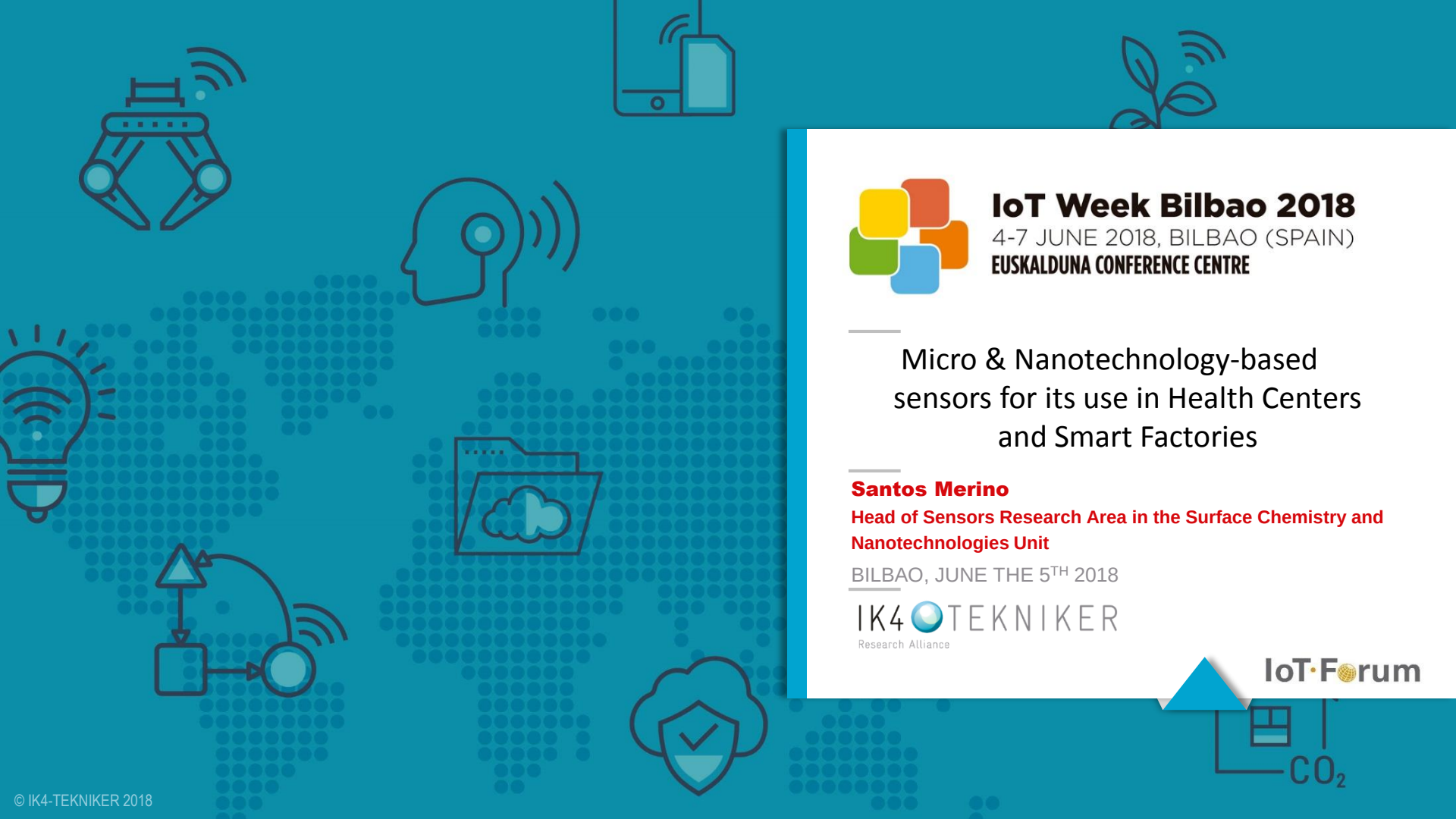

IoT Week Bilbao 2018
4-7 JUNE 2018, BILBAO (SPAIN)
EUSKALDUNA CONFERENCE CENTRE

Micro & Nanotechnology-based sensors for its use in Health Centers and Smart Factories

Santos Merino
Head of Sensors Research Area in the Surface Chemistry and Nanotechnologies Unit

BILBAO, JUNE THE 5TH 2018

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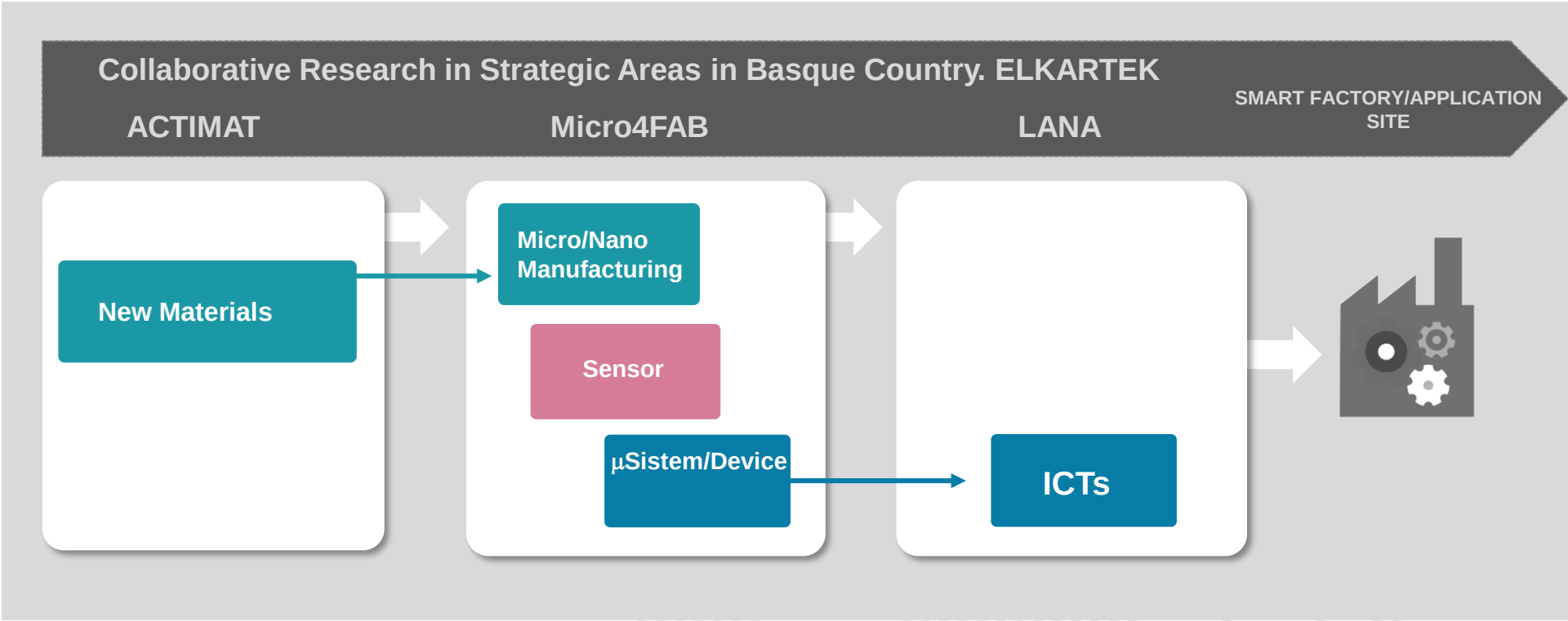
Research Alliance

IoT·Forum

Outline

- Collaborative Research projects in the Basque Country towards smart sensitive connected sensors.
- Use Case 1. Point-Of-Care for molecular biomarkers detection in a Health Center
- Use Case 2. Point-Of-Care for malignant cells counting in a Health Center
- Use Case 3. Allergens detection in a Food processing plant
- Use Case 4 . Bacteria detection in water or in a Food processing plant
- Conclusions

Our strategy towards high sensitive connected sensors



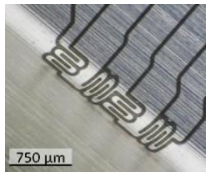
Our strategy: Micro4FAB

ACTIVITY 1 | ACTIVITY 2 | ACTIVITY 3 | SMART FACTORY / INDUSTRIAL SECTORS

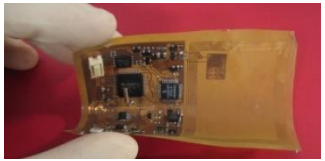
µ/Nano Manufacturing → Sensor → µSistem

Knowledge generation:
PUBLICATIONS & PATENTS

Sensor Integration in machine-tools for Advance Manufacturing



Pollutants detection for agro-food industry and environmental control (allergens, pesticides, bacteria or gas)



- TRANSPORT
- CAPITAL GOODS
- AGROFOOD
- MACHINE-TOOL
- MULTI SECTOR

Our strategy: micro4FAB

ACTIVITY 1

µNanomanufacturing

- µLaser Manufacturing
- µ- Nano Inyection/Nanoimprint Lithography
- Electrospinning
- 3D Microstereolithography
- Ink – jet & Screen printing

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ACTIVITY 2

Transduction/Sensor

- Magnetoimpedance & Magnetoelastic sensors for Surface Health Monitoring
- Piezospectroscopic sensors for SHM
- Piezoresistive & stress impedance sensors for SHM
- VIS/NIR sensors for monitoring fresh quality in vegetables and fruits
- Electrochemical sensors for pollutants & microorganisms detection
- Luminiscent sensors for identifying pollutants in fluids

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ACTIVITY 3

Device/Microsystem

- System Integration (Smart Systems)
- Low-power electronics
- Energy Harvesting
- Autonomous Devices
- Miniaturization
- Packaging
- Automous Nodes

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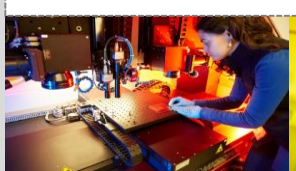
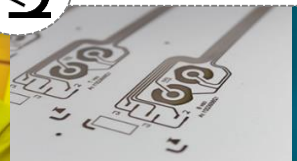
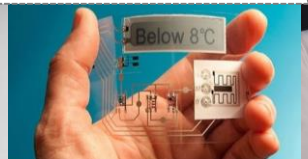
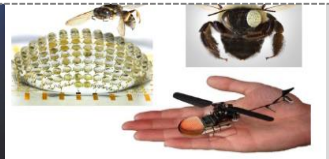


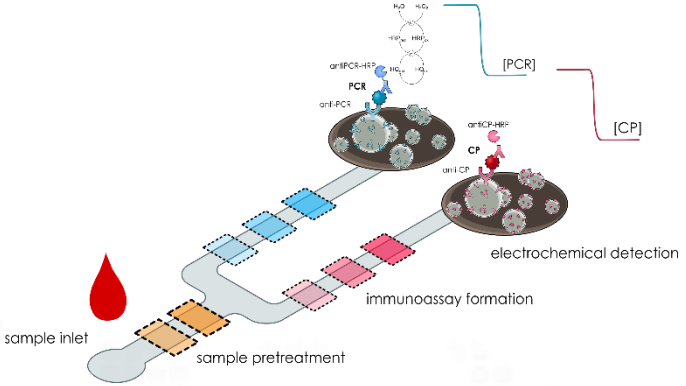



Use Case 1. Point-Of-Care

Electrochemistry magnetoimunoassay

Chronoamperometry detection	Inmunoassay	Magnetic Particles



Excellent Sensitivity and Specificity with real samples
Low cost detection
Very easy use
Easily integrated into a smart device,
On-line connected for data transference to sanitary personnel

Biomarkers detection (LoD of a few pg/ml):

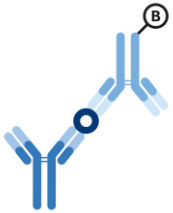
- Inflamation (*TNFα*)
- Breast cancer (*ErbB, ER, PR*)

Operative under different samples:

- Serum
- Blood
- Cell lysates
- Intact breast cancer cells

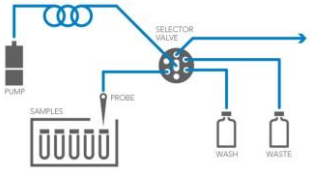
PCT15382066. Method and device for detection and quantification of analytes

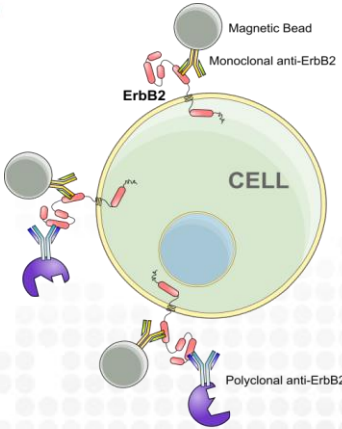
Use case 1. Point-Of-Care

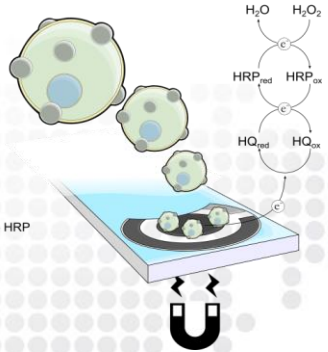


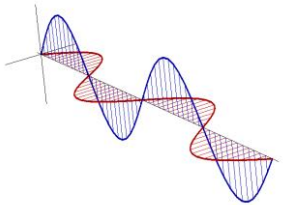
Inmunoassay

Microfluídics



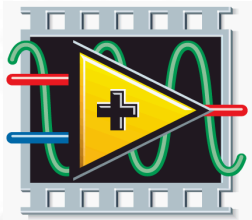






Sample preparation

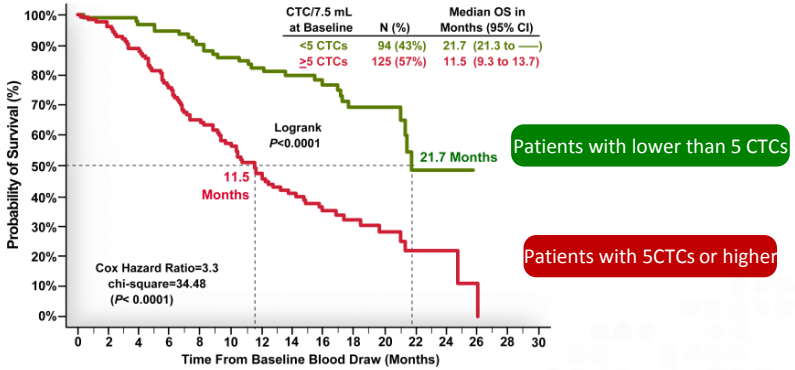
Control



NATIONAL INSTRUMENTS
LabVIEW™

Miniaturized integrated device for its use in Outpatients Departments and/or Emergencies in Hospitals. Quick and real time decision about diagnosis or prognosis once data are transfered to the decision maker

Use case 2. Point-Of-Care

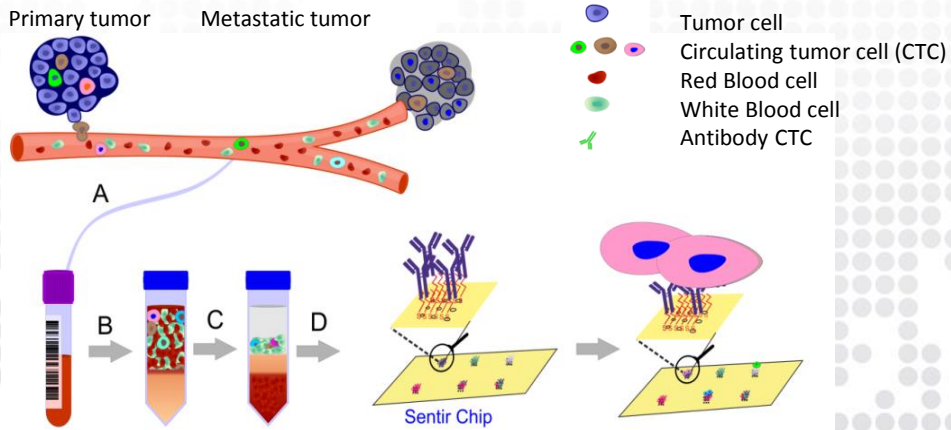


Patients with lower than 5 CTCs

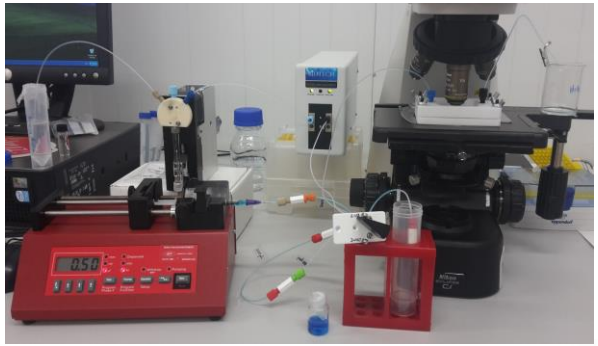
Patients with 5CTCs or higher

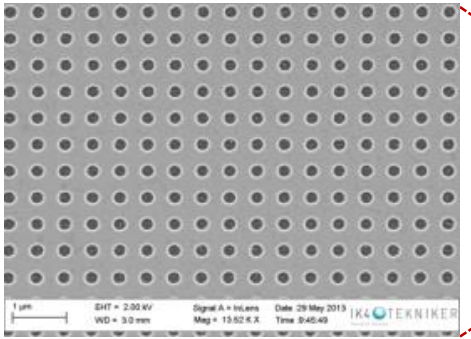
Integrated device to be used in liquid biopsies. CTCs counting for monitoring periodically the outcome from different therapy strategies

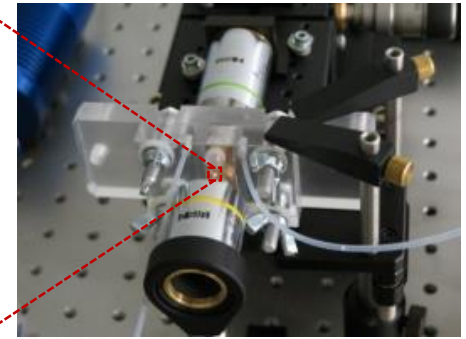
The concept



Use case 2. Point-Of-Care







Plasmonic device:

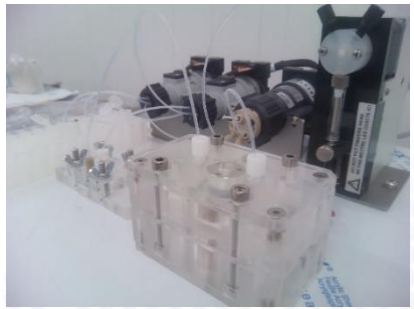
- Cells counting per ml
- Possibility to detect CTCs with different phenotipes
- Miniaturized integrated optical system with data treatment and storage on a common platform for patients' follow-up

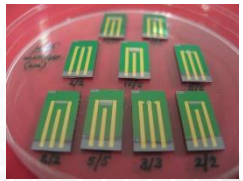
EP17382519.Cartridge, Device and Method for detecting, capturing, identifying and counting CTCs

Use case 3. Allergens detection

- Allergens selection for *on-line* detection (Tropomyosin, Gluten)
- Development of an electrochemical sensor with the thresholds required by legislation and useful for determination of cross-contamination during production
- Implantation of *on-line* sensors in food production chains for *in-situ* real time decision.

Shrimp Tropomyosin
Wheat Gluten





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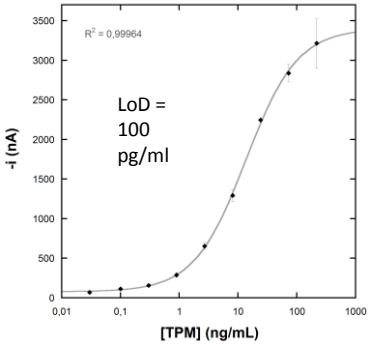

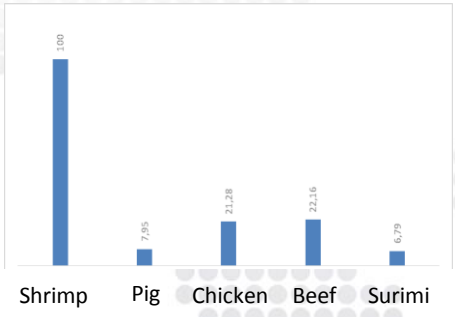

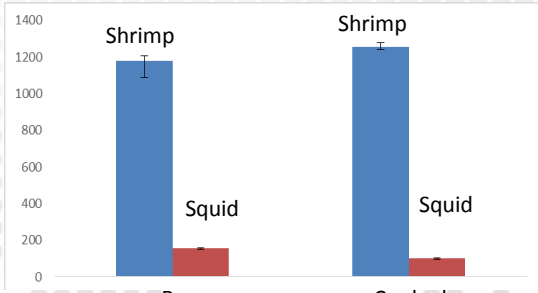

Use case 4. Bacteria detection

- Legionella pneumophila detection in water by LAMP (Loop-mediated isothermal amplification) and electrochemical detection (cyclic voltammetry).
- Gen 16S ribosomal RNA chosen by its high degree of homology and polymorphisms with other legionella species.
- Methylene blue used as an electrochemical marker, which is intercalated into the amplified DNA, reducing the amount of free compound in the medium.

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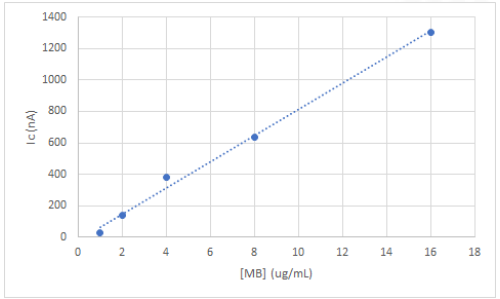

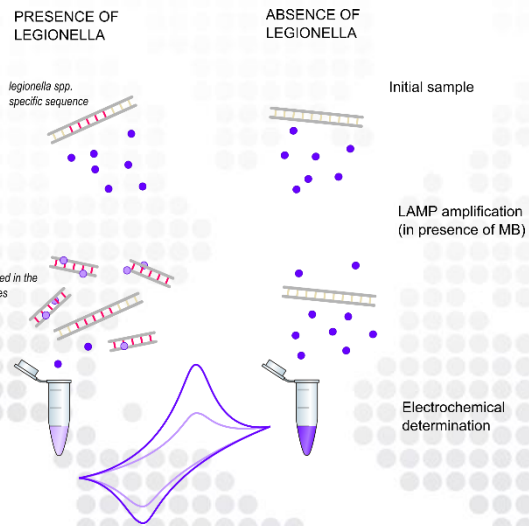

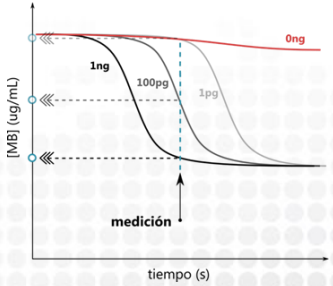

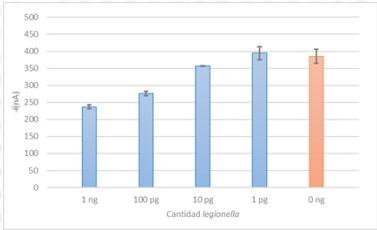

Conclusions

- The use of Micro and Nanotechnology can provide sensitive sensors for different scenarios and industrial sectors.
- The involvement of quite different backgrounds is esential to get good solutions for each end-user specification.
- These sensors as connected to the network, can provide quick and real-time measurements as compared to sending samples to a certified central lab and wait for an answer within several days.

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Research Alliance

PARKE TEKNOLOGIKOA
C/ Iñaki Goenaga, 5
20600 EIBAR GIPUZKOA
SPAIN
www.tekniker.es