

A sensitive gold nanoparticles-based sampler for indoor monitoring of gaseous mercury

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Abstract

Gaseous elemental mercury (GEM) can lead to serious health problems. Its emission on the environment can originate from natural and anthropogenic sources at global scale. Thus, it is very important the development of practical samplers to monitor GEM. In this context, the production of a passive sampler has been the aim of this work. For this purpose, gold nanoparticles (AuNP) were synthesized and deposited on SH-modified glass slides, which were employed as GEM sampler.

Key words: Gaseous elemental mercury, gold nanoparticles films, passive sampler

Introduction

Mercury is a metal with high toxic potential considered a global threat to human and environmental health. Although, it is an element that occurs naturally in atmosphere, the human activity is an important contributor to the overall increase in mercury levels.¹

In order to reduce the risks associated with the Hg exposure, there is an increase in the development of new technologies for Hg monitoring and removal in contaminated environments.^{2,3} In this context, the aim of this work was the development of a gaseous elemental mercury (GEM) passive sampler, highly sensitive, portable, and cheap. For this purpose, gold nanoparticles (AuNP) were synthesized and deposited on SH-modified glass slides, which were employed as GEM sampler.

Results and Discussion

In UV-vis absorption spectrum of AuNP colloid, it was observed a band with a maximum at 526 nm related to the surface plasmon resonance of gold, indicating the formation of spherical gold nanoparticles. In spectrum of AuNP film, the same band was observed, but with lower intensity and there was a wide band around 700 nm, which can be associated with the formation of nanoparticles aggregates, as verified by SEM images.

These images showed that AuNP were uniformly distributed over the entire surface of the glass support. This feature may be an advantage during the mercury sampling, because it can contribute to a uniform Hg⁰ adsorption and amalgamation with gold on the substrate surface.

In order to evaluate the performance of the AuNP films for Hg⁰ sampling, some slides were exposed to the laboratory atmosphere for different periods (1 to 28 days), and the others were stored (unexposed), during the same time. Analyses of slides using Direct Mercury Analyser (DMA-80)

allowed to quantify the mercury retained on each slide.

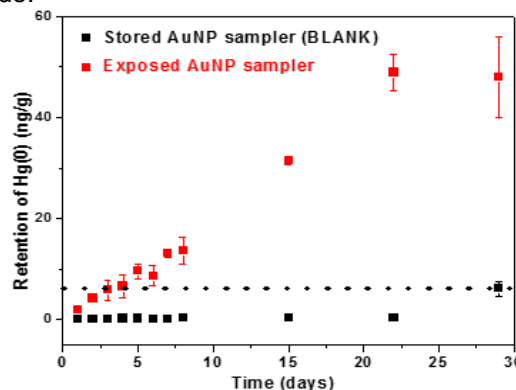


Image 1. Retention of Hg⁰ by exposed AuNP samplers (N = 3) as a time function.

According to Figure 1, there was a linear increase in the retention of Hg⁰ in function of the exposure time. The maximum Hg amount retained was 50 ng per g of material, with an average retention of 2.2 ng g⁻¹ day⁻¹. The high linear correlation (R² = 0.95) between mercury retention and exposure time, beyond the high sensitivity, qualify the system as a passive monitor with potential for future field applications.

Conclusions

Very promising initial data: AuNP films have an effective performance for atmospheric GEM monitoring.

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