



# Technologien für miniaturisierte Gassensoren für die Messungen von VOC

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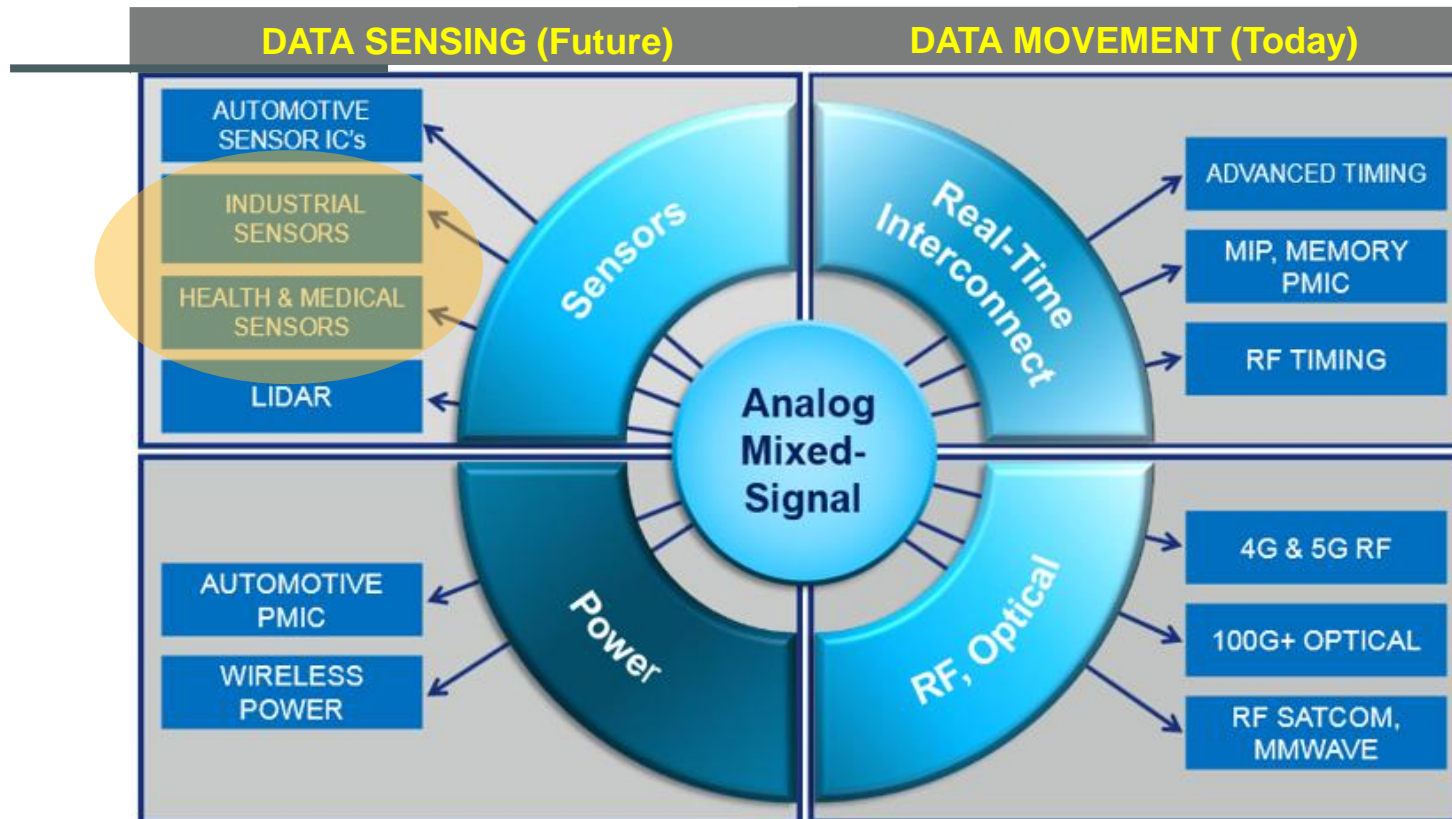
WaBoLu Innenraumtage , Berlin, 2019

# Outline

- About IDT
- Market Overview and Demands for Gas Sensors
- Gas Sensor Applications
- Gas Sensor Basics and Types of Sensors
- IDT goes MOx
- Summary

# IDT Fields of Expertise

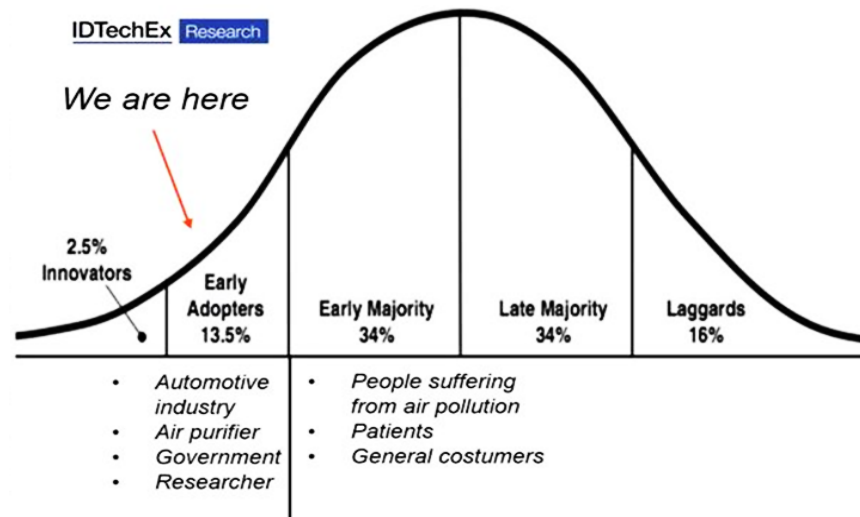
## Analog Mixed-Signal Competencies



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# Market Overview

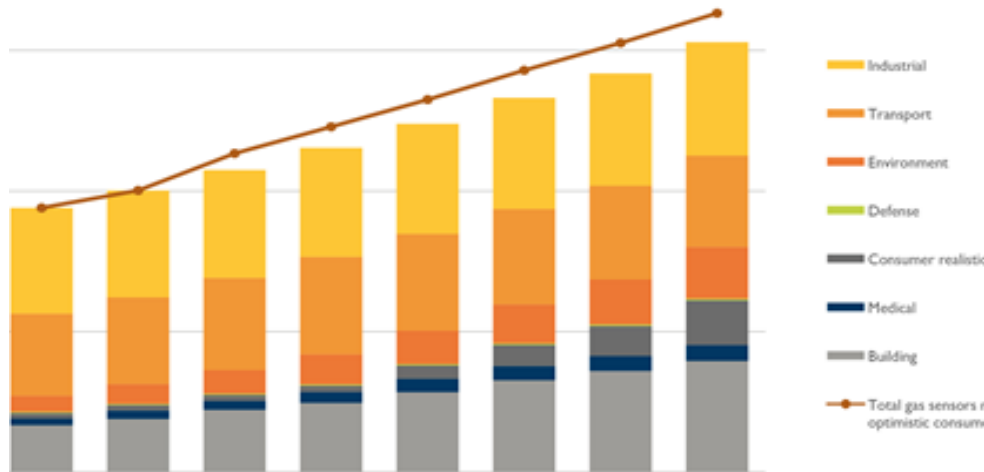


- We are still at the early stage of adopting gas sensors for consumer
- Early adopters will come from **automotive** industry, **air purifier** devices, HVACs and governments (smart city projects) researchers and **those who suffer from air pollution**
- Increasing demand for air monitoring (health awareness)
- Large market for Smart Home/Smart Devices/Wearables but also Automotive is waiting for solutions
- One challenge is how to make use of the information that the gas sensor provides and link it to customer

# Market Overview

## 2014-2021 gas sensors forecast - In US\$ million value

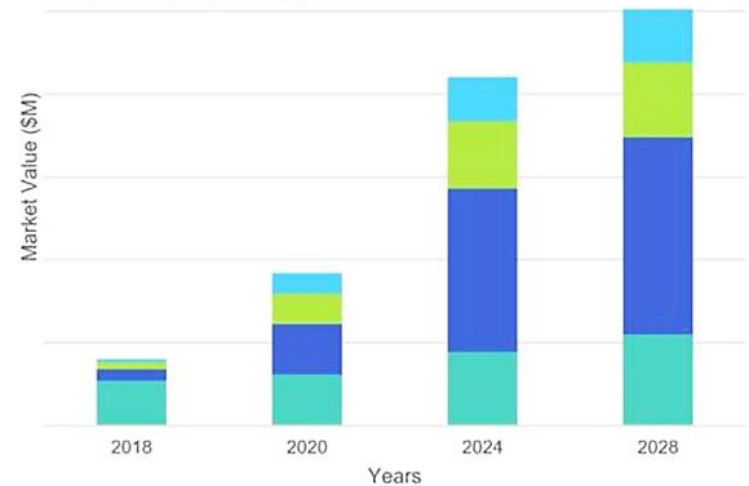
(Source: Gas Sensor Technology and Market Report, February 2016, Yole Développement)



## Gas sensor in IoT applications

Automotive personal devices Smart City sensors smart home

IDTechEx Research



## Barriers to market growth

- No IAQ universal standard
- Connecting devices within the building
- Chemistry experiments & validation

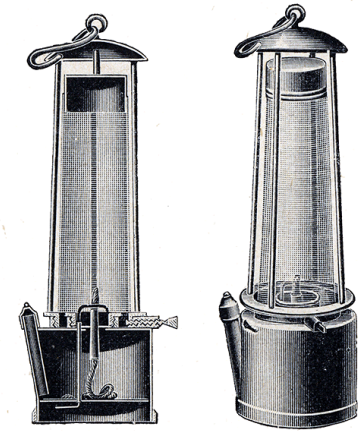
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# Applications – Industrial

## Industrial Applications:

- Safety
- Process control
- Emission control
- ...



Source: Wikipedia



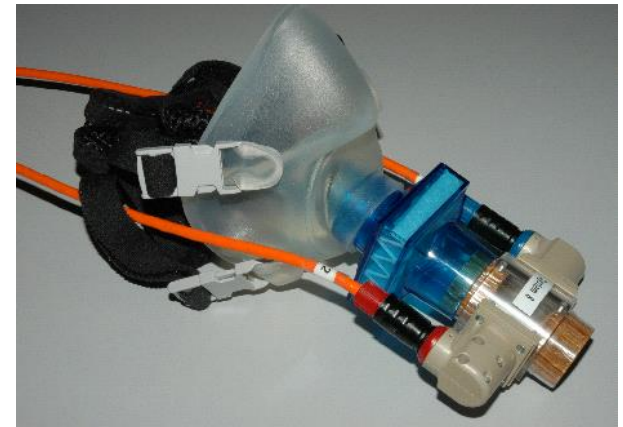


# Applications – Medical

## Medical Applications:

### ➤ Breath Analyses

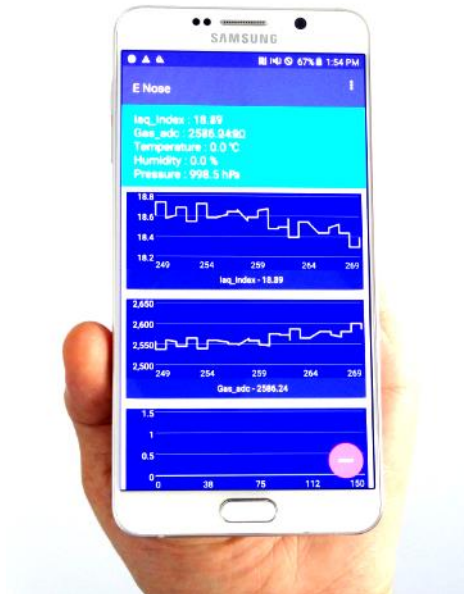
- Asthma
- Metabolism (fat burning)
- Cancer
- Kidney Disease
- Halitosis
- ...



# Applications – Consumer

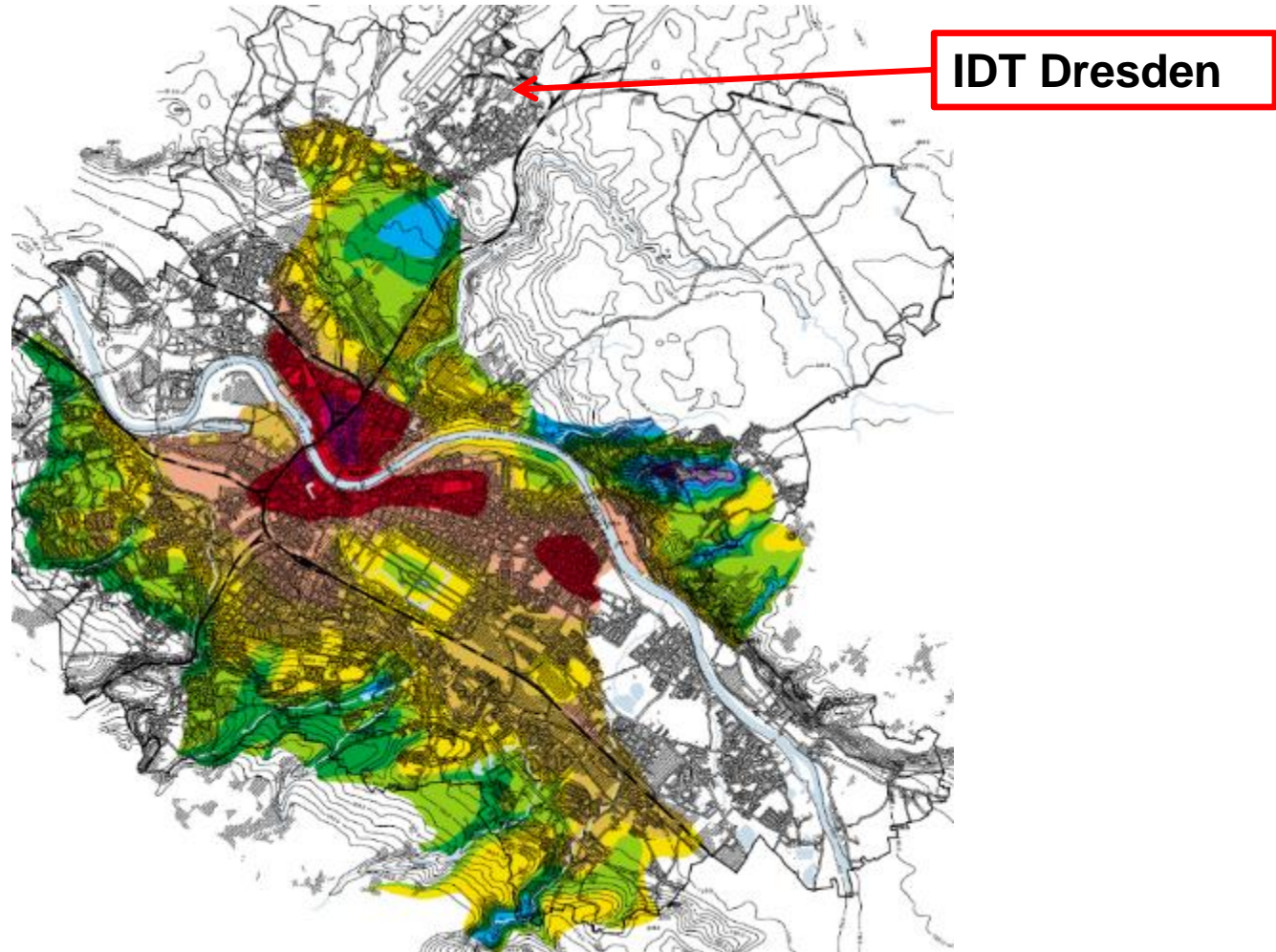
## Consumer Applications:

- Wearables
- Smart Homes
  - AC / Fans
  - Smell control
  - ...
- Refrigeration



→ Target gases: Volatile Organic Compounds (VOC) to monitor air quality, outgasing, pollution etc.

# Application – Life Quality

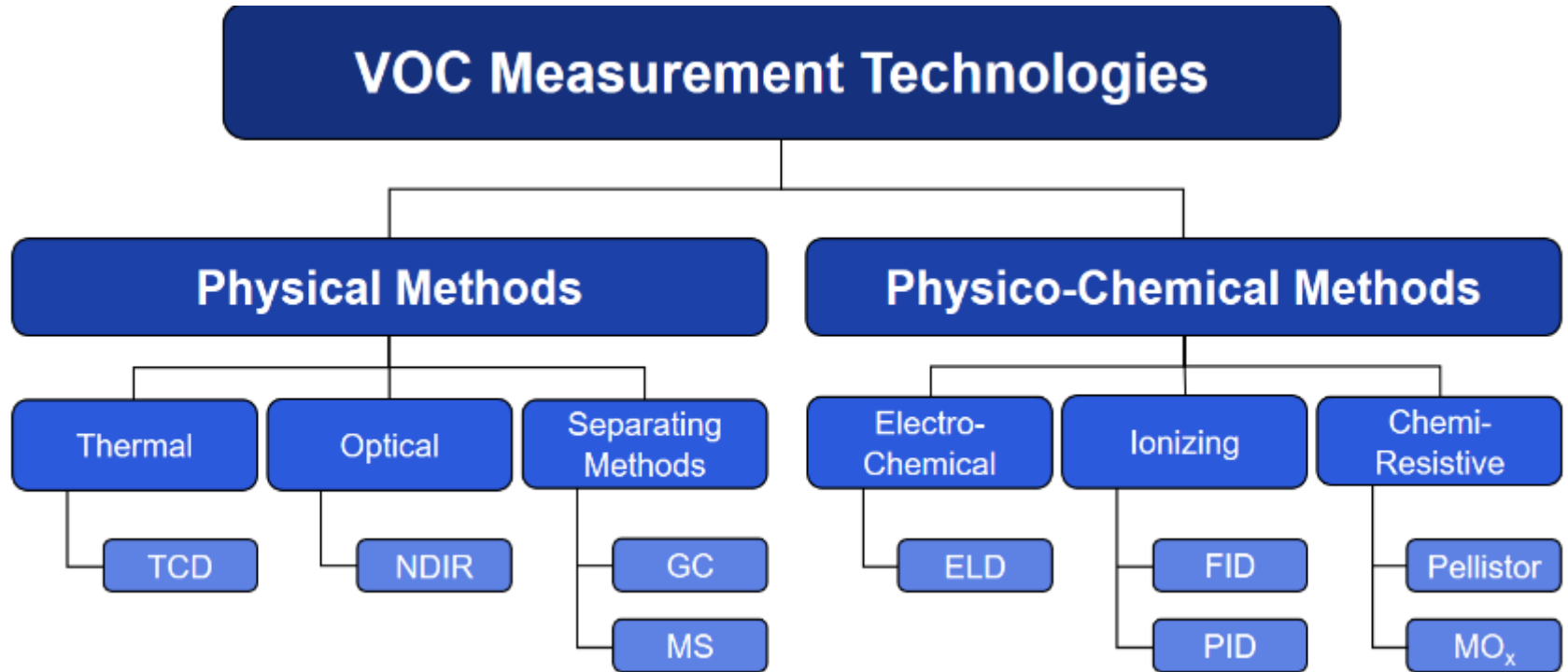


Source: City of Dresden, Environmental Department

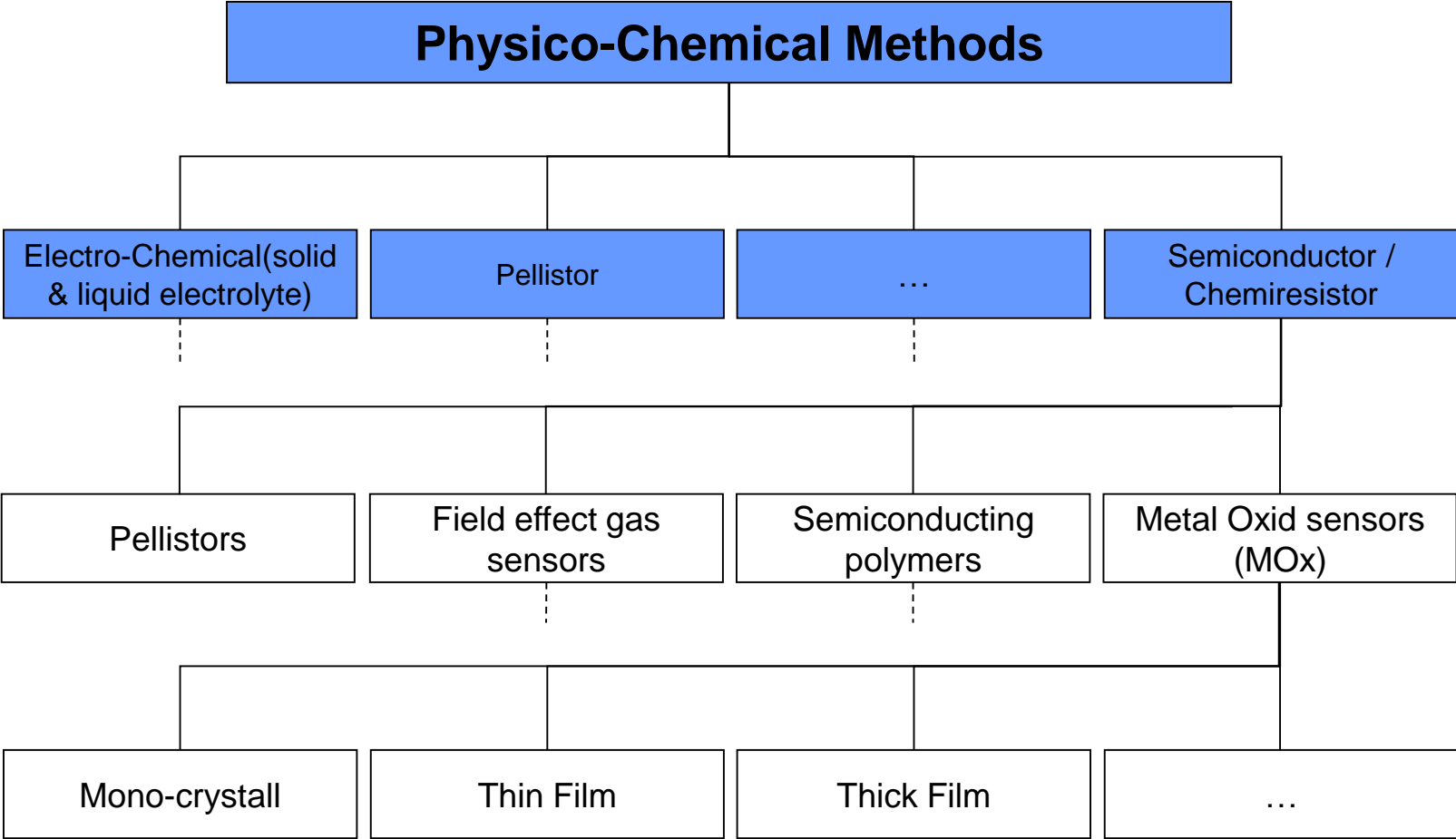
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# Sensor Principles



# Sensor Principles



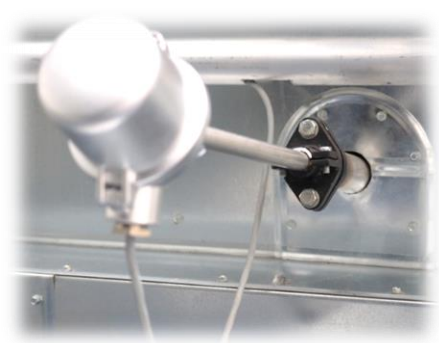
# Sensor Principles (selection)

## ➤ Electrochemical

- Chemical reaction → Movement of ions in electrolyte  
→ Electrical signal
- Lifetime < 3 years (liquid electrolyte)
- Lifetime > 5 years (solid electrolyte)

→ **Low selectivity and/or selectivity only available for a few gases (e.g. Lambda-Probe in Automotive, certain toxic gases)**

→ **Can be damaged by extreme environments**

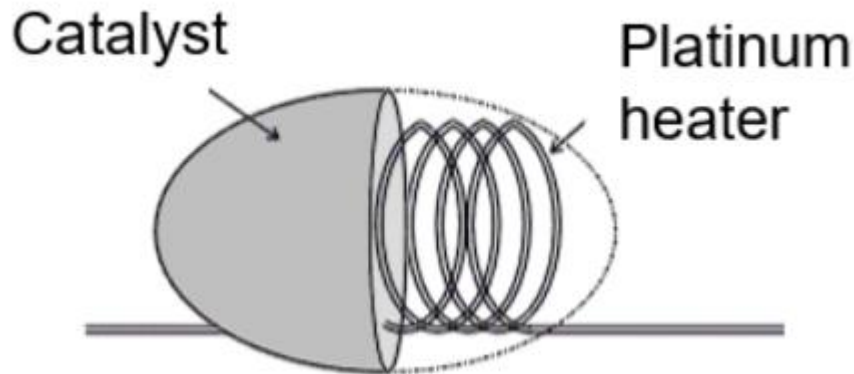


# Sensor Principles (selection)

## ➤ “Pellistor” (Pellet + Resistor)

- Resistor works as heater and temperature sensor
- Gas “burns” on hot catalytic surface  
→ Temperature change

→ **Low sensitivity (explosive levels) and very low selectivity**

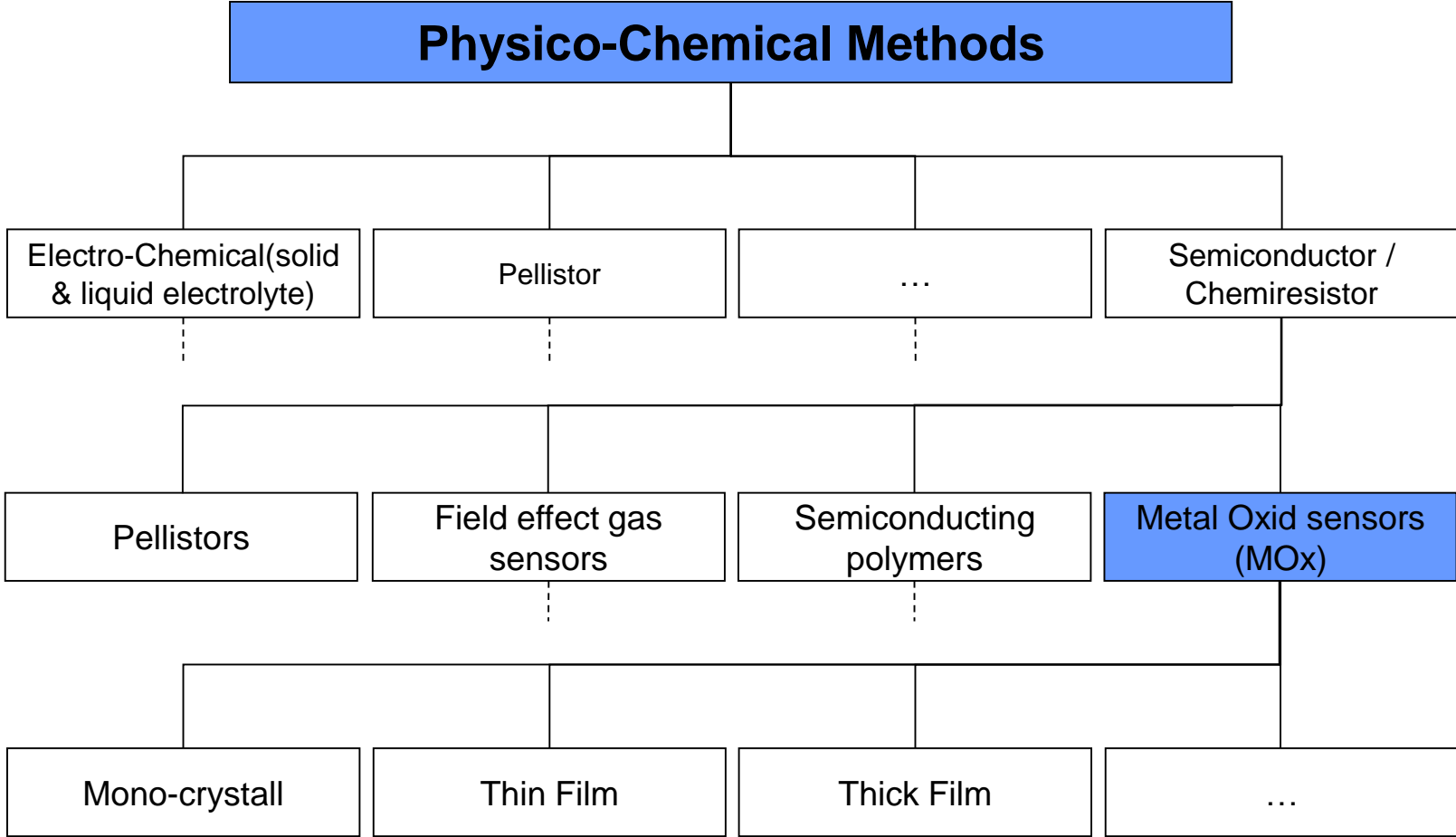




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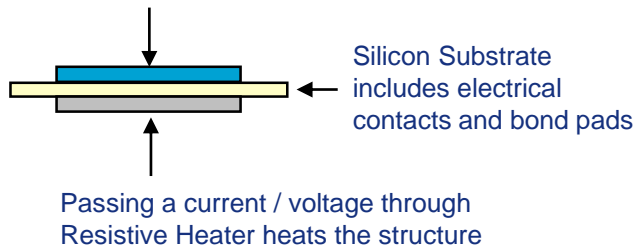
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# Sensor Principles

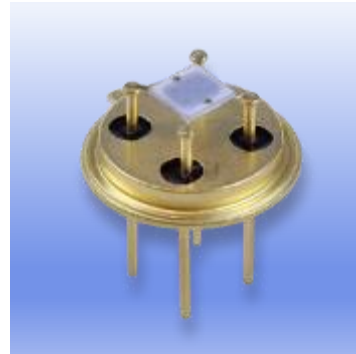


# Sensor Principles (MOx Sensors)

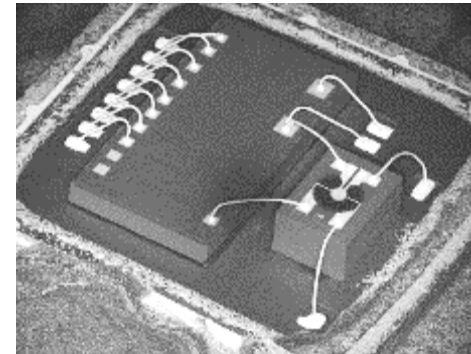
Heated Sensing Material Changes Resistance in presence of target gas



Working Principle



Ceramic-based Analog Gas Sensor



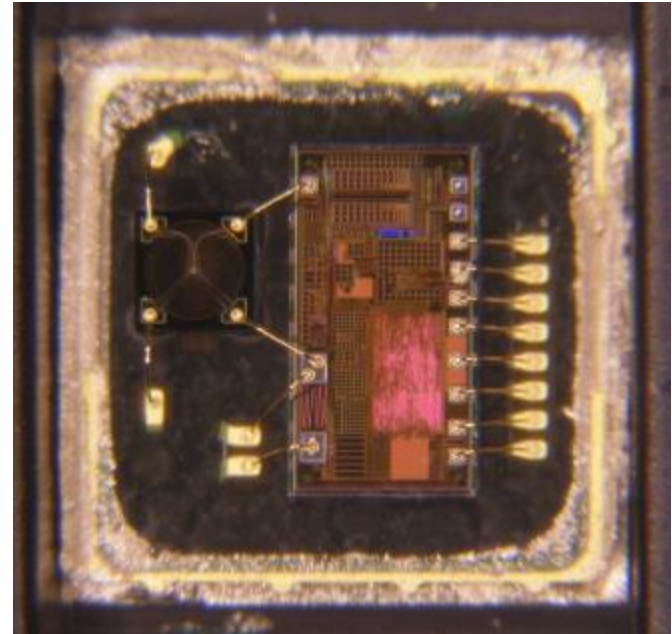
Silicon-based Digital Gas Sensor

- Sensors reliably measure gases in air
- Fast response and recovery to gas
- Excellent stability and sensitivity
- Sensors operate via diffusion or active flow

# Sensor Principles (MOx Advantages)

## ➤ Advantages for using MOX Sensors

- Well known technology with many years in industry
- High volume production possible (low price)
- High sensitivity (ppb to ppm range)
- Able to detect wide range of gases
- Extremely low power consumption
- Very small dimensions
- Chemically robust
- Mechanically robust
- Withstands harsh environments
- Long lifetimes
- Easy to implement



# VOC Sensors for Indoor Air Quality

## Status:

- At present, there is no global standard, which defines Indoor Air Quality (IAQ)
- Some countries have local approaches, research papers and studies, which give indication on ambient air pollution and its implications – all have one common link: **TVOC** ↔ **IAQ**
- Some publications also include non-VOC related IAQ parameters such as Radon, Mercury, Bacteria and others, which are not detectable with gas sensors

## Umweltbundesamt (UBA)

IDT IAQ Rating	Reference Level*	Air Information	TVOC (mg/m³)	Air Quality
≤ 1.99	Level 1	Clean Hygienic Air (Target value)	< 0.3	Very Good
2.00 – 2.99	Level 2	Good Air Quality (if no threshold value is exceeded)	0.3 – 1.0	Good
3.00 – 3.99	Level 3	Noticeable Comfort Concerns (Not recommended for exposure > 12 months)	1.0 – 3.0	Medium
4.00 – 4.99	Level 4	Significant Comfort Issues (Not recommended for exposure > 1 month)	3.0 – 10.0	Poor
≥ 5.00	Level 5	Unacceptable Conditions (Not recommended)	> 10.0	Bad

Source: Umweltbundesamt, Beurteilung von Innenraumluftkontaminationen mittels Referenz- und Richtwerten, (Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz, 2007)

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# Summary for (T)VOC Gas Sensors

## What is expected

3-Sensor “S”:

Sensitive (ppt to %); Gas selective; Very long-term stable

## What is needed

Disadvantages:

Size, Price, Complexity



## What you get

Good compromise  
of all factors above





Thank You

Analog Mixed Signal Product  
Leadership in Growth Markets