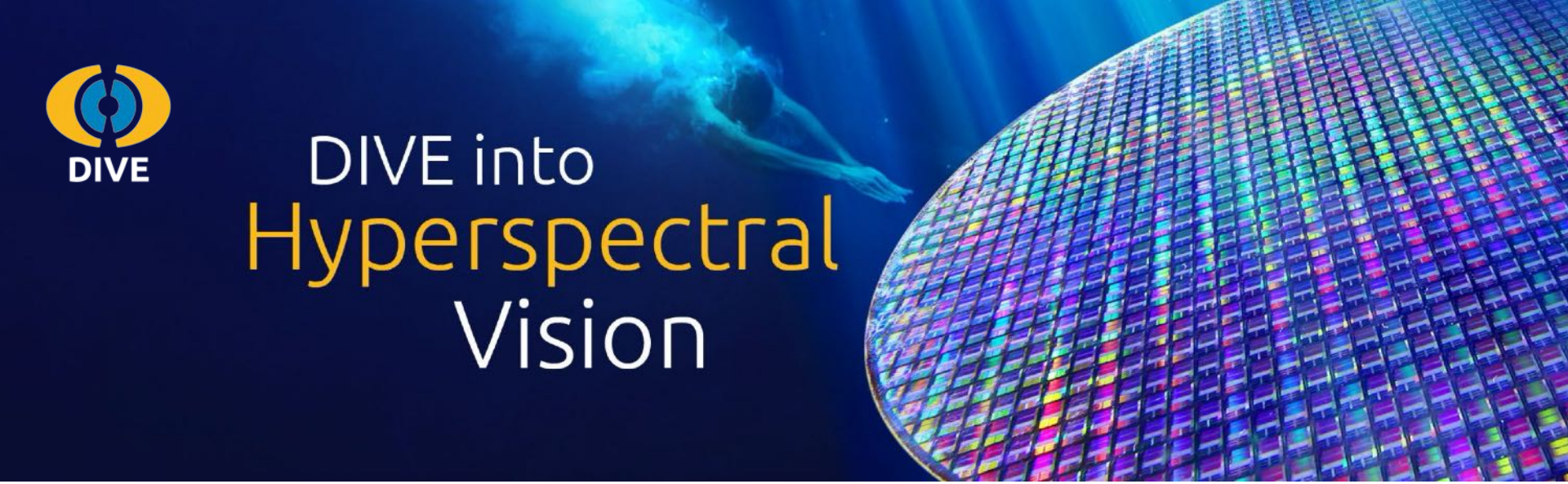


Hyperspectral Vision Technology introduction

DIVE imaging systems GmbH

Comprehending the invisible

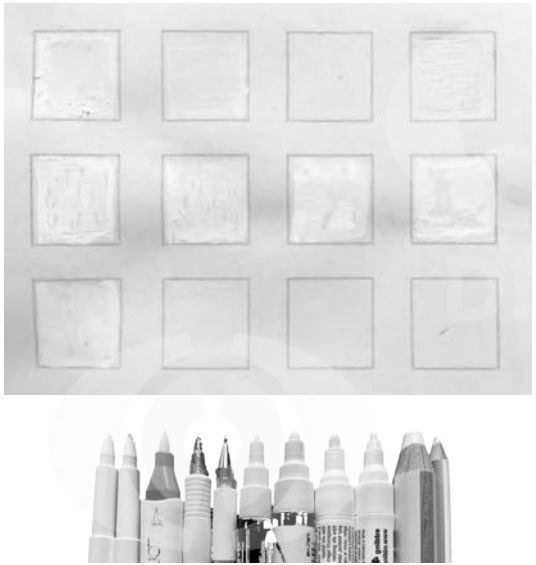
1 color (monochrome)

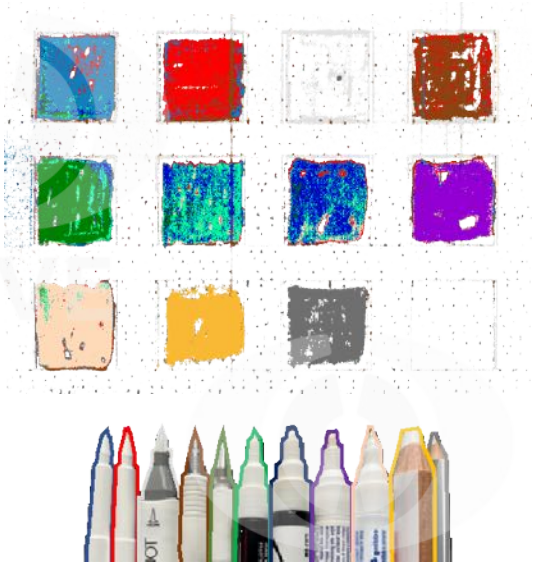
3 colors (RGB)

1000 colors

Machine Vision

Hyperspectral Vision





TECHNOLOGY

1 color (grayscale)

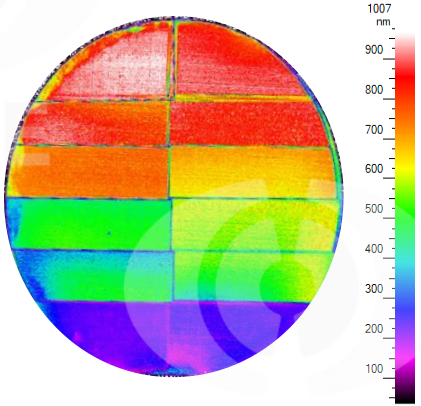
information:
size | shape | texture

3 colors (RGB)

information:
size | shape | texture | **color**

1000 colors

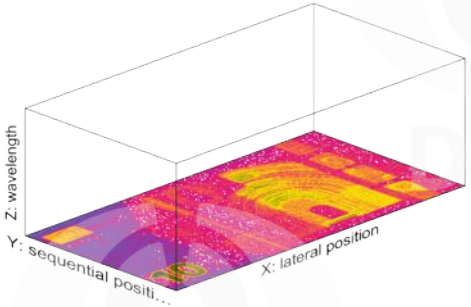
information:
size | shape | texture | color
thickness



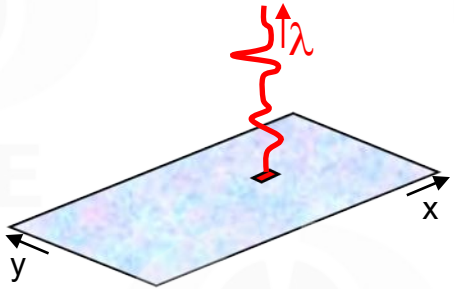
HYPERSPECTRAL VISION (HSV)

Hyperspectral Vision (HSV)
= combination of spectroscopy and imaging

sample is characterized by
 # sub-images (for each λ)



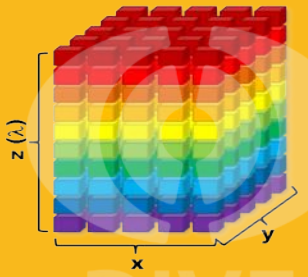
each **pixel** is characterized by a **complete spectrum** of the reflected or transmitted beam



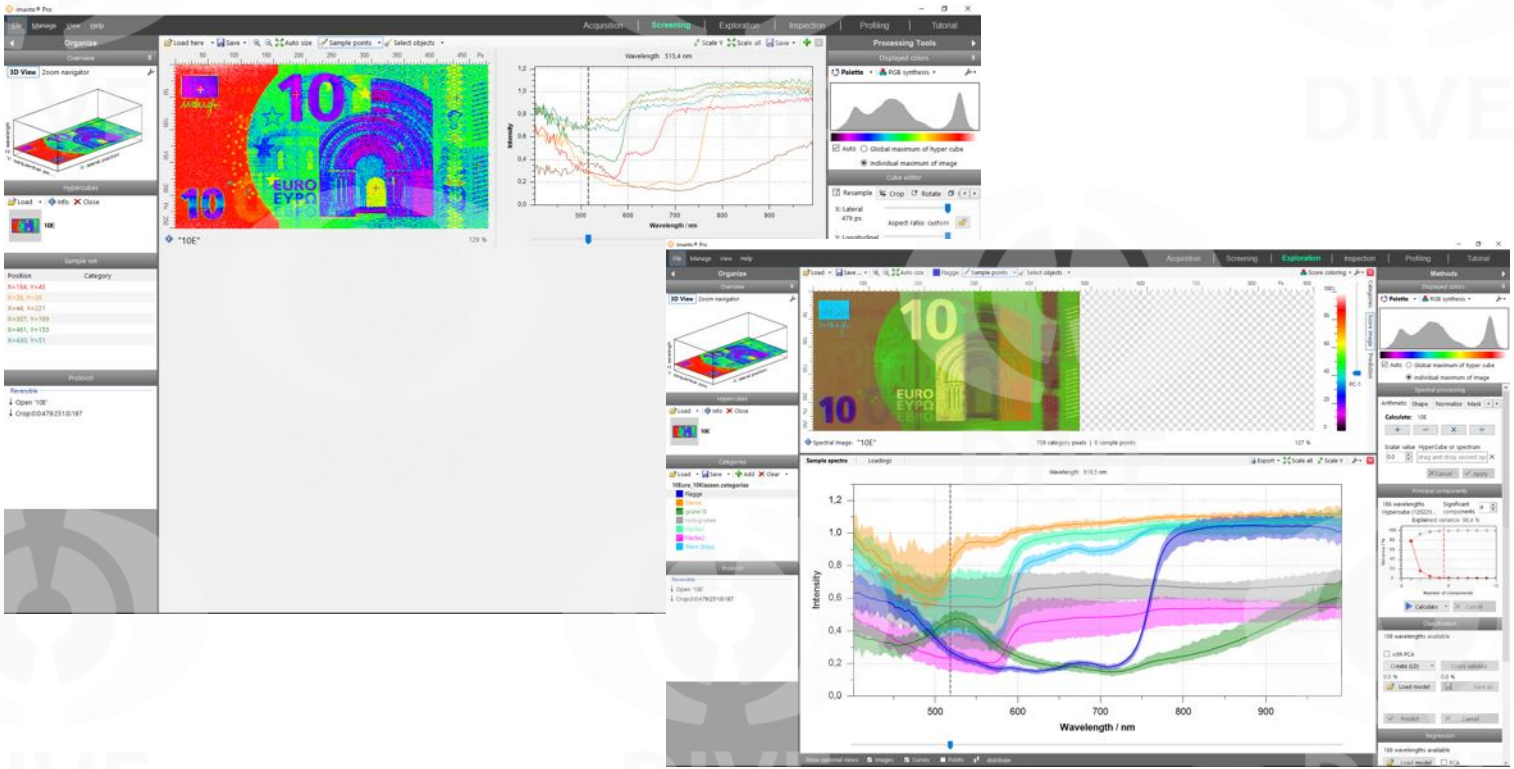
HSI = analysis and evaluation of **spatial differences** in sample chemistry / sample morphology / sample topology

The „Hypercube“

- the HSI raw data are called “Hypercube”
- Reflection, Transmission, Fluorescence, Raman, ...
- = $f(x, y, \lambda_1, \lambda_2 \dots \lambda_n)$
- UV – VIS – NIR - MIR

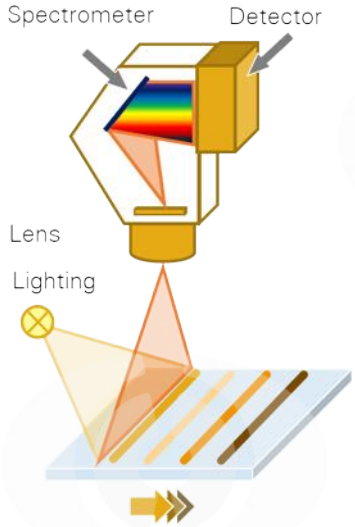


INTERACTIVE EXAMPLE

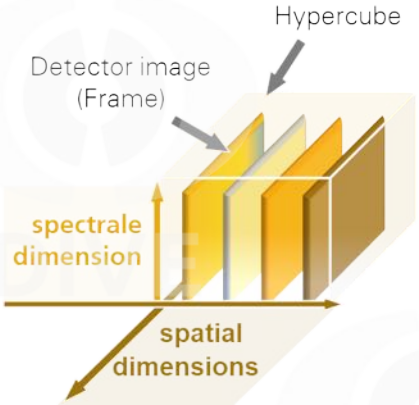


HSV: Generation of information

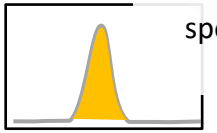
Hardware



Raw data



Data analysis



spectroscopic analysis

AI / machine learning

Information

Feature image

Material | thickness

Area properties

Quality | Performance
Cleanliness | Adhesion

HSV: VERSATILE MEASUREMENT DESIGNS

Hardware	Raw data	Data analysis	Measurement parameters

Camera
Spectral range: (UV –IR)
#pixel → $\Delta\lambda$, Δx

Lens (+distance)
FOV | Δx | Δy

Lighting
broadband | Laser
black light | LED
diffuse |specular | ring

Drive
Δy

Reflection (UV-IR)

Transmission (UV-IR)

Fluorescence

Raman

Dark /bright field

Exploration

Classification

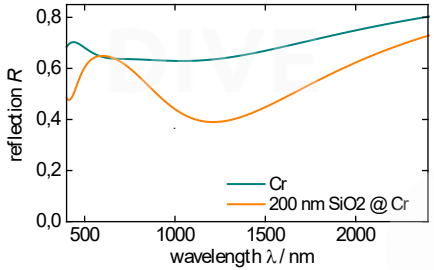
Regression

VNIR – Standard
Laser-HSI
λ: 535 – 1000 nm
FoV: 100 mm @ 150 µm
5 mm @ 5µm

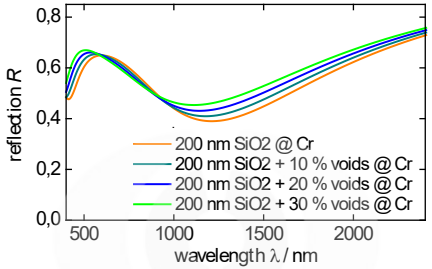
VNIR-Microscopy
λ: 400 - 1000 nm
FoV: 1,8 mm @ 1,8 µm
0,45 mm @ 0,45 µm

SWIR- Standard
λ: 1000 – 1700 (- 2300 nm)
FoV: 145 mm @ 450 µm

SPATIAL THIN FILM INSPECTION

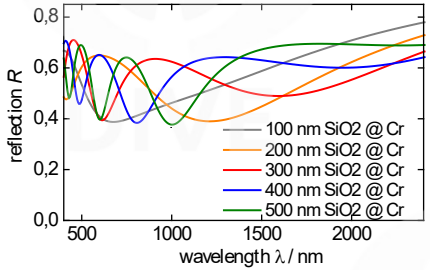


Presence of a layer

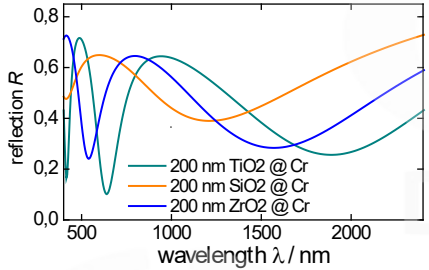


Layer porosity

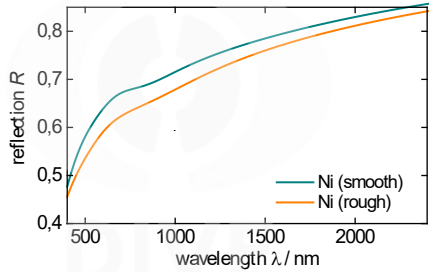
Layer thickness



Layer material



Surface roughness



Access to sample parameters

- presence of layer
- material
- layer thickness
- porosity
- surface/interface roughness
- … their combinations
- … and much more …

… at any point of the sample area

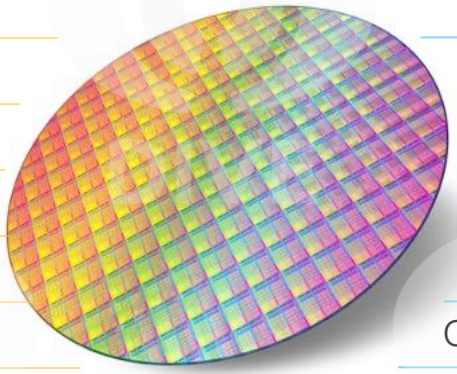
APPLICATIONS

Wafer processing

- Implantation
- Metallisation
- Cleaning
- Etching
- Polishing
- Resist deposition
- …

Wafer inspection

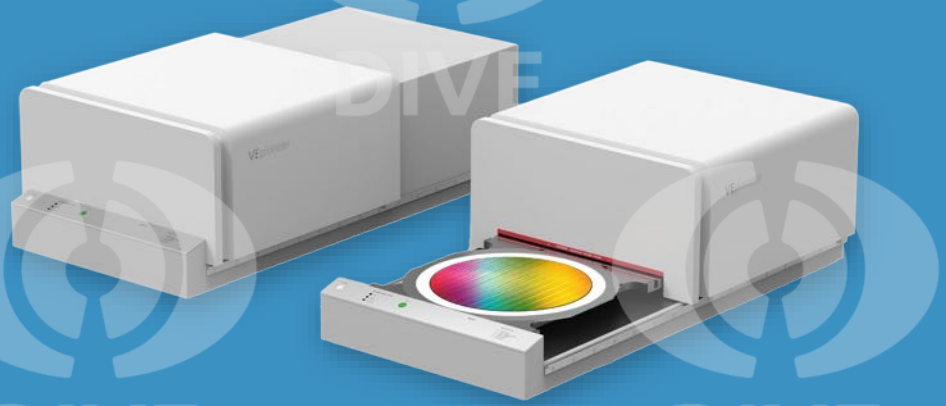
- Geometric accuracy
- Contamination
- Film thickness
- Homogeneity
- Surface energy
- Chemical composition
- …



Use-cases

- Polishing / Planarization
- Lithography
- Metallisation
- Defect density
- Pre-Assembly
- Physical failure analysis

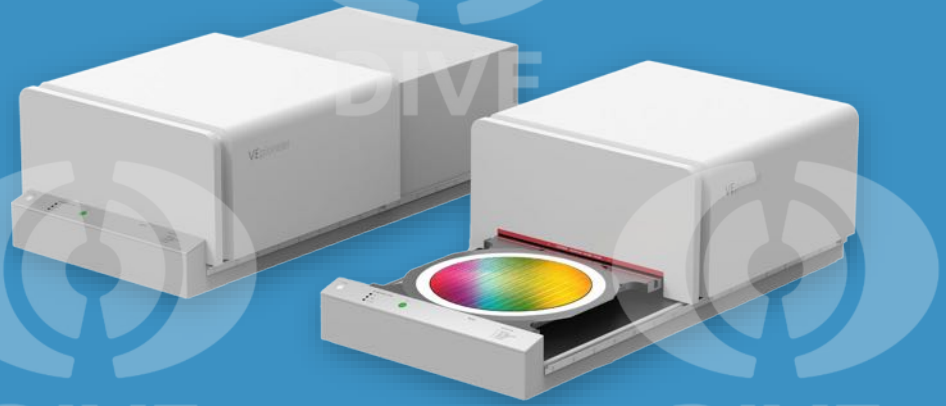
Hyperspectral Vision Systems



VEpioneer®

assesses the entire (wafer) surface,
in a fast and non-invasive manner.

VEpioneer® + VEsolve®



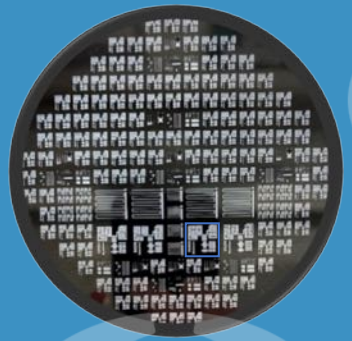
Efficient semiconductor manufacturing

Resource-saving production

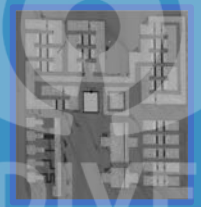
Cost reduction

Comprehending the invisible

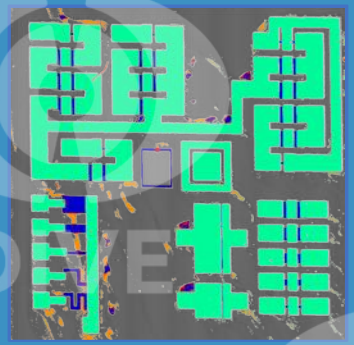
Wafer



Wafer for educational purposes

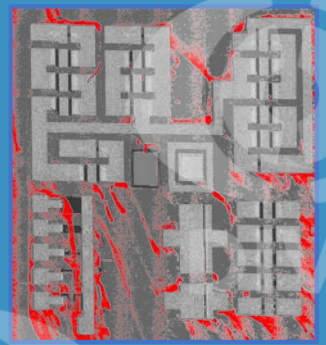


Material



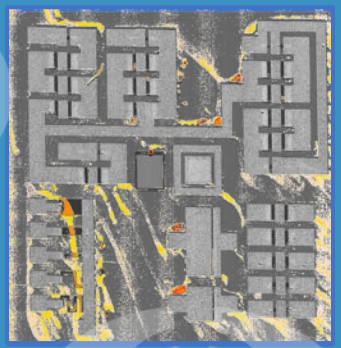
- Silicon (+SiO_x)
- Residuals
- Aluminium (+AlO_x)
- Gateoxide
- Contamination

Localisation



Contaminations (Residuals)

Quantification



0 thick

Contamination thickness

DIVE imaging systems GmbH

Comprehending the invisible.

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eXIST Existenzgründungen aus der Wissenschaft

ESF Europäischer Sozialfonds für Deutschland

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