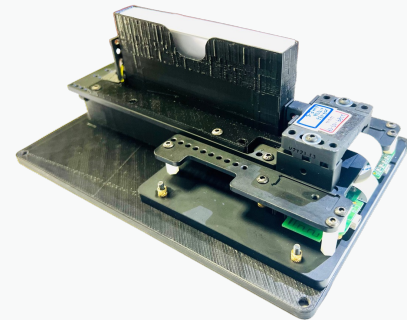
Next Generation Spectrometers/Modules based on SpectroChip technology



**Micro VIS-NIR High Resolution
Spectrometer Modules (USB or
Raspberry Pi Connection)**



**SpectroEngine
(Micro VIS-NIR
High Resolution
Spectrophotometer
for Liquid Samples)**



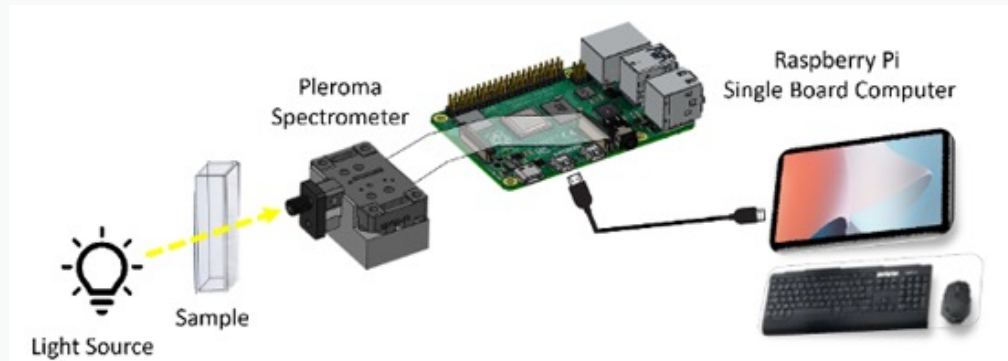
**SPU Module For
SiO₂ Detection
In Ultra Pure
Recycling Water for
Semiconductor
Industry**

Note: The modules illustrated here are prototypes. Actual modules on market will have a more sophisticated presentation and packaging.

Pleroma Micro-Spectrometer – A Customizable Module for Integration

Optical	
Optical Module	SPU
Principle	Flat-field concave grating
Spectral Range	300-1000 nm
Spectral Resolution	5.0 nm
Spectral Accuracy	0.5 nm
Stray light	0.04%
Electrical / Mechanical / Dimension	
A/D conversion	8 bits
Integration time	0 ~ 1,000,000 μ s
Total noise level	1.1 %
Data Interface	CSI camera connector
Power Consumption	158 mW
Image sensor	OV9281
Number of pixels	1280
Dimension	44 x 47.28 x 26.25 cm ³
Weight	12 g

- Spectral range : 300-1000 nm
- Flat-field micro concave grating chip
- Highly accurate optical characteristics
- Direct connection to Raspberry Pi SBC
- Python source code available
- Compact design for easy integration

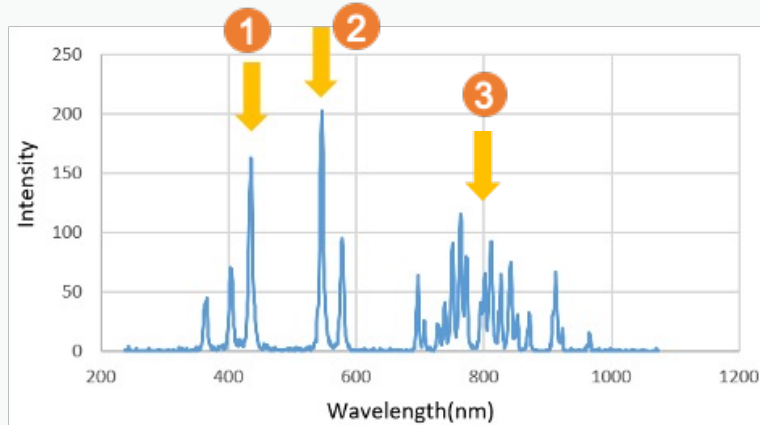


Pleroma Micro-Spectrometer Shows Outstanding Performance

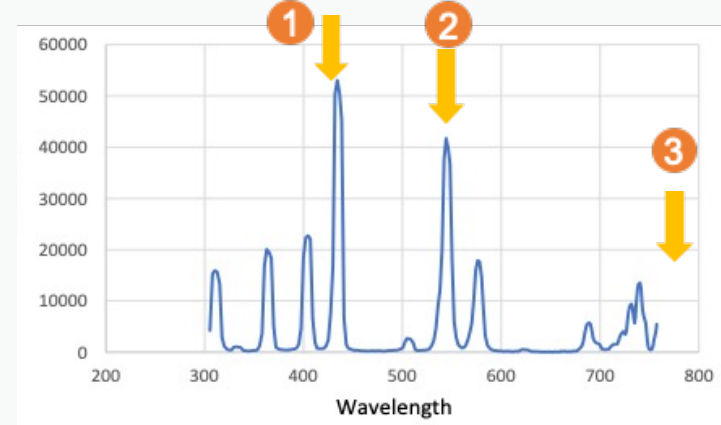


--- Ideal for Continuous Real Time Monitoring and Subsequent Big Data Analysis

Spectrum from Pleroma Spectrometer



Spectrum from Competitor Spectrometer



Pleroma Advantage: Higher Sensitivity, Wider Spectral Range & Better Resolution

SpectroChip Ranking No. 1

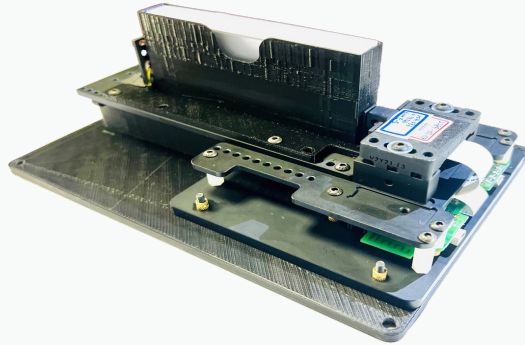
Specs \ Products	 	 PHOTON IS OUR BUSINESS	 by Consumer Physics	 EL-WERKE	
Detection Principle	 Concave Micro Grating (MEMS Optical SOC)	Concave Micro Grating (Precision Assembly)	Filter (Nano Etching)	Fourier Transform IR (MEMS)	Planar Grating (Optical Bench)
Spectral Range (nm)	 350-1000 (Vis+NIR) + UV + IR	340-780 (Visible)	700-1200 (only NIR)	1350-2500 (only IR)	350-800 + UV + IR
Spectral Resolution (nm)	 1.5 ~ 5	15 ~ 20	20	16	1.5 ~ 12
Module Size (mm ³)	 25 × 25 × 7	20 × 13 × 10	28 × 10 × 10	30 × 30 × 20	40 × 42 × 24
SNR	 300 : 1	N/A	N/A	N/A	150 : 1
Dynamic Range	 4600 : 1	3000 : 1	2400 : 1	2000 : 1	4600 : 1
Power Consumption (mWatt)	 < 5	< 10	< 20	< 10	< 10
Wafer-Based Mass Production	 Yes	No	No	Yes	No

SpectroChip Inc., 2018

Broad Applications of Our Technologies Across Industries



SPU Module for SiO₂ Detection In Ultra Pure Recycling Water



Features:

- Simplified measurement (quick installation)
- Downsized (Sized like an AirPods charging case.)
- Open-source software
- Realtime monitoring
- Covers board wavelength range (300-1000 nm)
- High spectral resolution (0.5 nm)
- Diverse applications in water measurement

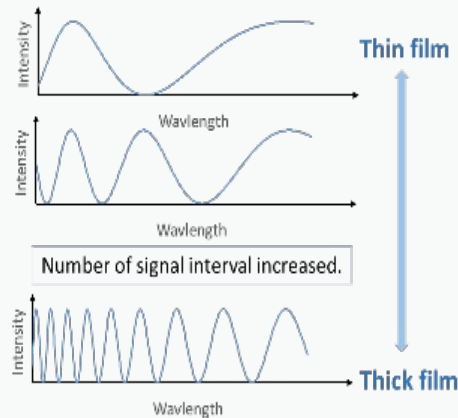
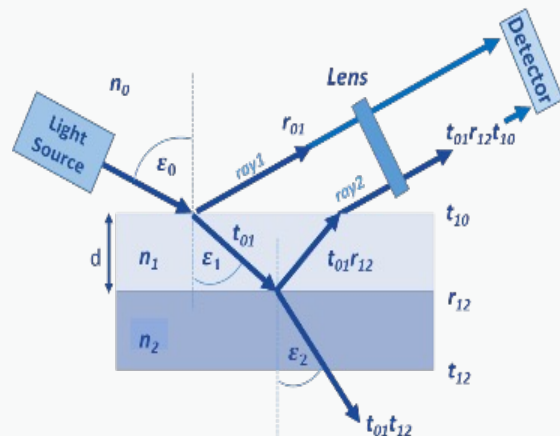
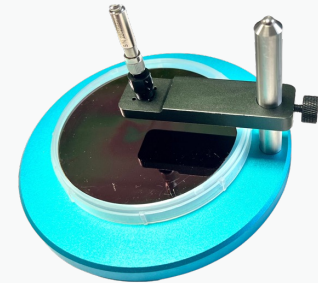
Model Number	MSW-100
Wavelength range	300 ~ 1000 nm
Spectral resolution	5 nm
Spectral accuracy	0.5 nm
Stray light	0.04 %
Image sensor	CMOS (AR0130) A/D 12 bits
Light source	LED: 810 nm
Optical path	100 mm
Measurement accuracy	+/- 0.07 ~ +/- 0.25 ppb
Detection Principle	Molybdenum blue method
Measuring range	ppb ~ ppm range
Measuring time	10 seconds
Dimensions (W×D×H)	200 × 140 × 95 mm ³
Weight	750 g

Note: The modules illustrated here are prototypes. Actually modules on market will have a more sophisticated presentation and packaging.

Optical Measurement of Thin Film Thickness Using SPU Module

Interference spectrum is used to determine film thickness.

Through analyzing the interference spectra, the film thickness can be determined. In this application, SPU module is used for optical thin film thickness measurement. It can measure film thicknesses above $1\ \mu\text{m}$.



Providing New Solutions for Environmental Monitoring



Multiple
SPU
Modules



NVIDIA Jetson Orin
Nano Module



SPU + AI on Unmanned Aerial Vehicles (UAV)

– A Powerful Combination for Real Time Water Quality Testing

Note: SPU modules can be integrated with other GPU/AI chips. Here, the NVIDIA Jetson Orin Nano is what has been under testing.

Innovative UAV + SPU+AI Technology for Monitoring Algae Bloom

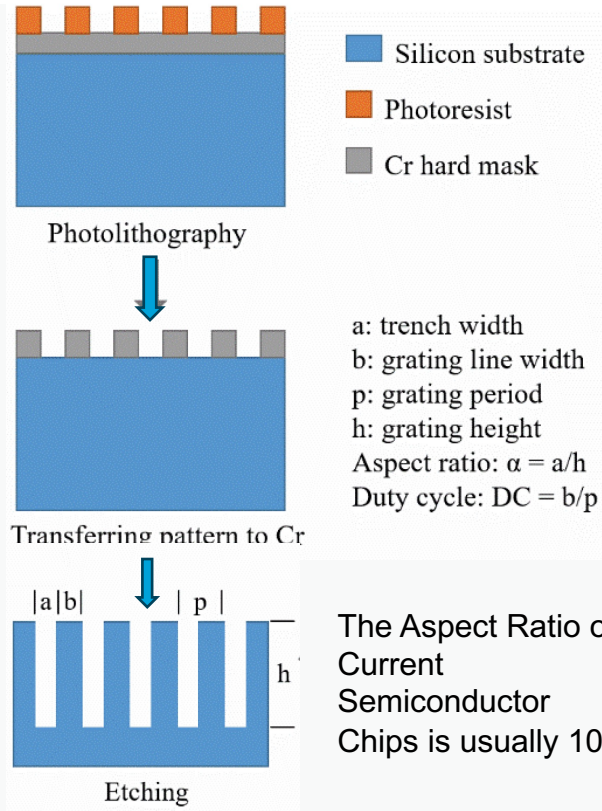


90% of blue-green algae blooms go undetected.

UAV + SPU will enhance the sensitivity and accuracy of detection with secured data collection and give us the ability to detect blooms in real-time, which helps us to respond faster and prevent potential hazards.

- Quick Detection** → Utilize drone technology to quickly detect algae blooms
- Smart Detection** → Utilize SPU+AI technology to accurately detect algae blooms (Fluorescence)
- Efficient Coverage** → UAV can cover large areas of water more efficiently than humans & Buoys
- Data Collection** → Collect data on the size and location of the bloom for proactive management
- Reduced Costs** → Reduce costs associated with manual monitoring and reactive management

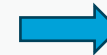
Our Plan to Develop SpectroChip-based Raman Sensors/Spectrometer



The Aspect Ratio of Current Semiconductor Chips is usually 10

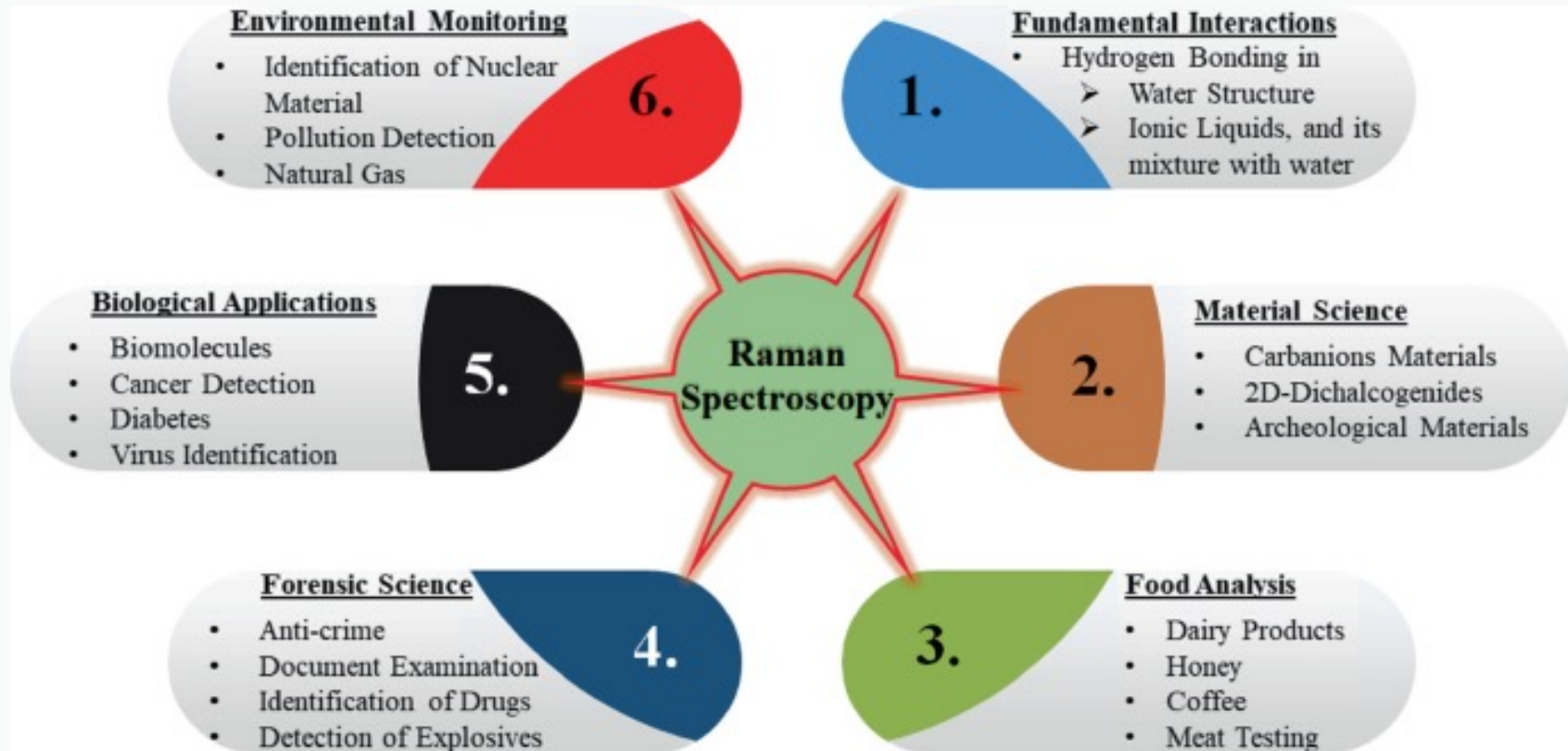


Structure Depth of Current SpectroChip Is 200 um.

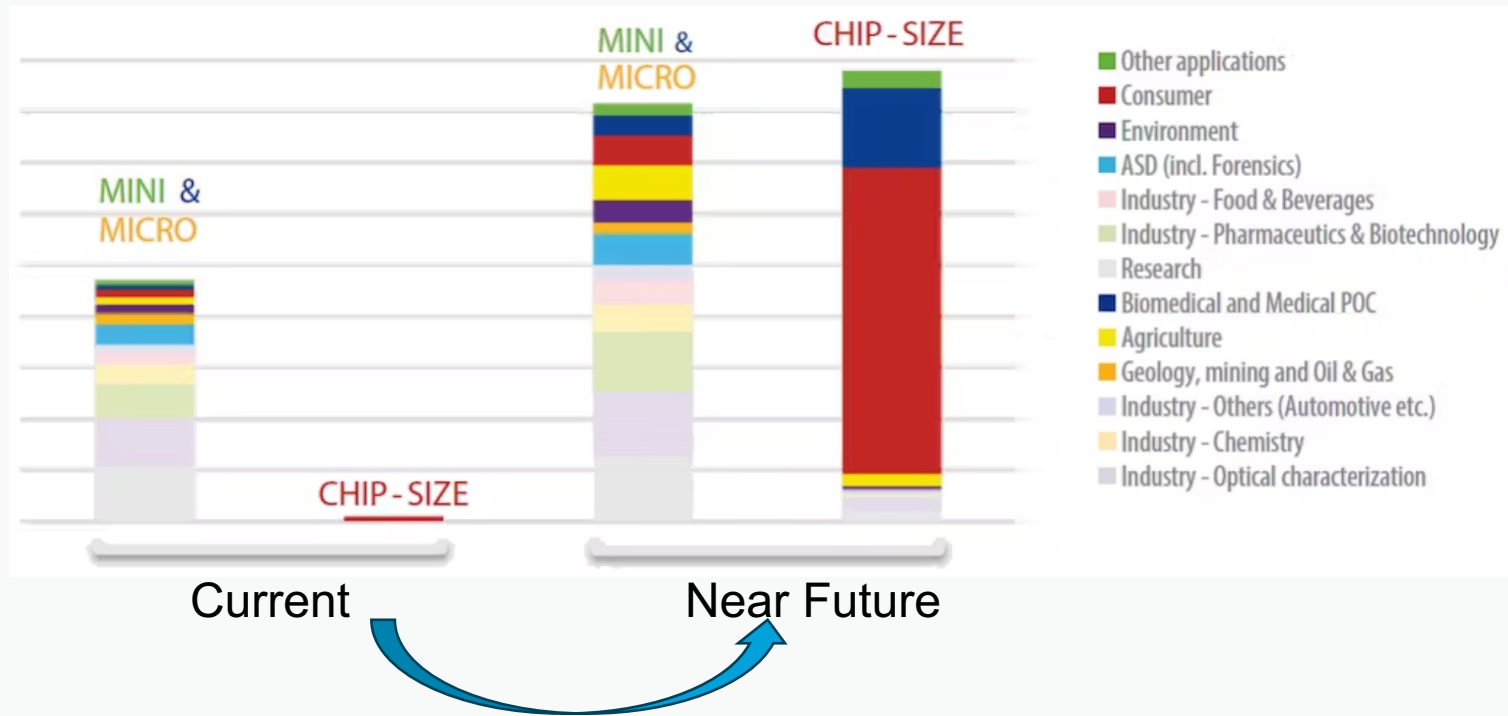


Structure Depth of future Raman SpectroChip Is designed to be 500 um.

Huge Application Potentials for Raman Spectrometry



From Compact/Portable Raman Spectrometer to Chip-based Raman Spectrometer

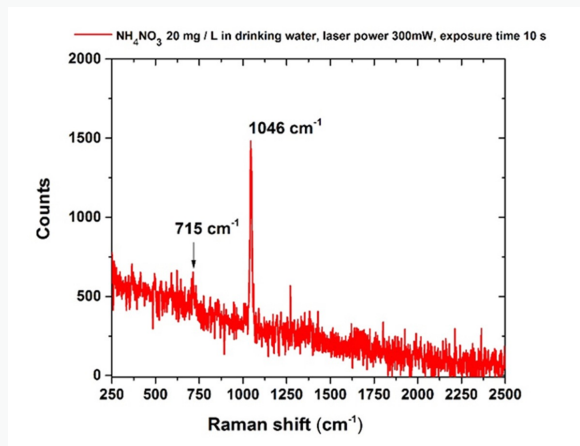


SpectroChip-based Chip-size Raman Spectrometer will boost the transition

Developing SpectroChip Raman Spectrometers to Cater For Various Applications in Water Testing

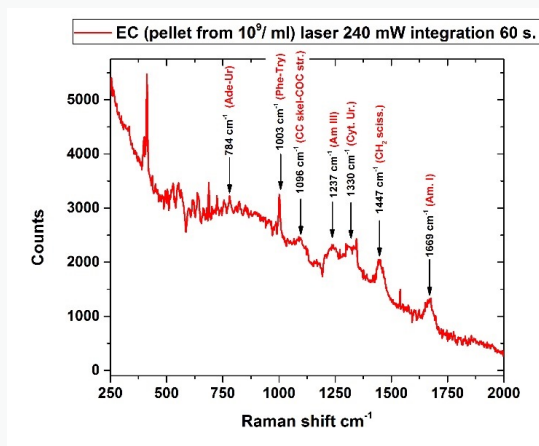
Application examples:

Nitrate Detection



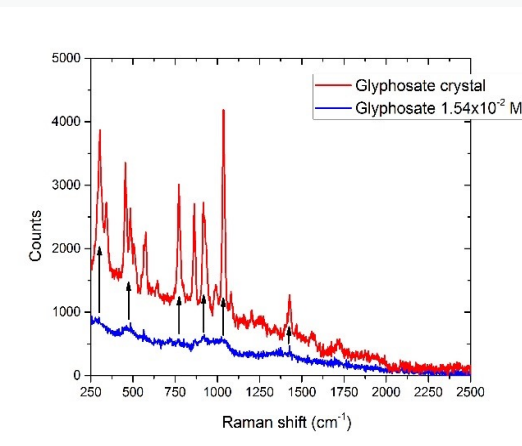
Raman spectrum of ammonium nitrate in drinking water at 20 mg/L.

Bacteria Detection



Raman spectrum of an E.coli pellet extracts from bacterial suspension.

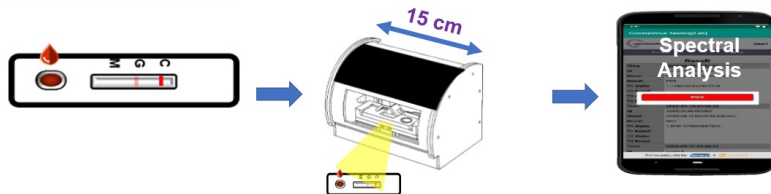
Pesticides Detection



Raman spectrum of glyphosate crystal compared with the analyte dissolved in drinking water.

Developed a SpectroChip-based Immunoassay Reader

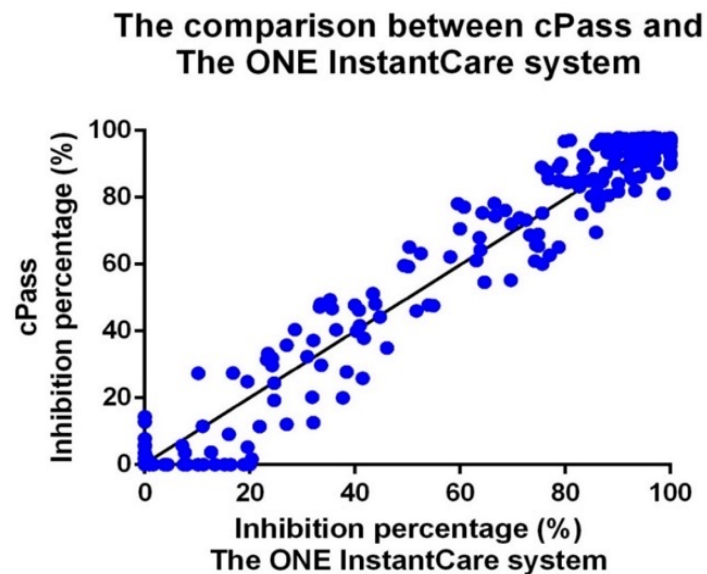
- One InstantCare Device



Detection of Covid-19 Neutralizing Antibody / 400 Clinical samples

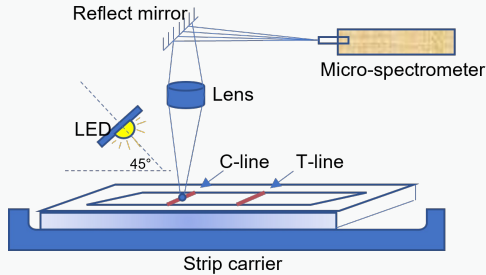
- Top Lab-grade Precision Achieved
- Same Accuracy as cPass / ELISA:
With Pearson factor: 0.9801 when compared to cPass ELISA reader
- Excellent Sensitivity: **LOD=186 pg /mL**

To Support COVID Antibody Detection Using Rapid Detection Kits.



Immunity Surveillance in Taipei City Community:

COVID-19 Antibody Tests in 5000 People Using the One InstantCare Device



One InstantCare Device (Gen I)





FDA

Spectrochip's Owner Number in FDA: 10078261
Spectrochip's Listing number in FDA: D422000
Spectrochip's Registration number in FDA:
3017810861

<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cf/r1.cfm>



TFDA



Awards



項目	證照名稱	證號
神光晶片股份有限公司	藥商販賣許可證	竹縣藥販字 6233059853
神光臨床用分光光度計	衛福部醫療器材許可證	衛部醫器製字第008089號
“神光照護”免疫分析儀	衛福部醫療器材許可證	衛部醫器製字第008090號
“神光測立得”呈色分析儀	衛福部醫療器材許可證	衛部醫器製字第008091號

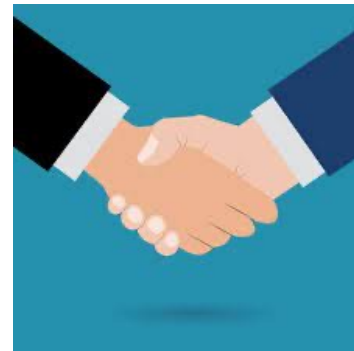
Summary -- Advantages of SpectroChip/SPU technology:

- High performance: spectral resolution 5nm, range 300 - 1000nm
- Very small form factor: 44 x 34 x 10 mm³
- Very light in weight: 50 grams
- Easy app development: SDK for Android (mobile phone), Window, Linux, Raspberry Pi, Nvidia AI
- Very low power consumption
- Easy and direct optical integration: no optical fiber required
- Very cost effective in high volume demand: spectrometer-on-chip wafer-based mass production technology
- Broad applications: optical sensors, sensor arrays, and micro spectrometers for precision sensing, process control, chemical analysis, etc.

Contact Us to Try Testing our Module with Your Applications



Email: contact@spusystem.com



We Embrace Collaborations:

- OEM Components/Parts
- Joint R&D projects
- Application Development

www.spusystem.com

Sincere Appreciations to:

- SEMI MSIG TEAM
- SEMI APHI TEAM
- Albany Nanocomplex
- Excelsior Microfoundry LLC
- SPU Board of Advisors