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On behalf of the Organizing and Scientific Committees, we extend a warm welcome to the 6th Iberoamerican Conference on Advanced Oxidation Technologies (VI CIPOA), taking place in Florianópolis, Brazil, from October 7th to 11th, 2024.

The CIPOA conference aims to bring together scientists, Ph.D. students, master's and undergraduate students, and professionals to share their research findings and engage in discussions about the future directions and opportunities in Advanced Oxidation Technologies. The focus areas encompass environmental protection, chemical and food engineering, energy, and climate sectors, all contributing to a sustainable and carbon-neutral circular economy.

The conference program will encompass a diverse range of engaging sessions, including invited lectures, oral communications, short oral communications for Ph.D. students, poster communications, and an interactive round-table discussion.

We cordially invite you to submit your abstracts for poster or oral presentations to the 6th Iberoamerican Conference on Advanced Oxidation Technologies. We eagerly await your contributions to the scientific program and sincerely appreciate your support in advance!

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(Chairwoman VI CIPOA 2024)

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Organization



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Electrochemical degradation of benzotriazole by UV/H₂O₂ in a Printex L6 carbon-based gas diffusion electrode modified with of lanthanum oxide

POSTER

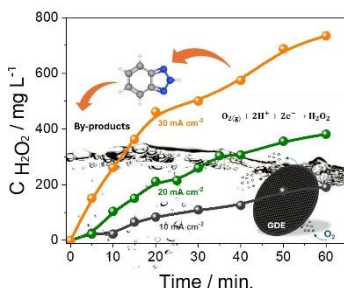
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This study evaluated various La₂O₃/Printex L6 carbon (La/C) ratios (1.0-1.0%) for H₂O₂ electrogeneration applied to Benzotriazole (BTA) degradation. The rotating ring-disk electrode (RRDE) technique identified 5.0% La/C ratio as optimal for H₂O₂ selectivity in acidic media. Using Printex L6 carbon-based gas diffusion electrode (GDE) modified with 5.0% La/C, H₂O₂ concentration of 735 mg L⁻¹ was achieved at 30 mA cm⁻² at pH 5.8 during 1 h. The modified GDE was used to assess the electrogenerated H₂O₂/UVC degradation of 10 mg L⁻¹ BTA, being reached 100% and 63% of removal and mineralization, respectively.

Introduction

BTA is a toxic and bioaccumulative heterocyclic compound used extensively as a corrosion inhibitor and stabilizer, causing significant water pollution due to widespread release of wastewater.

Several advanced oxidation processes (AOPs) have been studied for BTA degradation in aqueous solutions. UV/H₂O₂ and UV/TiO₂ methods are effective but incur high costs due to energy use, H₂O₂ dosage, and catalyst requirements.

Electrogenerated H₂O₂ (e-H₂O₂) by GDE proves to be a attractive approach for the BTA degradation, being advantageous because, in principle, is a system that is easy to assemble and economically competitive with other technologies [1-2]. This study explores the use of La₂O₃ as metal oxide in GDE to improve the selectivity and activity of oxygen reduction reaction (ORR) via 2e⁻. The e-H₂O₂/UVC process was evaluated in the modified GDE with low content of La₂O₃/Printex L6 carbon applied for the BTA degradation at acidic condition.

Material and Methods

Synthesis and characterization of La₂O₃

The synthesis of La₂O₃, employed for modifying GDE, was performed using a modified Pechini method with La(NO₃)₃·6H₂O as the precursor. Thermogravimetric analysis, X-ray diffraction, Raman spectroscopy, and scanning electron microscopy were used to evaluate its thermal stability, crystalline structure, vibrational modes, and surface morphology, respectively.

Electrochemical characterization

The ORR was assessed using the rotating disk electrode technique with La/C ratios (1.0-10%) supported on Printex L6 carbon. Measurements were conducted on a commercial ring-disk electrode (Pine Instruments, N= 0.37) as the working electrode, a platinum wire as the counter electrode

and an Ag/AgCl (3 M KCl) electrode as the reference. The electrolyte was a 0.05 M K₂SO₄ solution (pH 5.8). The solution was saturated with O_{2(g)}, being maintained during the measurements. Experiments were performed with an Autolab PGSTAT 302N potentiostat/galvanostat and a rotator, at a constant scan rate of 5.0 mV s⁻¹ and electrode rotation speeds from 300 to 1,500 rpm.

H₂O₂ quantification using La/C-GDE

The optimal metal/carbon ratio (5.0%) identified by the RRDE were used to prepare GDE. GDEs not modified and modified were tested in a non-divided cell to measure H₂O₂ production at various current densities. An Ag/AgCl (3 M KCl) electrode acted as the reference, and a DSA[®] electrode served as the counter electrode. A 250 mL 0.05 M K₂SO₄ solution, was used as supporting electrolyte. O_{2(g)} was supplied to the GDEs at 80 mL min⁻¹. H₂O₂ concentration was quantified using the peroxymolybdate complex method and analyzed by UV-visible spectrophotometry at 350 nm with a UV-1900 spectrophotometer.

BTA electrochemical degradation

The optimal current density, determined from H₂O₂ production studies, was applied to evaluate the degradation of 250 mL of 10 mg L⁻¹ BTA in 0.05 M K₂SO₄ (pH 5.8). The same non-divided cell used for H₂O₂ electrogeneration was employed. BTA degradation and mineralization was performed using the e-H₂O₂/UVC method. A UV-C light source (NUCHONG 9W lamp) was used as irradiation source.

Results and Discussion

Morphological analysis of La₂O₃

Fig. 1a shows the thermal decomposition of La₂O₃ in an oxidizing atmosphere. Analysis indicates the

presence of $\text{La}(\text{OH})_3$ and minor oxycarbonate. The decomposition occurs in three stages: loss of adsorbed water, decomposition of $\text{La}(\text{OH})_3$ to LaOOH , and dehydration of LaOOH to La_2O_3 at 100, 367 and 514 °C, respectively. The final weight loss is attributed to the decomposition of surface carbonates formed from atmospheric CO_2 interaction. Figure 1b shows the X-ray diffraction pattern characteristic of the La_2O_3 structure.

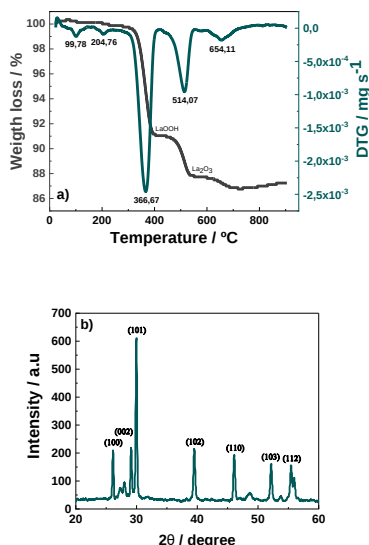


Figure 1. a) Thermogravimetric (TG) and differential thermogravimetric (DTG) curves for La_2O_3 obtained in an oxidizing atmosphere b) X-ray diffraction pattern.

Electrochemical characterization of La/C ratios

Fig. 2 compares LSV curves in acidic media, for the ORR for 1.0-10% content of La supported on PCL6. The disk LSV curves for 1.0 and 5.0% La/C ratios show similar shapes and currents to PCL6, indicating selective to O_2 reduction by $2e^-$. 10% La/C modifier exhibited a lower ORR initiation potential and higher disk current, but a lower ring current than PCL6, suggesting reduced H_2O_2 production. These results suggest that higher modifier concentrations may favor the $4e^-$ pathway, increasing water production.

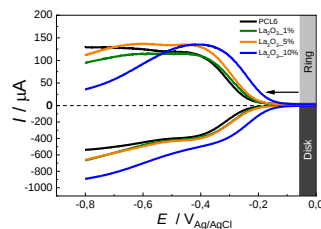


Figure 2. LSV curves for the ORR at 1.0 – 10% content of La/C in a 0.05 M K_2SO_4 solution, saturated with $\text{O}_2(\text{g})$. Electrode rotation speed: 900 rpm.

H_2O_2 electrogeneration

Fig. 3 show electrogenerated H_2O_2 in 0.05 M K_2SO_4 at current densities of 10, 20, and 30 mA cm^{-2} . Increasing the current density from 10 to 30 mA cm^{-2} increases H_2O_2 production. Optimal results at the highest current density studied are obtained, achieved a peak H_2O_2 concentration of 735 mg L^{-1} .

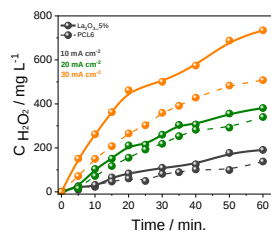


Figure 3. Concentration of H_2O_2 electrogenerated in a 0.05 M K_2SO_4 as a function of the applied current density.

BTA electrochemical degradation by $e\text{-H}_2\text{O}_2/\text{UVC}$ process

Fig. 4 show the degradation of 10 mg L^{-1} BTA at 30 mA cm^{-2} by $e\text{-H}_2\text{O}_2$, $e\text{-H}_2\text{O}_2/\text{UVC}$, anodic oxidation (AO) and AO/UVC process. The $e\text{-H}_2\text{O}_2/\text{UVC}$ treatment show total removal of the contaminant in 20 min of electrolysis and 63% of and mineralization after 1 h.

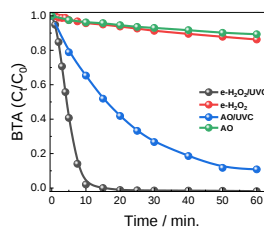


Figure 4. BTA degradation by $e\text{-H}_2\text{O}_2$, $e\text{-H}_2\text{O}_2/\text{UVC}$, AO and AO/UVC process at 30 mA cm^{-2} .

Conclusions

The La_2O_3 used as a modifier in low proportions demonstrated high performance for the ORR via $2e^-$ pathway, showing enhanced activity at lower potentials compared to PCL6, at acidic condition.

Acknowledgments

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References

- [1] J. Wang, C. Li, M. Rauf, H. Luo, X. Sun, Y. Jiang. Sci. Total Environ. 759 (2021) 143459.
- [2] J. Xie, J. Jing, J. Gu, J. Guo, Y. Li, M. Zhou. J. Environ. Chem. Eng. 10 (2022) 107882.