Hybrid devices based on nanostructured sensors for gas and VOCs monitoring

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Some hybrid devices based on nanostructured sensors, both portable and mounted on land vehicles, have been designed and developed in IIA-CNR and then tested for potential applications in ADAMO project.
Specifically, a multisensory array has been designed both for monitoring volatile compounds coming from the bio-deterioration of artefacts (e.g. stones, ancient manuscripts) and environmental conditions (indoor/outdoor). The deterioration of an artwork is in fact strictly related to its chemical composition but overall to the environmental conditions in which it is exposed. The sensors housed within the device are based on both gravimetric transducers (QCMs, microbalance of quartz) and conductive transducers (IDEs, interdigitated microelectrodes) in modular systems easily replaceable. Nanostructured sensors were designed to be sensitive and partially selective to organic acids (potential precursors responsible for the solubilization of stones) and further gases known as potentially dangerous to artworks. Further groups of sensors have been developed with greater sensitivity for aldehydes, aromatic and nitrogen compounds that could be used in monitoring wooden and paper degradation. The sensors are based on composite polymeric nanostructured materials, inspired to natural sensory receptors (cilia, fibrous structures, pores, etc.). Such materials have been developed by electrospinning technology and then tested to interact selectively with defined classes of VOCs.
The modular sensing devices have been housed also on a terrestrial drone for monitoring environments difficult to reach by an operator. Such a device is based on a radio-control system that not only drives the vehicle remotely, but also allows the explored environments to be viewed (e.g. catacombs, dungeons, tunnels, etc.) through a camera and is able to receive and store data in real time. Specifically, the terrestrial drone has been developed to monitor gas and fine dust. The sensor platform on board is equipped also with a sensor a NDIR optical transduction for carbon dioxide CO_2 and with electrochemical sensors for carbon monoxide CO, nitrogen dioxide NO_2, sulfuric anhydride SO_2 and hydrogen sulphide H_2S. Each sensor has been housed in a specific measuring chamber. A pneumatic system controls the sampling, and an electronic front-end card converts all the signals coming from the sensors into common readable electric signals (volts).