Environmental monitoring system integrated in an Autonomous Underwater Vehicle for automatized analysis of sea water quality near offshore sites

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The goal of this project is the design of an autonomous system for the monitoring of the neighborhood of offshore sites, to detect the presence of heavy metals that could be potentially dangerous for the environment. The research was focused on the use of the spectrophotometric analysis, indeed through a monochromatic laser source it is possible to accurately detect traces of heavy metals in water. Moreover, the method exhibits high selectivity and sensitivity, making it competitive with respect to more sophisticated and expensive techniques (ex: ICP - MS). The ground-breaking idea integrated in this project is the implementation of a system inspired to the latest innovative techniques in the field of Nano sensors with a particular focus on the microfluidic analysis based on Lab-on-Chip technique. Such a choice is due to the unique advantages in terms of reduction of sample and reagents volumes, energy budget and analysis times. In addition, with small samples volumes , it is possible to use different chambers for multiplexed materials analysis. The automated microfluidic system works thanks to an automatic syringe system, controlled by a full costum electronic system sampling and mixing filtered water from the surrounding environment with the right reagents. In order to have a clear and correct measurement of the complexed sample, the system is integrated with a series of bubble traps and high-pressure draft valves, suited to work up to 100 bar. Indeed, the system is designed to be embedded in an Autonomous Underwater Vehicle (AUV) and guided in the depths of the sea; for this reason, the best configuration to minimize dead volumes was accurately studied. The automated microfluidic system was then integrated in an AUV, through a cylindrical plastic payload. This vehicle is able to sail in deep water (down to 300 meters) near any interesting site. So far, four spectrophotometric analysis methods were optimized for four different metals (Chrome, Copper, Zinc, Nickel). Laboratory tests have produced excellent results, while tests on the field are planned for the near future.

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