

EMBERION

Broaden your Vision





Emberion technology for hyperspectral imaging

EPIC Technology Meeting

Vision 2024

Emberion in brief

From leading edge research to disruptive products

EMBERION – in brief

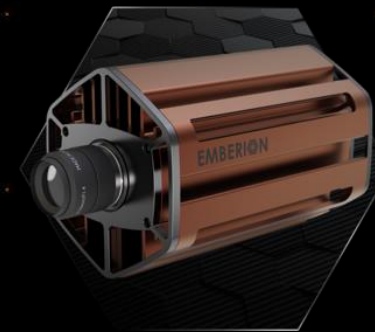
- **Established** in 2016 as a spin-off from Nokia with a highly experienced team
- **Provides** game-changing solutions for professional imaging and detection
- **Presence** in Finland (Espoo) and the UK (Cambridge) with both locations having R&D and production
 - **Espoo, Finland:** camera electronics & image sensors
 - **Cambridge, UK:** photosensitive nanomaterials
- **Team** of 35 highly skilled professionals with world-class research and venture building background
 - **Motivated** personnel with great retention
- **Unique skills** in combining graphene, nanostructured optical absorbers and state-of-the-art custom ROIC⁽¹⁾ design & circuitry

Note: 1) ROIC = Read out integrated circuit.

Disruptive products

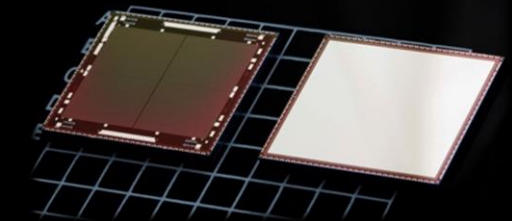
Emberion VIS-SWIR Camera

First-in-class SWIR VGA camera with extended wavelength range



Emberion Image Sensor

High-performance VGA image sensor



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Established in 2016



38 employees



2 locations (Finland & UK)



Founder member of the EU FET Graphene Flagship project

Emberion VS20 camera offerings



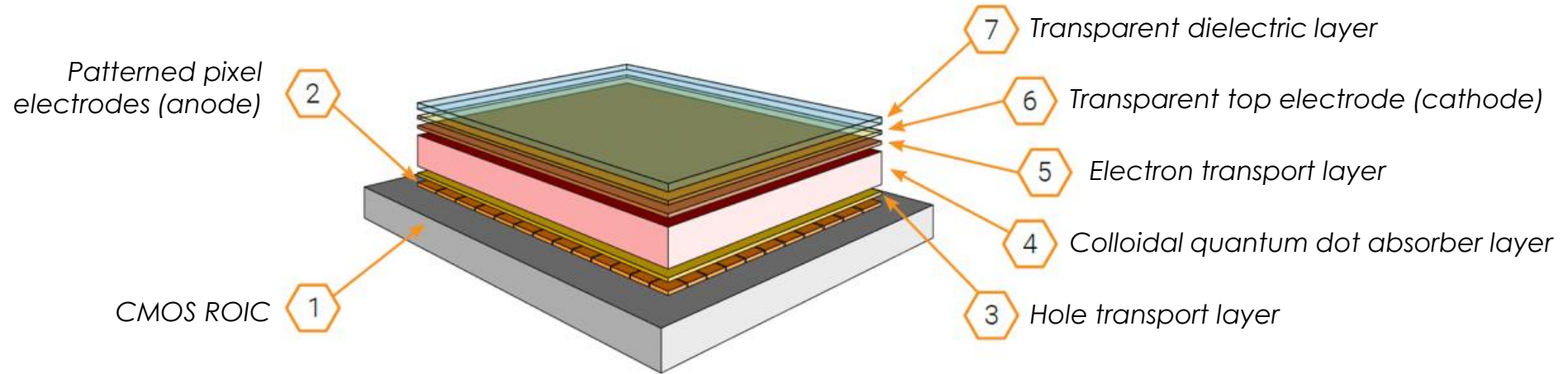
Broad-spectrum VIS-SWIR Camera portfolio

- Based on Emberion's VIS-SWIR image sensor - spectral response range up to 2000 nm with HDR over 120 dB
- Optimized for system integration, from fully integrated cameras to ready-made camera core solutions
- Standard camera interface compatible
Camera Link, GigE Vision



Technical Data	
Image sensor	Emberion Vis-SWIR image sensor
Frame rate (full res.):	max 86 fps (Camera Link) max 400 fps (GigE Vision)
Interface:	C-mount
Operation temp.:	-40 to +40 °C
Supply voltage:	12 V
ADC resolution:	14 bits
Camera I/O:	Camera Link GigE Vision

Emberion Image Sensor Technology



Technology in brief

- Ultra-sensitive image sensors based on a layered colloidal quantum dot (CQD) photodiodes, in a PIN diode configuration
- Broad wavelength range (400 – 2,000 nm) by engineering of the light absorber layers
- Photosensitive layers are monolithically integrated on optimised CMOS readout integrated circuits (CMOS ROICs)

Unique benefits

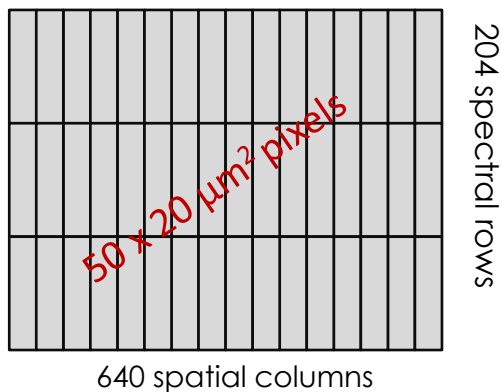
- Broad and tailorable spectral range
- Low noise equivalent power
- Large dynamic range
- Scalable pixel size
- Cost efficient manufacturing

Emberion Core for Hyperspectral Systems



Emberion VIS-SWIR sensor built into camera core for hyperspectral imaging system integration

- High-speed (1000 fps), monochromatic wide-spectrum (400-2000 nm) FPA image sensor
- Resolution and rectangular pixel format optimized for pushbroom hyperspectral imaging system integration
- Configurable pixel size and number of spectral & spatial lines (during fabrication)
- Unique ROIC solution that enables measurement both in linear and high dynamic range (HDR) modes for optimal hyperspectral imaging



Technical Data	
Spectral range:	400 – 2000 nm
Array size:	204 × 640 (configurable)
Pixel size:	50 μm × 20 μm (configurable)
Image size:	12.8 × 10.24 mm
Frame rate:	1000 fps with 204 spectral lines
NEI	10 ⁻⁴ W/m ²
Dark current at 5 °C:	< 1 pA (linear mode), RB=20mV
Saturation current density 5 °C:	0.1 μA/cm ²
Read-out modes:	Integrate-while-read (IWR) & Integrate-then-read (ITR)
Dynamic range:	70 dB (linear, 100 μs exp time)
Shutter:	Global electronic
Duty cycle:	90% with 100 μs exposure
Camera I/O:	GigE Vision
Exposure time:	Min 1 μs, adjustable with 1 μs resolution
Region-of-interest (ROI)	Freely selectable spectral lines
Sensor Cooling:	1-stage TEC

Fastest QD based camera running 1500 fps



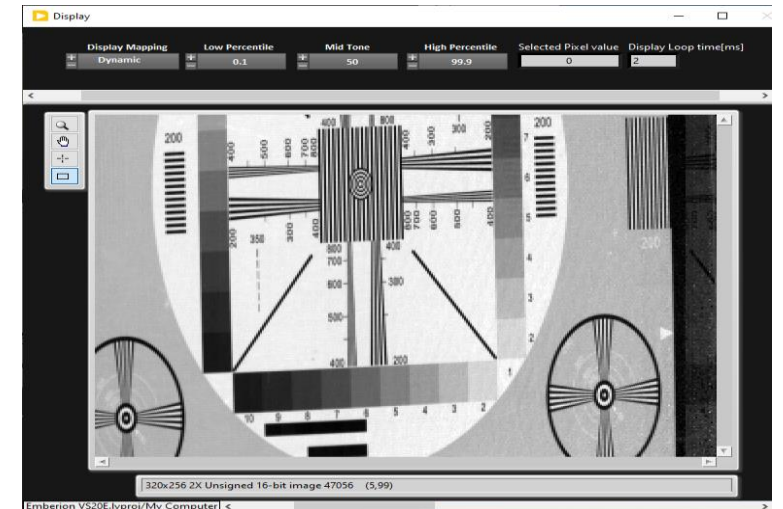
Emberion Demonstrates Fastest Quantum Dot Based SWIR Camera on the Market

Camera speed 1500 fps showcased with ROI

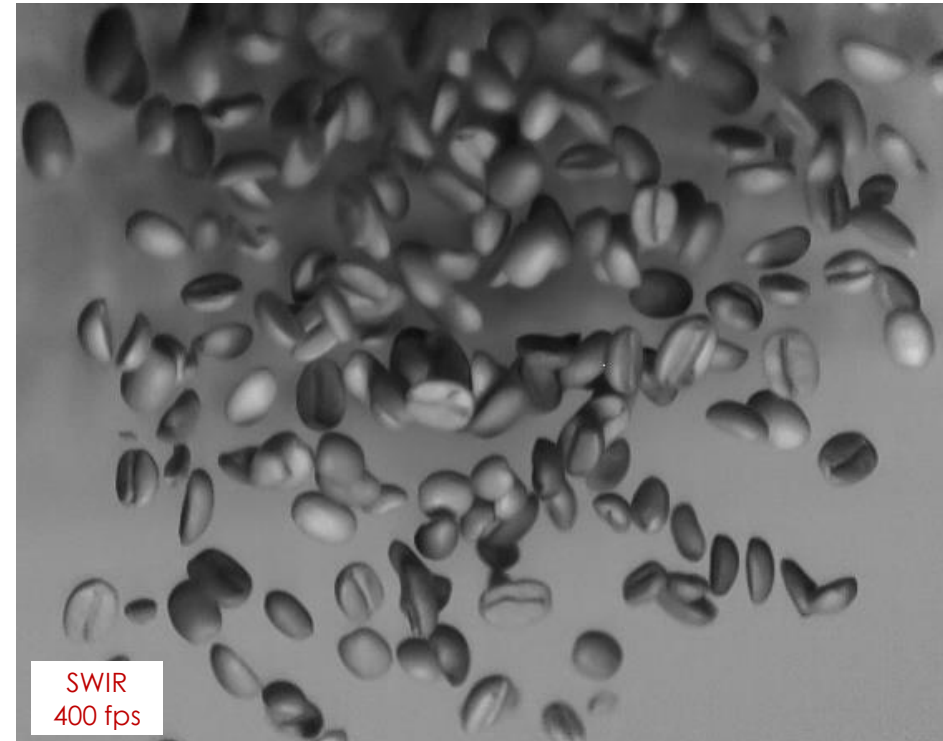
- QVGA resolution 256 x 320 with ROI implementation
- Fastest QD based SWIR camera
- Proves QD based sensors can run with high speed needed for optical sorting

Espoo, Finland – 3.10.2024 – Emberion, a leading innovator in quantum dot based

03/10/2024

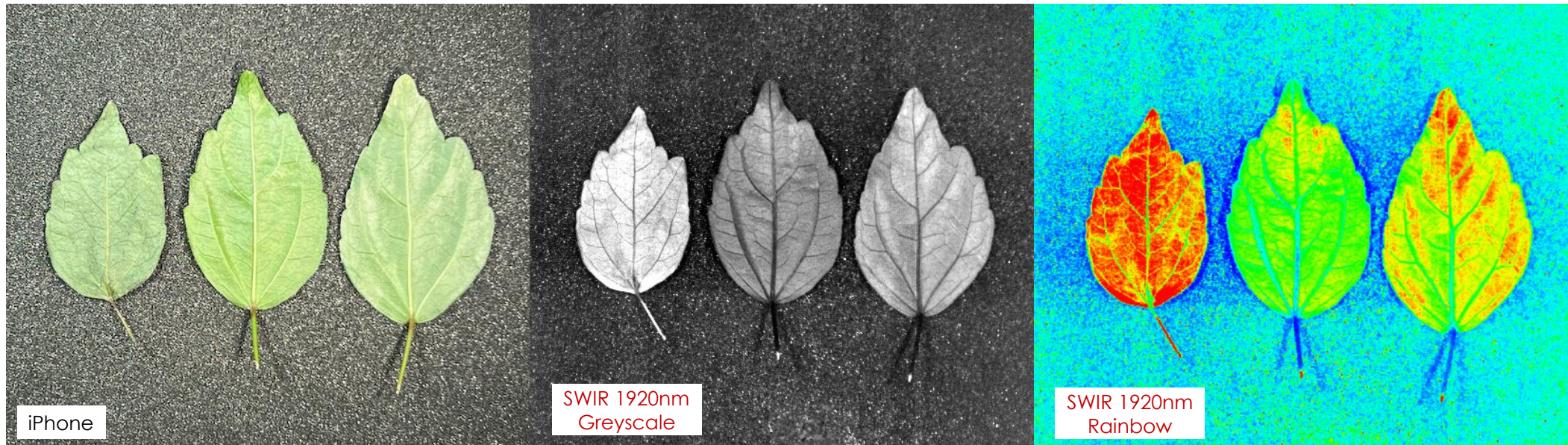


Moisture detection during free fall



Wet coffee beans appear darker than fresh ones at 1920 nm, which makes them easy to be detected even during free fall.

Water in leaves



Leaves from left to right

- Picked previous day
- Fresh leaf from healthy plant
- Leaf from plant not watered for 48 hours

Different levels of water content in leaves can be effortlessly identified, using 1920nm Bandpass filter.

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