Solar-driven Electrochemical Advanced Oxidation Process for wastewater treatment

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(a) Purpose of study or research hypothesis

This study investigated the spontaneous catalytic oxidation of As(III) over Pt nanoparticles loaded on TiO2 under ambient aqueous conditions (i.e., air-saturated and room temperature). The proposed catalytic process requires dissolved O2 only as an oxidant, instead of chemical oxidants and energy input, where electrons spontaneously transfer from As(III) to O2 on the Pt–TiO2 catalyst.

(b) Key issue(s) or problem(s) addressed

The pre-oxidation of As(III) is essential for effective removal of arsenic in contaminated water. Although diverse arsenic oxidation methods have been developed, most require the input of chemical oxidants and external energy (e.g., electricity, photon energy)

(c) Methodology or approach used

The concentration of As(V) in the solution was colorimetrically determined at 870 nm by using the molybdene blue method. A withdrawn sample (1 mL) was directly added into a conical tube containing 3 mL of distilled water and, 100 ?L of ascorbic acid solution (5 ± 0.1 g/50 mL) and 200 ?L of molybdate reagent solution. The tube was mixed vigorously and kept for 2 h before the analysis. The absorbance at 870 nm was measured using the UV/visible spectrophotometer. As for experiments with low As(III) concentrations, the quantitative analysis of As(V) was performed by using a Dionex ICS-2100 IC (Dionex IonPac AS18 (4 × 250 mm) column with a conductivity detector, 39 mM KOH eluent). For the analysis of residual As(III), the sample was allowed to pass through a silica-based anion exchange cartridge (LC-SAX SPE Tube, supelco), which can hold As(V), so that As(III) could be collected in the effluent solution. The effluent was used to measure the concentration of As(III) by ICP-AES (Iris Advantage).

(d) Results or conclusions derived from the project

In this study, we have successfully demonstrated a viable and facile method of the spontaneous catalytic As(III) oxidation on Pt–TiO2 under ambient conditions (room temperature and air-equilibrated) without the addition of chemical oxidants or external energy inputs.

The catalytic As(III) oxidation process proposed herein offers several advantages over the previous methods: it requires O2 only, no chemical oxidant and energy inputs; it works efficiently in a broad pH range (2–11); it maintains the durable catalytic activity over repeated uses and in the presence of high concentration of interfering anions.

(e) Implications of the project relevant to congress themes

The present findings provide basic information that should be utilized for the further development of practical catalytic oxidation systems for As(III) oxidation as a green chemistry.

Keywords : Arsenic, Heavy Metal, Advanced oxidation process (AOP), Platinized TiO2