

Konica Minolta Day

Hyperspectral Imaging

Toward Solving Material Issues

March 15, 2023



Tapio Kallonen, CEO

Good afternoon, my name is Tapio Kallonen, and I'm the CEO of Specim. I'm here today to explain how Specim is solving material issues with hyperspectral imaging, as a member of Konica Minolta Group.



Specim and hyperspectral imaging technology has a great impact to the world we live in. We make our existence more sustainable in the world by increasing the efficient use of our common scarce global resources through spectral imaging, a non-invasive material identification technology. We improve the use of materials, enhance food quality, reduce waste, support health and life of humans and nature, and provide valuable information on our environment, from land to sea.”

SPECIM TODAYFOUNDED IN **1995**

> 9 000
SPECTROGRAPHS
+
SPECTRAL CAMERAS
DELIVERED

PERSONNEL CIRCA **90****>20% CAGR** IN INDUSTRIAL SEGMENT

PART OF
KONICA MINOLTA
SINCE 2020

HEAD OFFICE
OULU, FINLAND



SPECIM LOCATIONS
BARCELONA, MUNICH,
NEW JERSEY, SHANGHAI
+ WORLDWIDE DISTRIBUTOR NETWORK

Specim is founded in 1995 in Oulu, Finland. Oulu is located in the middle part of Finland, and the city is famous for its unique knowhow particularly in optoelectronics due to the presence of Oulu university and Finnish National Research Institute.

Specim is the manufacturer and designer of hyperspectral imaging cameras, software, and related accessories. We employ 90 people, and only in the past few years we have established own presence in the US, China, Germany, and Spain. We sell and deliver our products worldwide to all continents both directly and through worldwide distributor network.

Specim is experiencing strong growth in the market, in average above 20% compound annual growth rate since the last five years in the industrial segment.

OUR VISION : SPECTRAL IMAGING MADE EASY

MACRO TRENDS

- Environmental
- Automation
- Health and Life
- Circular Economy

Improving fulfillment in work and corporate dynamism



Addressing climate change



Using limited resources effectively



IMPORTANCE OF ENSURING QUALITY AND SAFETY

HIGHER LEVELS OF AUTOMATION

GROWING DEMAND FOR DETAILED INFORMATION

GROWTH DRIVERS

OUR MISSION
Create new value for customers and society

Our vision is Spectral Imaging Made Easy.

In a nutshell this means that we work towards the goal that this extremely powerful technology would be easily applied in various different industries across the globe in the future.

Our journey is supported by global macro trends such as increased environmental consciousness, automation, health and life, and circular economy. The obvious growth drivers for us are the higher levels of automation nowadays applied more and more throughout industries, constantly growing need of detailed information, and the increasing importance of ensuring quality and safety.

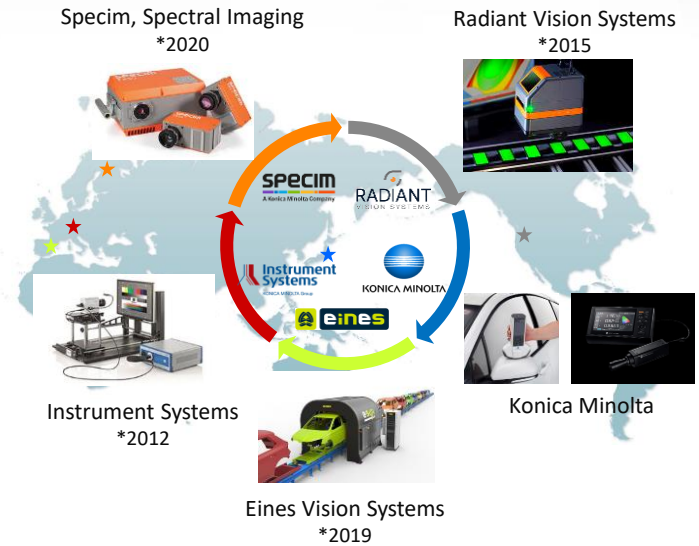
Our mission is to create new value for customers and society.

POSITIONING WITHIN THE KONICA MINOLTA SENSING BUSINESS

Industry

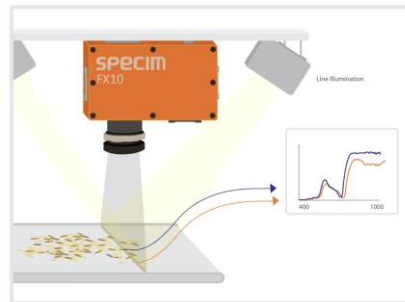


Sensing	Materials and Components	Imaging-IoT Solutions
<ul style="list-style-type: none"> ■ Measuring Instruments 	<ul style="list-style-type: none"> ■ Performance Materials ■ Optical Components ■ IJ (inkjet) Components 	

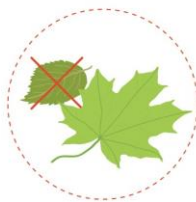


Specim belongs to Konica Minolta Sensing Business together with companies such as Instrument Systems from Germany, Radiant Vision from the US, and EINES from Spain. Konica Minolta Sensing business consists of 4 business pillars. Color measurement, display measurement, visual surface inspection and hyperspectral imaging.

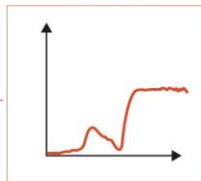
WHAT IS HYPERSPECTRAL IMAGING?



Classify different materials based on their *unique spectral signature*.



Spectrum



Fingerprint



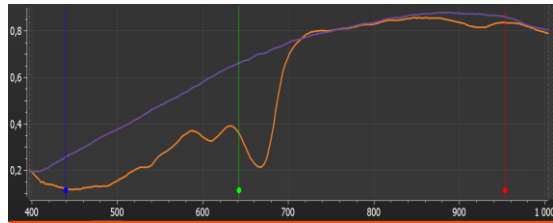
What is hyperspectral imaging?

Hyperspectral imaging is a completely non-destructive way to identify different materials or define their properties. Since every material and compound reacts with light differently, the hyperspectral imaging provides individual spectral signatures that can be used to identify materials. Hyperspectral imaging enables identification, mapping, and separation of materials by their chemical or color differences.

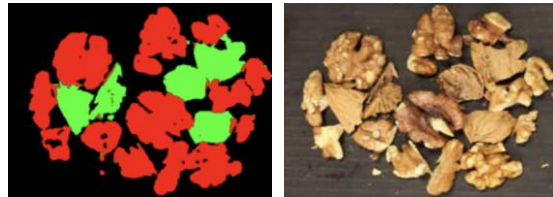
WHAT IS HYPERSPECTRAL IMAGING?



Specim HSI system obtains chemical information across the full product stream in real-time with a single scan.



The unique spectral signature of nuts vs. shells captured with the HSI camera.



Hyperspectral vs. RGB image of nuts and shells.

On the left-hand side of the slide, we can see how hyperspectral imaging solution is installed in a very typical industrial in-line application where the objects are moving with the conveyor belt, and the hyperspectral imaging cameras are collecting the data from the full product stream and analysing it in real-time.

On the right-hand side top corner, it is illustrated how easily hyperspectral camera is able to detect the difference between nut shell and nut meat due to their very distinguished spectral signature.

On the right-hand side bottom corner, we notice that visually these look very similar, and thus traditional cameras can't detect the difference. But hyperspectral imaging camera can do that, and the analysing software has indicated nut shells in green colour and nut meat in red colour. Thanks to the precise and real-time analysing capability the machine can then detect and sort the material in a way which increases quality and safety.

CHRONOLOGY

- 1 EARLY LEADERSHIP ON RESEARCH
- 2 COMMERCIALISATION
- 3 RAPID ADOPTION

Building on the early leadership on research, Specim is increasingly focusing on ready-to-deploy integrated solutions for the growing industrial market.



Industrial platform solutions

Application specific solutions

Spectral cameras

1995

Spectrographs

2023

Since the beginning, from 1995, Specim has designed the core technology capabilities in-house, and has gained both the technical and commercial leadership position in the hyperspectral imaging world.

Step by step Specim has increased its position in the value chain, from the complex optical components and spectrographs to complete hyperspectral cameras, and then to industrial and scalable value-added platform solutions which are combining hardware and software to deliver business value to its customers.

SYNERGIES AS A KONICA MINOLTA GROUP

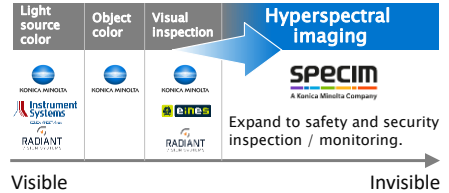
GEOGRAPHIC COVERAGE EXPANSION

Cooperation with Konica Minolta sales companies.



TECHNOLOGY EXPANSION

See beyond the human eye.



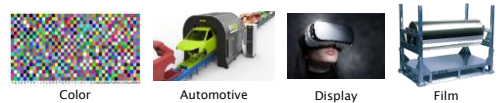
TARGET CUSTOMER SEGMENT EXPANSION

Offer new value to Konica Minolta's customer base, especially to brand owners.



CUSTOMER VALUE EXPANSION

Create new value with Konica Minolta's group companies.



There are clear synergies for Specim as a member of Konica Minolta Group. The main benefits to support Specim's strong growth from Konica Minolta are quick expansion of geographical coverage, broadening technological capabilities to solve customers' problems together with other group companies, widening the customer segments, and providing more value to customers in Konica Minolta core business applications, particularly to brand owners such as automotive manufacturers.

COMPETITIVE LANDSCAPE IN RELATION TO THE MAIN COMPETITORS

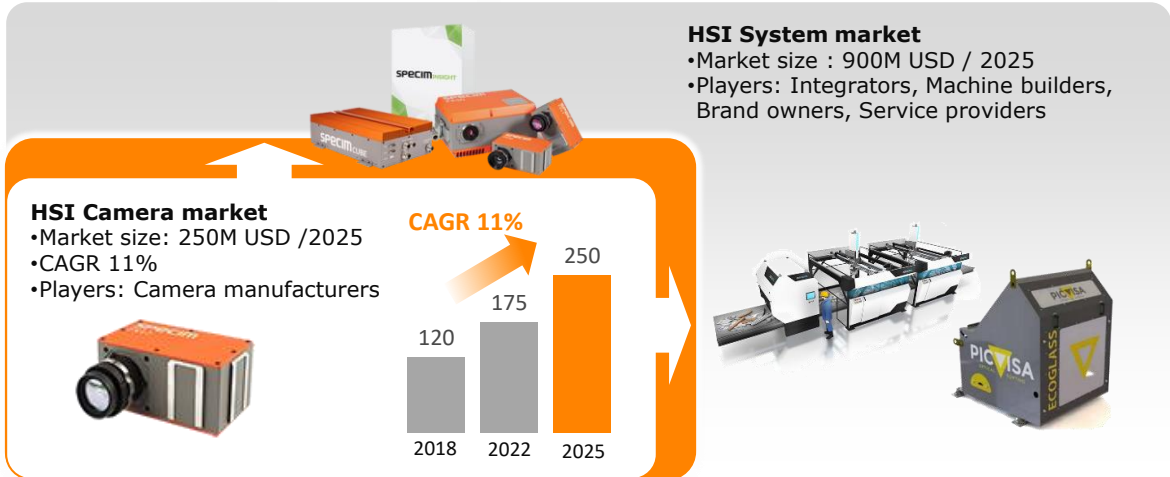


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Specim is the leading provider of hyperspectral imaging solutions in the world. Compared to the main competitors in the market, Specim has established the strongest position in terms of global reach and industrial scalability. We believe that hyperspectral imaging will be one of the dominant optical measurement technologies to be used in various industrial applications in the future, and for that bright future Specim has gained the best position over competition.

TARGET MARKET

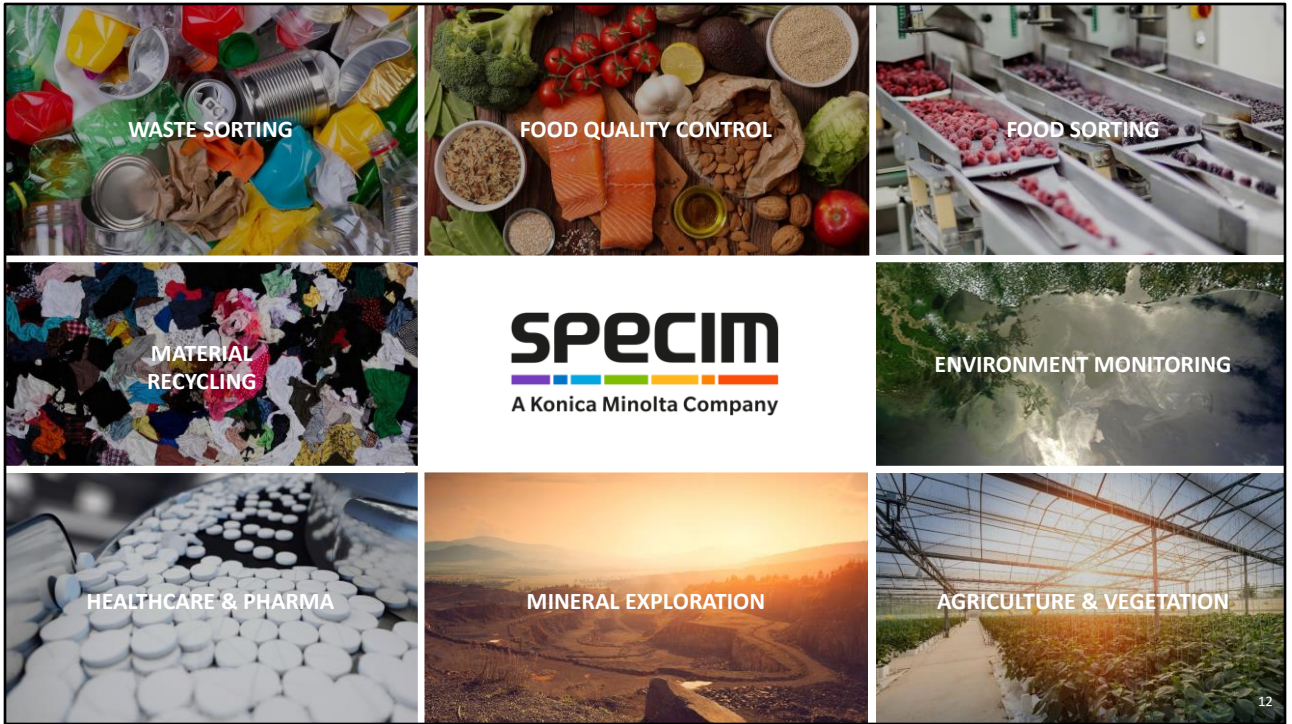
Specim has been outperforming the market growth. Our industrial platform, SpecimONE, allows us to grasp new opportunities in the growing HSI system market.



Source: Specim estimation based on market reports

Specim provides industrial cameras, optical components, and accessories to companies such as machine builders, machine vision integrators, data service providers, production facility owners, and R&D departments. The recently launched SpecimONE industrial hyperspectral imaging platform provides ground-breaking equipment for the users to really apply the full potential of this technology. SpecimONE allows users to build models and applications, and to run them in real-time in SpecimONE environment helping the users to acquire the information they need, on the spot, and with 100% accuracy. Hyperspectral imaging market is expected to have a double-digit compound annual growth rate for the next years.

Specim has been growing faster than the market in the past years which is strengthening our position as the market leader. Specim has above 10% market share in hyperspectral imaging camera market, and even stronger position in the strategically most important segment which is the industrial market. In addition to the state-of-the-art industrial cameras and optical components, Specim’s scalable industrial SpecimONE platform allows Specim to grasp new opportunities in the growing markets.



Specim technology serves various type of industries and applications. We contribute to major megatrends as sustainable use of natural resources, recycling and reuse of materials. Major machine builders and brand owners trust on Specim technology in the fields of waste recycling and sorting, food sorting and quality control, healthcare and pharma, agriculture and vegetation, as well as mineral exploration.



PLASTICS

SPECIM

Global plastic waste generation more than doubled from 2000 to 2019.

Globally, only 9% of plastic waste is recycled

while 22% is mismanaged and 50% ends up in landfill.

Source: OECD

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Plastics are very important for various industries, but they are still produced mostly from fossil based raw materials. Their production is very resource intensive, and most of the plastics waste today is not recycled but put on landfill, water systems or burnt. Sustainable use of plastics and efficient plastics recycling reduces marine litter, greenhouse emissions and dependence on fossil fuels.

Specim hyperspectral cameras and SpecimONE platform can reliably identify and sort various different plastics types in recycling process. Near infrared imaging is a relatively standard method in Europe to restore valuable plastics in recycling industry. Also, many major brand owners are now taking initiative to recycle and reuse the plastics products they've produced to give them a second life, and thus to contribute to sustainability. This is also driven by legislation.



TEXTILES

The apparel and footwear industries account for 8% of the world's greenhouse gas emissions.

Globally, less than 1% textile waste is recycled while roughly 73% is landfilled.

Source: OECD

The textile sector is resource-intensive with notable climate and environmental impacts. It is estimated that less than 1% of all textiles worldwide are recycled into new textiles. Due to different chemical content, natural and synthetic textiles can be sorted using hyperspectral imaging technology. Replacing manual sorting and recycling with machine vision improves turnaround time, safety and accuracy of the recycling process. Similarly to plastics recycling, also in textile industry the brand owners are actively working toward recycling and reusing of the virgin textile materials.

RECYCLING & WASTE MANAGEMENT



HSI

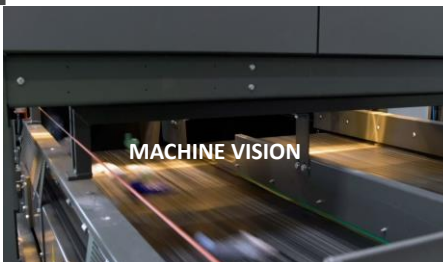
- ✓ Near 100% purity and higher value of recycled fragments



ROBOTICS, AUTOMATION

Solutions

- ✓ Plastics sorting
- ✓ Textile recycling
- ✓ Construction waste
- ✓ Household waste
- ✓ etc.



MACHINE VISION

Needs

- ✓ Automate waste sorting
- ✓ Improve quality and efficiency
- ✓ Turn waste into reusable material
- ✓ Reduce health and safety risks

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Hyperspectral imaging is a complementary solution to traditional machine vision technologies. Especially our SpecimONE platform offers seamless integration to machine vision systems and provides them ability to see beyond visible range. Specim's customers have successfully unlocked various type of applications in recycling and waste management industries. Large throughput, high speed of the material flow and real-time decision-making capability are crucial in any industrial application. Due to hyperspectral imaging capability, a recycling machine is able to sort various different materials on the same production line, including plastics, wood, textile, paper cardboard, glass, etc.



<https://www.specim.com/case-study-picvisa-machine-vision-solutions-for-waste-treatment-recycling/>

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On the video Daniel Carrero, Product Manager of Picvisa presents their plastics sorter ECOPACK equipped with Specim hyperspectral cameras. Picvisa is a Spanish company that has over 20 years' worth of experience in providing machine vision solutions for waste treatment, recycling, and various industrial processes. Assisted by the Specim hyperspectral cameras, ECOPACK is able to sort up to 6 tons of plastic packaging per hour. This was previously done by six workers.



Black materials are difficult in recycling process, as the black color is usually based on carbon which hides all the spectral information until thermal wavelengths. Specim took the challenge to develop an industrial thermal range hyperspectral camera, Specim FX50, capable of sorting black plastics, a task that is impossible for most of the technologies. Specim FX50 has been well adopted in the recycling industry, being one of our success stories from recent years.



FOOD

SPECIM

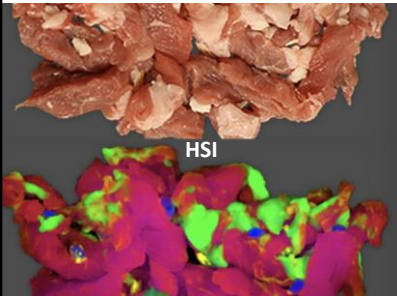
Globally of food produced for human consumption, **1/3 is lost or wasted.** If wasted food were a country, it would be the **third-largest producer of carbon dioxide** in the world.

Source: WFP

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Food production and food supply chain are one of the major industries affecting the environment and contributing to climate change. Sustainable use of water, land and fertilizers in farming phase are topics to address, as well as reduction of unnecessary waste both in production, transportation phase, and when finally bringing the product to consumers. Globally, one third of the food produced for human consumption is lost or wasted.

FOOD SORTING AND QUALITY CONTROL



“Integrating hyperspectral solution to machine vision equipment, we automate the work of three people.”

Emilio J. de la Red,
Head of Innovation, INNDEO



- ✓ Food sorting and quality control
- ✓ Foreign object detection
- ✓ Food grading
- ✓ Substance analysis
- ✓ Packaging inspection

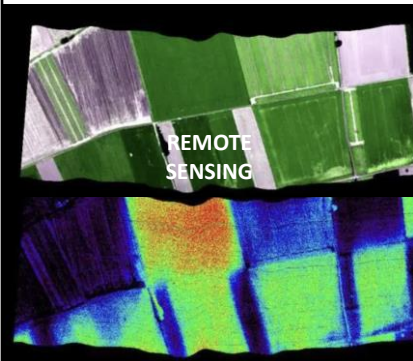


- ✓ Automate workflows
- ✓ Increase food safety
- ✓ Reduce food waste
- ✓ Avoid recalls
- ✓ Improve production efficiency

In food product supply chain, hyperspectral imaging technology is applied in various way. During the processing and packaging phase, detection of foreign objects, measuring fat or moisture content, or inspecting that package sealing does not have any leaks, are typical applications of Specim technology, even though difficult or even impossible task to many other technologies.

Typical customer for Specim cameras is a machine builder or integrator, who provides sorting or quality inspection machines to major food industry brand owners.

ENVIRONMENT, GEOLOGY & MINERALS



REMOTE SENSING

- ✓ Predict, monitor, assess, and aftercare for ecological catastrophes

- ✓ Improve yield quality
- ✓ Detect plant diseases
- ✓ Reduce waste, energy, and water consumption
- ✓ Estimate and quantify yield growth



PRECISION FARMING AND VEGETATION ANALYSIS



DRILL CORE SCANNING

- ✓ Efficient exploration and use of minerals
- ✓ Rapid and reliable mineral analysis of geological samples

Hyperspectral imaging is an extremely versatile technology. In food supply chain, we contribute not only to food sorting and quality control, but also to farming and production phase. Yield quantity and quality estimation, plant disease detection, and efficient and sustainable use of fertilizers are all applications that can be solved with Specim technology.

















Another important application field is geology and mining, where sustainable and efficient use of raw materials plays a major role. Hyperspectral imaging is used to map the mineral deposits in detail, and this information is to help decision making when planning the mining sites. Hyperspectral imaging technology can be also applied for more efficient control of the raw material streams of mining industry. Major international mining industry players trust on Specim cameras and technology.

SPECIM



A Konica Minolta Company

PRODUCT RANGE

	VNIR 400– 1 000 nm	NIR/SWIR 900 – 2 500 nm	MWIR 3 000 – 5 000 nm	LWIR 8 000 – 12 500 nm
TYPICAL APPLICATIONS	Colour, Fruit & Veg, Skin & Tissue, Plants, Film, Water	Sorting, Recycling, Chemical Waste, Pharma, Quality	Black Plastic, Surfaces, Minerals, Detection	Mining, Detection, Gas, Geothermal
IQ SERIES	SPECIM IQ 			
FX SERIES	FX10 	FX17 	FX50 	
AFX SERIES	AFX10 	AFX17 		
SISU SERIES	SisuCHEMA  SisuROCK  SisuSCS 			
SPECTRAL CAMERAS	PFD4K-65-V10E 	SWIR 		OWL 
	sCMOS-50-V10E 			LWIR-HS 
	FENIX 			

SOFTWARE



SpecimINSIGHT

- Off-line tool to browse and explore data, create and validate classification models.
- Part of the SpecimONE spectral imaging platform.



Specim IQ Studio

- Remote control the Specim IQ camera and handle the Specim IQ data.
- Process the hyperspectral data and create applications for the Specim IQ.



Lumo family

Selection of data acquisition software tools for Specim cameras, scanners and airborne systems.



CaliGeoPRO

Data processing tool to radiometrically correct and georeference hyperspectral data acquired with Specim AISA and AFX series sensors.

GLOSSARY

HSI Hyperspectral Imaging

A spectrograph is an instrument that separates incoming light by its wavelength or frequency and records the resulting spectrum in some kind of multichannel detector, like a photographic plate.