Nanoporous Anodic Alumina-based Portable Optical Sensor for the Detection of Hg+ ions

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Mercury is used extensively in various industries such as gold and coal mining and electrical equipment, batteries, semiconductors, and medical appliances. The unique mercury compounds are also naturally emitted into the atmosphere from volcanoes, forest fires, and the weathering of rocks. Although it has its advantages for some industries, it is toxic and dangerous for human health and ecosystems [**1**]. In addition, organic mercury is harmful to peripheral nerves like skin nerves or solid bone nerves related to the central dogma of the nervous system of humans. Due to the complexity and continuous use of mercury in industry, the rapid detection of mercury is warranted to control and monitor its concentration [**2**]. The typical detection techniques used to sense ionic mercury are atomic absorbing spectroscopy (AAS) and gas chromatography (GC) [**3**]. However, these techniques are expensive, time-consuming, and require expert personnel. To overcome these problems, we propose to fabricate a portable device by combining the optical properties of anodic porous alumina (NAA) and gold nanoclusters (AuNCs) for selective and fast detection of mercury [**Figure 1**]. AuNCs have a very high affinity and selectivity to mercury because Au^{+} can selectively sense Hg^{+2} through metallophilic interactions between the electrons in “d” orbitals. A higher photoluminescence (PL) intensity for mercury ions detection was observed for NAA with larger pores size (75 nm) compared to smaller pores (35 nm) [**4-7**]. Besides, AuNCs had the same stability and PL intensity for samples with/without NHS/EDC coupling. The sensing performance of the system was assessed through several tests, establishing its sensing performance and chemical selectivity. The sensor device showed sensitivity for Hg detection range in mM to µM [**Figure 2**] [**8, 9**]. The label-free merit of detection of the proposed sensor platform paves the way for future applications in heavy metal ion sensing.

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Figures

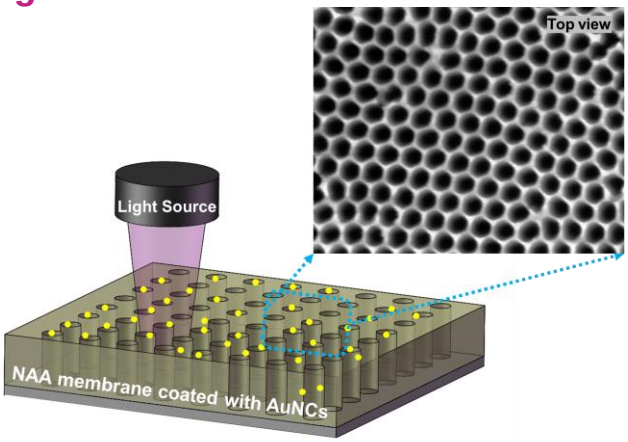

Figure 1. NAA surfaces with AuNCs for the selective detection of mercury.

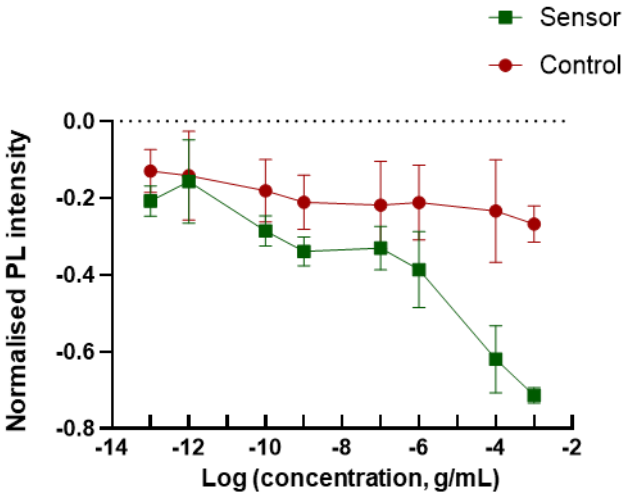

Figure 2: Normalized photoluminescence intensity of mercury ions (**green**) and control zinc ions (**red**) at 600nm wavelength.