

## Smart Sensors and Active Solutions for Chemical and Biological threat Detection and Protection.

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### Abstract

The word of sensors is very huge, including different technologies and typologies (pressure, temperature, chemical, gas, biological,...) and market sectors (petrochemical, environment, health & care, water, automotive, aerospace, defense, ...). The global market for sensors was valued at \$79.5 billion in 2013 and is expected to increase to \$86.3 billion in 2014, \$95.3 billion in 2015, and to nearly \$154.4 billion by 2020, a compound annual growth rate of 10.1% over the five-year period from 2015 through 2020 [1].

Sensors, like humans, react to the environment and the stimuli (sound, light, contact, ...) with or without intelligence, and are based in physical or chemical principles. A broad definition is provided by the Scottish Enterprise in "Sensing a brighter future review": "*sensors are those parts of larger systems which gather information about the world, make sense of it and then communicate that information*". The sensitive part of sensor, the smart or functional material, is combined with the electronics and the communication elements as a whole. To classify the sensor world is a difficult task, some communities classify them by the active principle (piezoelectric, resistive, capacitive, photonic chromatic, luminescent, ...) and other by the final application, where 22 subsectors have been identified (noise cancelation, imaging of object, odor, physical properties, textures, presence, biological species, chemical alerts, gas detection, ...).

The use of sensors for protection against chemical and biological threats is a gap on the existing technologies. The citizen protection in case of natural disasters, accidental events and manmade attacks is still a need where sensors can play an important role. Two main research areas need to be explored in this field: the development of low cost and effective sensors for the detection of chemical substances in fluids (air, water, drinkable, ...) and the development of active solutions for the protection against biological threats and pandemics.

The reason why sensors are more focused on chemical and not in biological threats is linked to the nature of attacks. It is difficult to distinguish between strains for the same bacteriological family. And sensors for identification need to be very specific to achieve the necessary success rate. In the opposite, chemical sensors are widely used for safety and security incidents and the rate success of detection with good sensibility and selectivity is achieved in most of the technologies.

Most commercial available monitoring tools are based on instruments developed for two sectors: chemical and quality laboratories and military applications. Several research efforts are focused on instrument miniaturization (chromatographs, spectrometers, etc.); but the cost of such instruments is expensive for their intensive use on some security applications. The reason is the high number of detection points required, i.e. in the station hall monitoring. In this scenario, the development of low cost, small size and easy to manufacture sensors is a market opportunity and an open field for sensor research.

TECNALIA is working on the development of chemical sensors technologies based on:

- ✓ Solid Oxide Resistive Sensors.
- ✓ Luminescent optosensors.
- ✓ LED induced fluorescence.
- ✓ Resistive sensor based on polymeric nanocomposite with CNTs or Graphene conductive fillers.

In the other hand, active solutions for the protection of citizens and personnel involved on the incident management (first responders, medical service, law enforcements, ...) are the key tool for the effective

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[1] Global Markets and Technologies for Sensors, BCC Research, 2014.

minimization of the threat impact. In this research area, TECNALIA is focused on two main target objectives:

1. Development of Chemical adsorbent materials and
2. Biological filters and dosimeter

The expertise of TECNALIA in non-woven materials is the base for the developments in both applications.

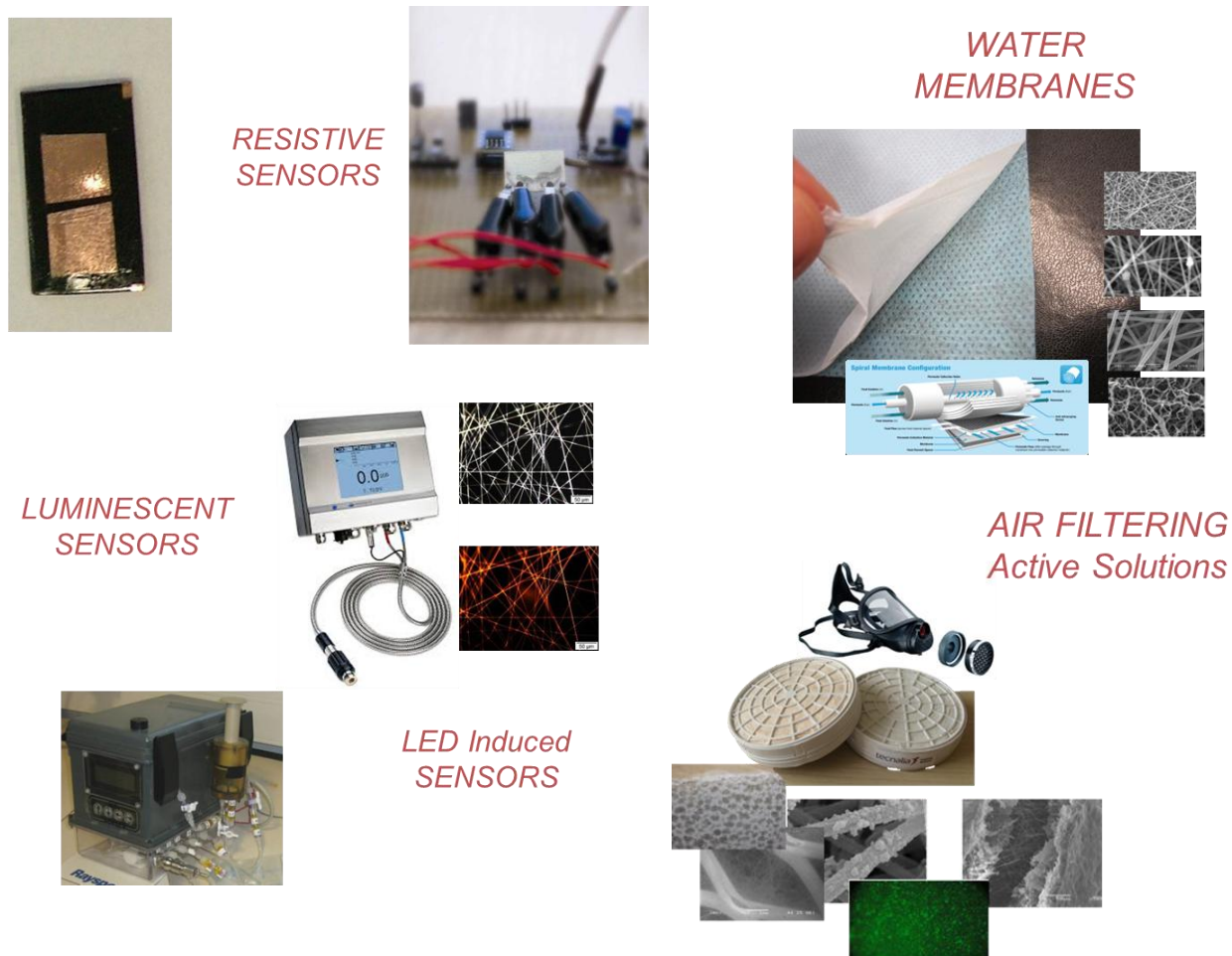


Figure 1. TECNALIA developments on Smart Sensors and Active Solutions for Chemical and Biological Protection.