



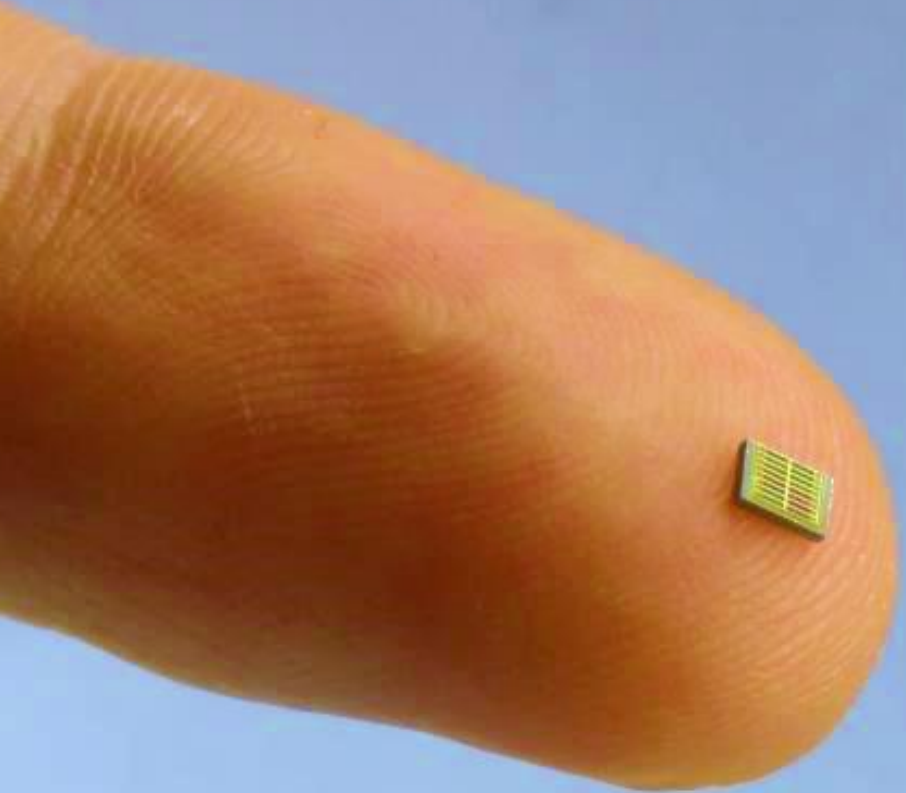
**Polyester or
Cotton?**



**Which Plastic
type?**



Adulterated?



The Spectral Revolution

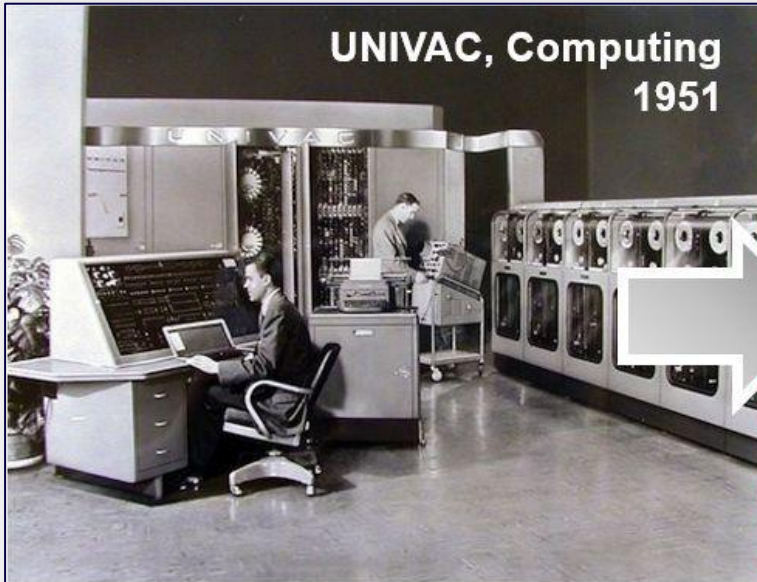
Maurangelo Petruzzella CEO,
Co-founder

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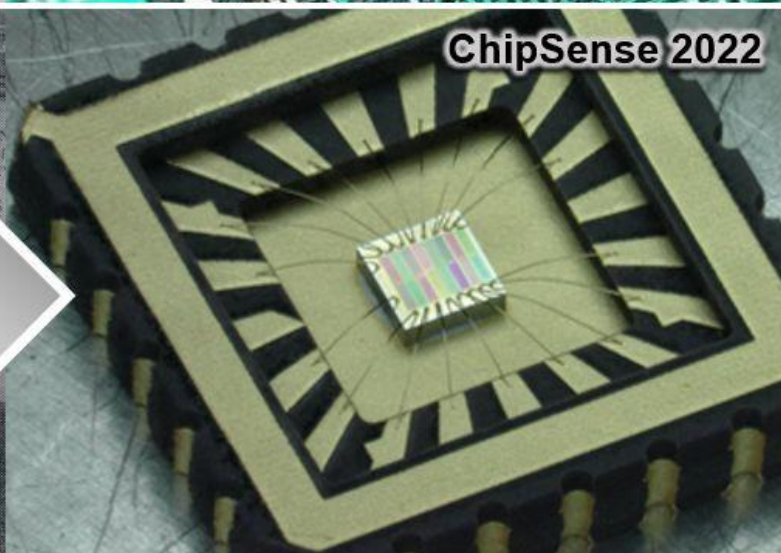


A spin-off of **TU/e** EINDHOVEN
UNIVERSITY OF
TECHNOLOGY

The Spectral Revolution



Electronics Integration
has revolutionized the
world.



Photonics Integration is
shaping the future,
here and now!

Near-Infrared Lab on-a-chip

ChipSense™

**Miniaturized
High Accuracy
IP Protected
Versatile**



How does it work?

“Unknown
Material”



Selective Detectors
+
Machine Learning

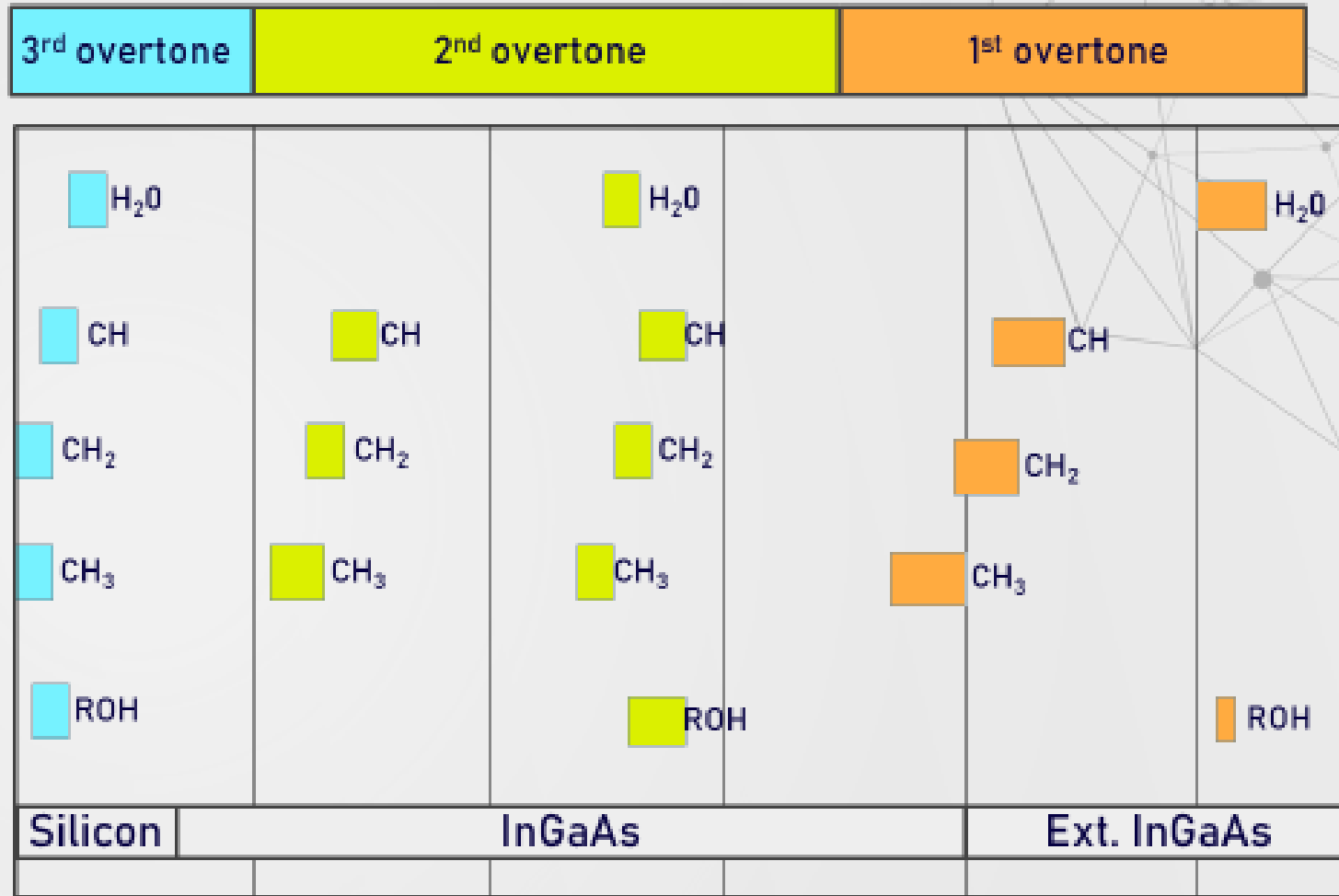


1 mm

16 spectral pixels =
Material Fingerprint

Classification and Quantification of material composition using light:
Fast, non-invasive, no sample preparation

Why longer wavelengths? (>1100 nm)



900 1100 1300 1500 1700 1900 nm

← Absorption range of functional organic group

- The spectral signatures at low wavelength (<1000 nm) are **ambiguous** and have low **absorption**
- **Longer wavelengths** = More sensitive and specific measurements
- Many applications are practically **not possible** in the VIS-3rd overtone region

Technology Comparison

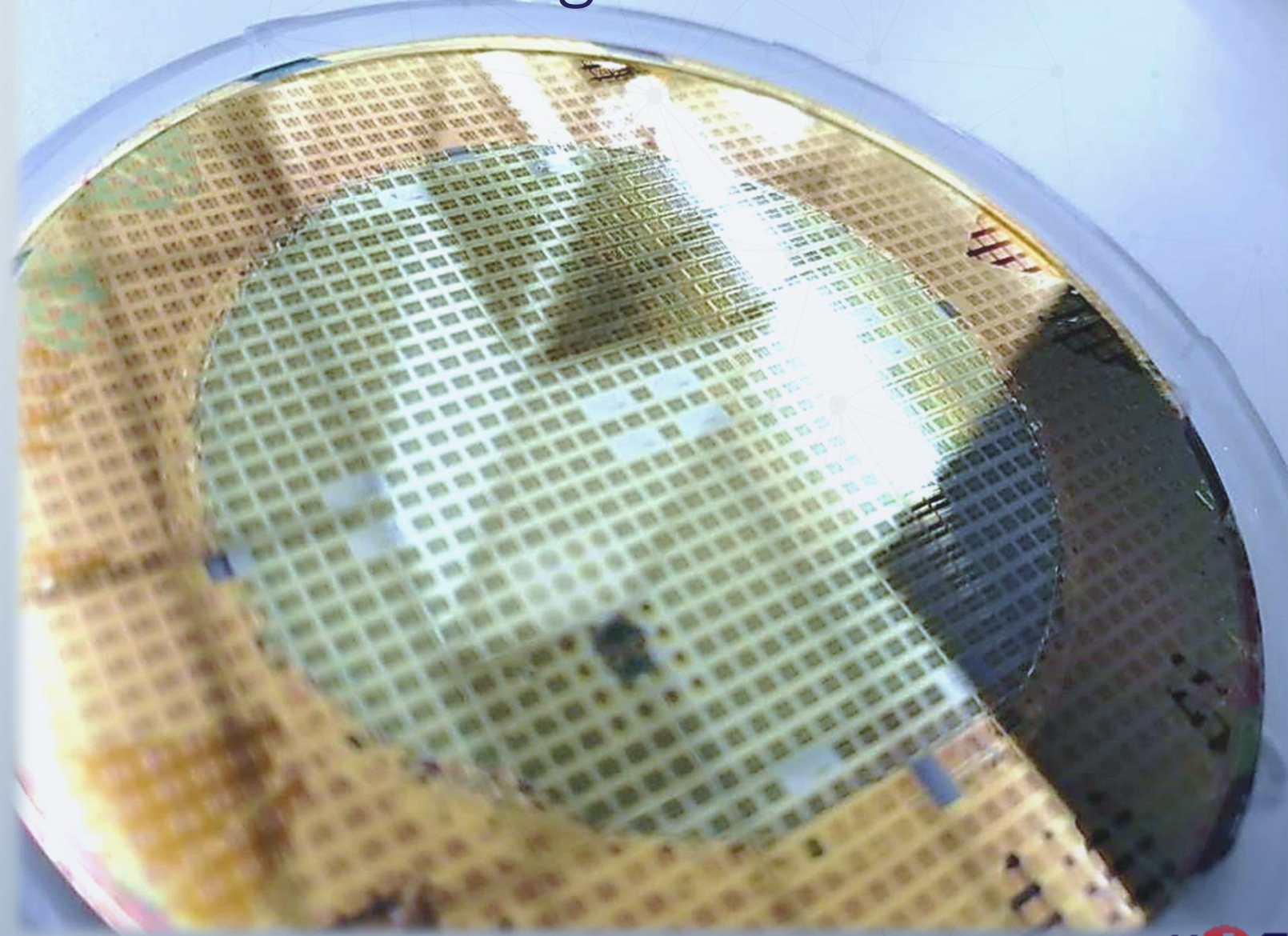
OUR TECH

| | FTIR | MEMS | PIC | Filters Based | | |
|----------------------------------------------------------------------|------------|------------|------------|-------------------|---------|------------------|
| | | | | VIS | Organic | Chipsense™ |
| Wavelength Range | Ext – SWIR | Sub – SWIR | Ext – SWIR | Less than 1100 nm | SWIR | SWIR Ext-SWIR |
| Volume Scale-up Low Cost | ✗ | ✗ | ? | ✓ | ✓ | ✓ |
| Shocks / Vibrations Resistance | ✗ | ✗ | ✓ | ✓ | ✓ | ✓ |
| Recalibration Degradation | ✗ | ✗ | ✓ | ✓ | ✗ | ✓ |
| SNR Sensitivity <i>(below 4k not reliable results)</i> | 1k | 100 - 1k | 1k | 100-1k | ~ 1k | 10k |
| Proven Tech / Market Ready | ✓ | ✓ | ? | ✓ | ? | ✓ |

The Beauty of Semiconductor Integration

**Thousands of Devices
on a single wafer**

Unparalleled



Past



Weeks
Expensive

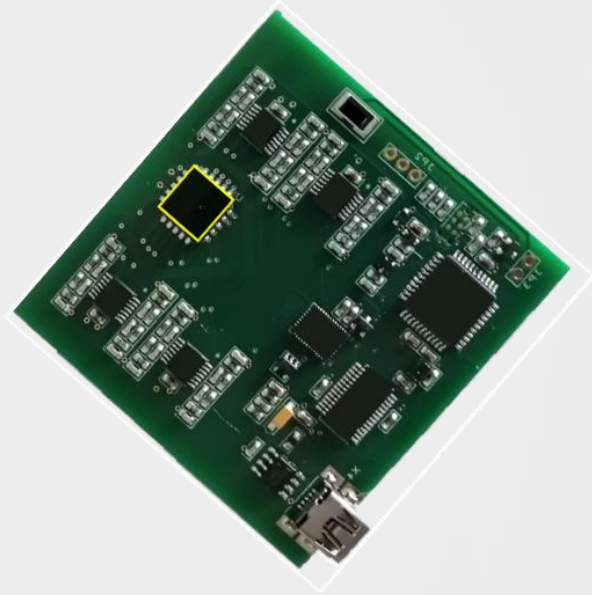
Now



Seconds
Cost-effective

Our Products

OEM Sensing Module



- 16 Channels (850-1700 nm)
- I2C Bus/USB-connection
- Customization possible

SpectraPod™



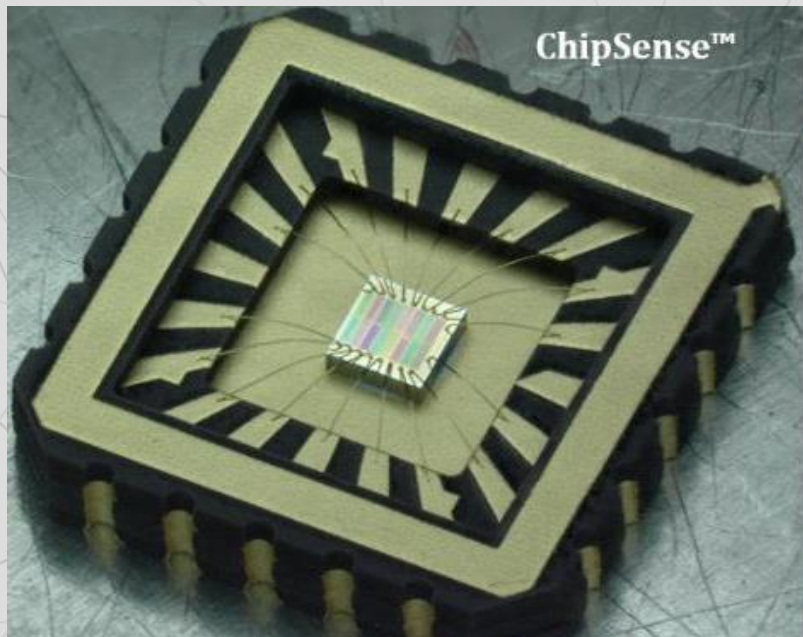
- Handheld and modular
- Illumination and Optics
- Software: SpectraByte™
- CE/FCC approved

Cloud Enterprise



- Cloud subscription
- API interconnectivity
- Real-time Data
- Customization possible

ChipSense™



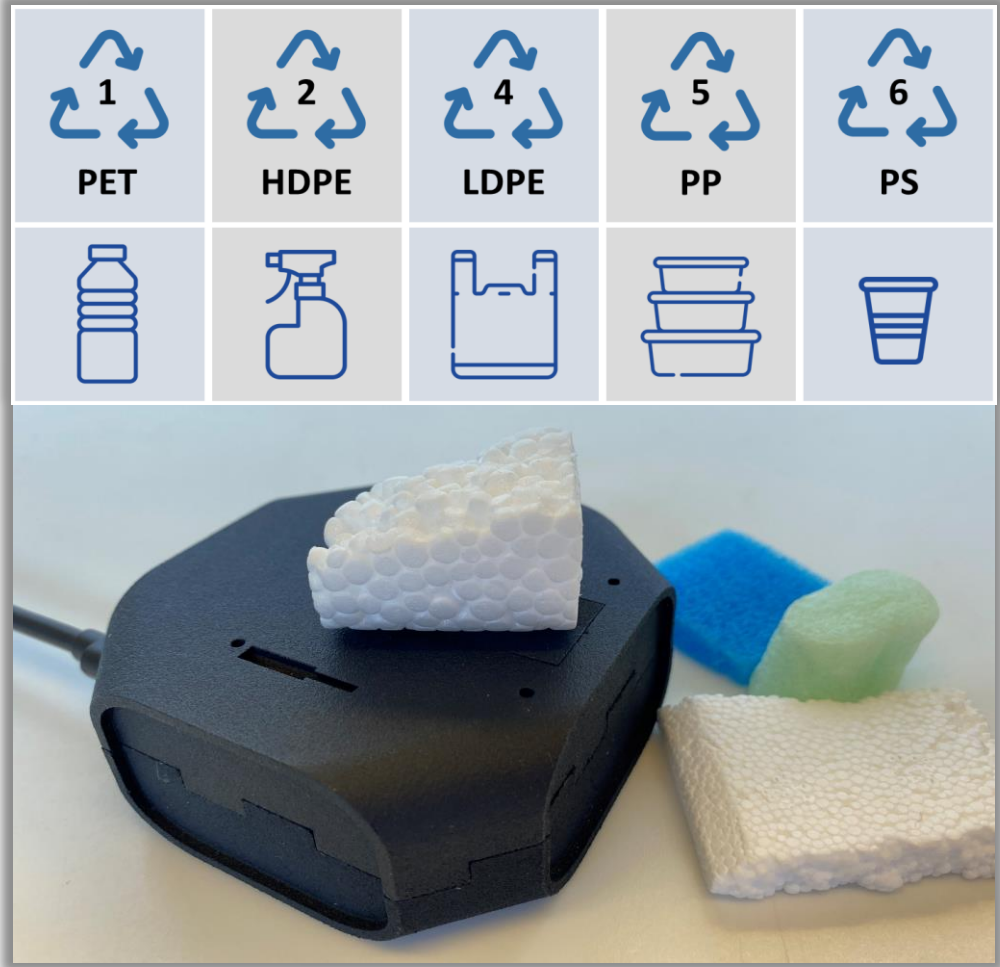
SpectraPod™



Application Cases

Plastics Classification

Material Classification Accuracy of 100%

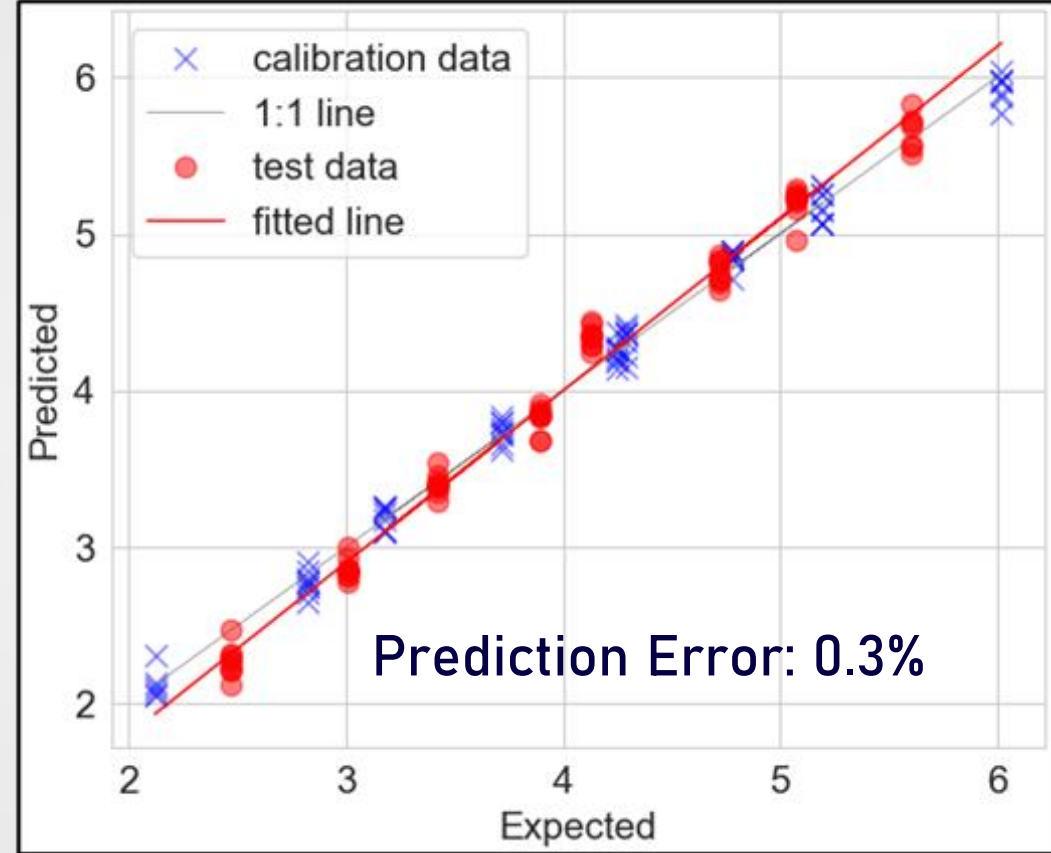


| | | | | | | |
|-------------|-----------------------|---------|--------|-------|-------|-------------|
| True type | 1: PET | 2: HDPE | 4:LDPE | 5: PP | 6: PS | 6f: PS foam |
| 1: PET | 1 | 0 | 0 | 0 | 0 | 0 |
| 2: HDPE | 0 | 1 | 0 | 0 | 0 | 0 |
| 4:LDPE | 0 | 0 | 1 | 0 | 0 | 0 |
| 5: PP | 0 | 0 | 0 | 1 | 0 | 0 |
| 6: PS | 0 | 0 | 0 | 0 | 1 | 0 |
| 6f: PS foam | 0 | 0 | 0 | 0 | 0 | 1 |
| | 1: PET | 2: HDPE | 4:LDPE | 5: PP | 6: PS | 6f: PS foam |
| | Predicted type | | | | | |

Sensors, 22(18), 7027 (2022)

Fat Content in Milk

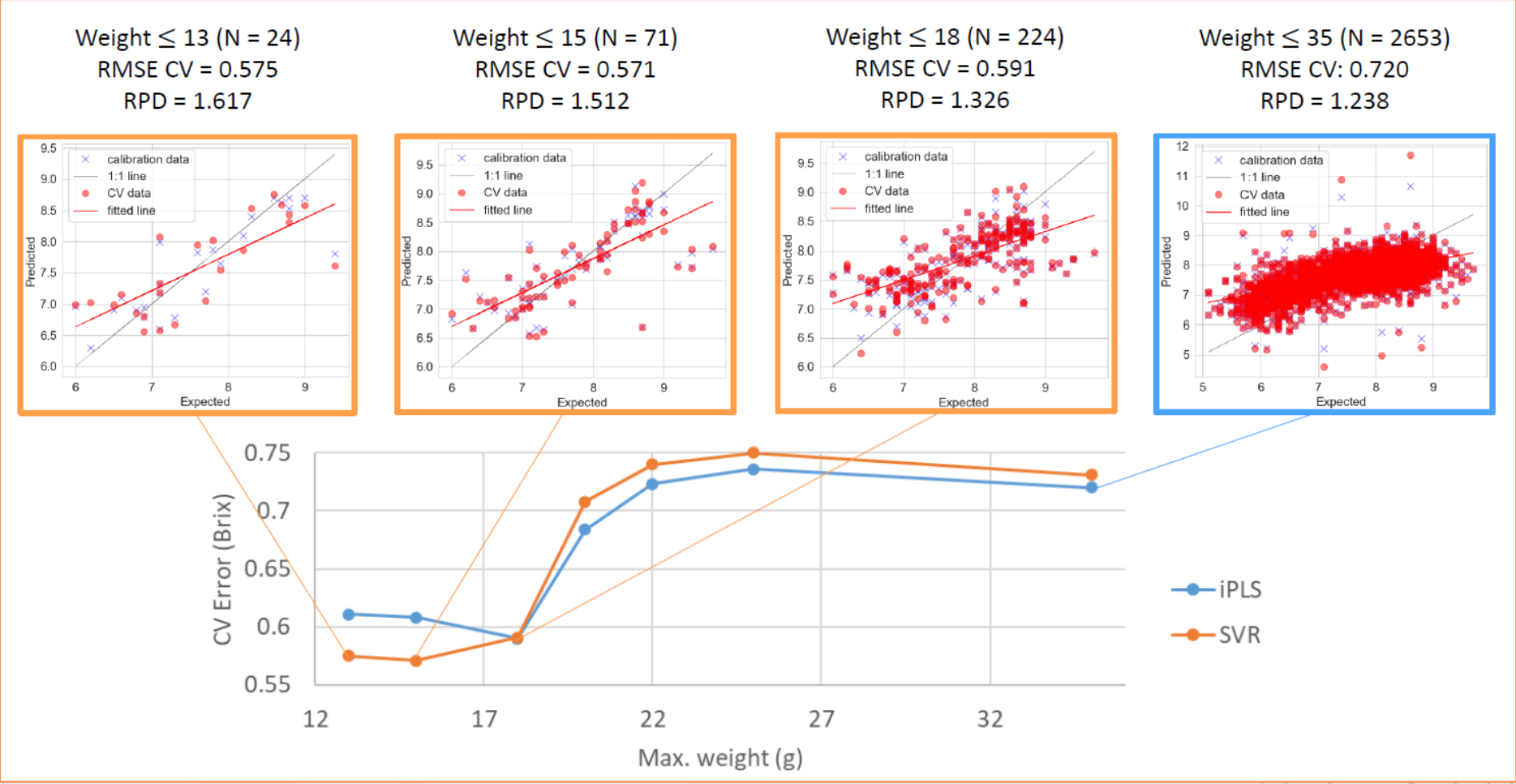
Quantification Accuracy > 98%



Nat. Commun. (2022)

Sugar/Ripeness level in Tomatoes

In collaboration with



Error of Prediction = ~0.57 Brix For small Cherry tomatoes

Let's have a Cup of Coffee...

Different origin, roasting, taste



| | | | | | | | | | |
|---|---|-------|-------|------|---|------|---|---|---|
| A | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 0 | 0 | 0.83 | 0 | 0 | 0.17 | 0 | 0 | 0 |
| D | 0 | 0.042 | 0 | 0.96 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| F | 0 | 0 | 0.042 | 0 | 0 | 0.96 | 0 | 0 | 0 |
| G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| H | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | A | B | C | D | E | F | G | H | I |

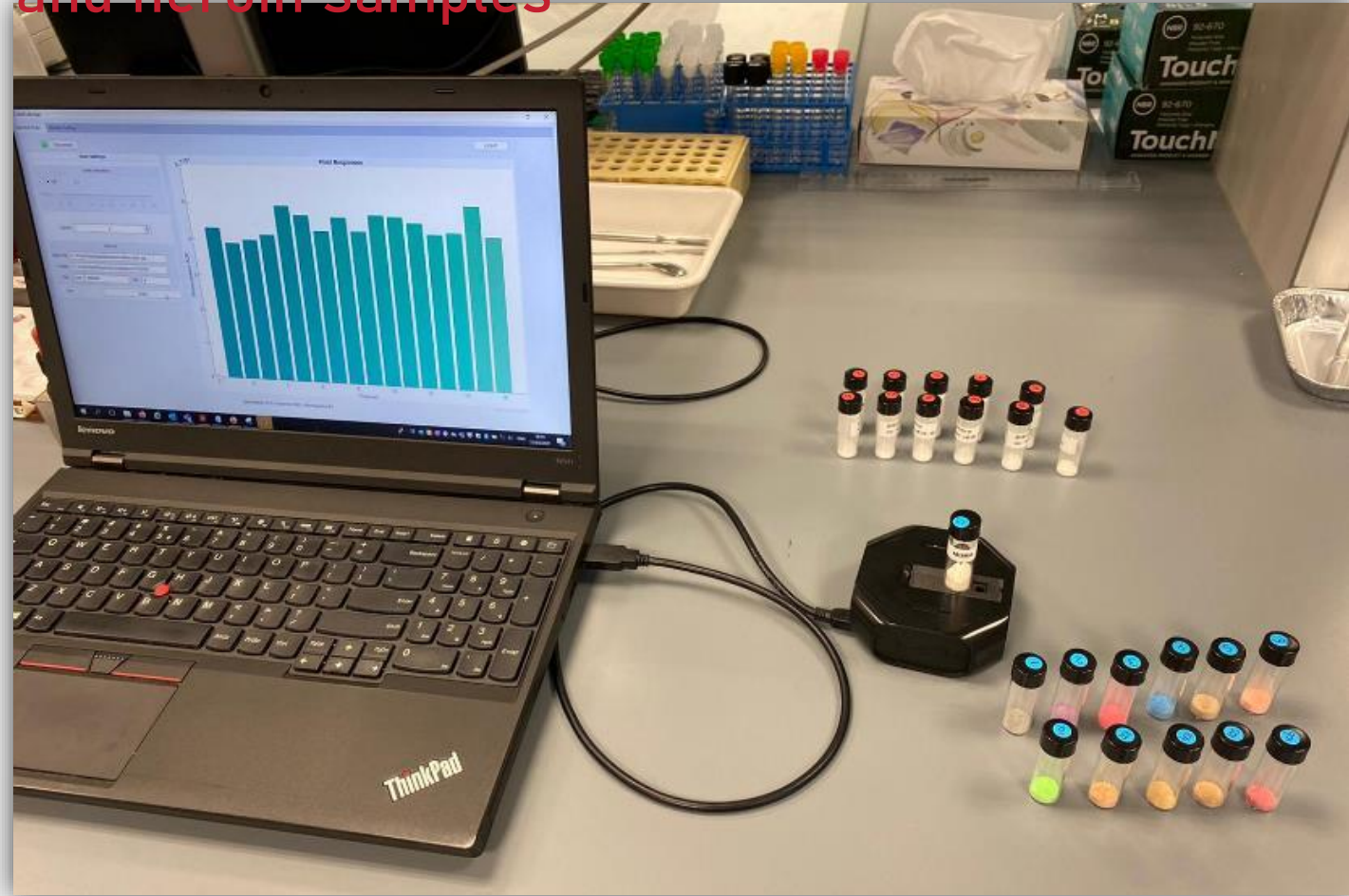
predicted label



Classification Accuracy > 97%

Illegal Drugs Identification

XTC pills, reference cocaine, MDMA, amphetamine, methamphetamine and heroin samples



Talanta (2022)

Test set prediction: 100%

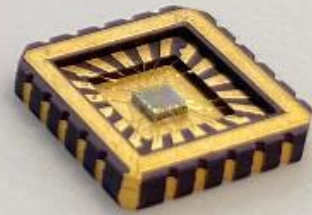
| | | | | | | | | | | | |
|-----------------|----|----|----|----|----|----|----|----|----|----|----|
| MDMA | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| amphetamine | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| caffeine | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| cocaine HCl | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | |
| cocaine base | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | |
| heroin | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | |
| ketamine | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | |
| levamisole | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 0 | |
| lidocaine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | |
| methamphetamine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | |
| paracetamol | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |

true label

predicted label



**Everybody will use a Spectral Sensor in 2030
in the same way that we all use GPS today**



**Join the
Spectral Revolution!**