We designed and developed a novel heavy metal ion sensing device, based on quenching mechanism, exploiting the characteristics of a polyelectrolyte nanostructured system, named nanocapsule[1]. Nanocapsule allows to entrap fluorescent probes sensitive to a specific metal ion, localizing fluorescent signal in a nano-bordered site within the outermost layers and improving the signal to noise ratio. Such quenching-based system can be used to monitor, through confocal microscope analysis, those variations of fluorescence intensity induced by specific quenchers, i.e. heavy atoms[2].

In order to improve the detection accuracy and sensitivity, we designed a micro-electrical device to drive localized fluorescence variations in real time[3]. In fact, applying an electric field, metal ions migration is induced with an associated increase (de-quenching) of fluorescence intensity near the positive electrode and an accompanying decrease (quenching) in proximity of the negative one. We tested our sensing system entrapping cyanine molecules to investigate copper ions concentration, proving the capability to follow precise fluorescence variations related to the spatial micromolar concentrations of metal ions. Moreover, due to the biocompatibility of the nanocapsules, it will be possible to move towards the entrapment of green fluorescent proteins (GFPs) genetically modified as selective quenchable probe for a specific metal ion [4]. In this case, some photophysical properties of the GFP probes can be enhanced by the nanocapsule confinement [5], also envisaging future biological applications.