Chemical Engineering Journal 393 (2020) 124794

Contents lists available at ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

Highly robust and efficient Ti-based Sb-SnO_2 anode with a mixed carbon and nitrogen interlayer for electrochemical 1,4-dioxane removal from water

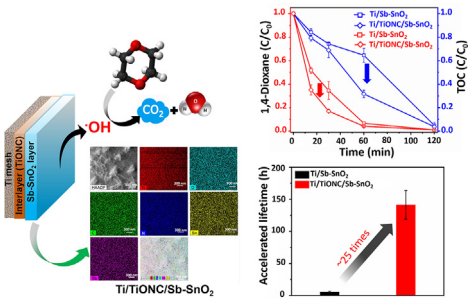
Naresh Mameda[a], Hyeona Park[b], Syed Salman Ali Shah[b], Kibaek Lee[a,c], Chi-Wang Li[d], Vincenzo Naddeo[e], Kwang-Ho Choo[a,b,*]

[a] Advanced Institute of Water Industry, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu 41566, Republic of Korea
[b] Department of Environmental Engineering, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu 41566, Republic of Korea
[c] Department of Biotechnology and Biochemical Engineering, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju 61186, Republic of Korea
[d] Department of Water Resources and Environmental Engineering, Tamkang University, 151 Yingzhuan Road, Tamsui District, New Taipei City 25137, Taiwan
[e] Sanitary Environmental Engineering Division, Department of Civil Engineering, University of Salerno, Fisciano 84084, SA, Italy

HIGHLIGHTS

- A novel Ti-based Sb-SnO_2 anode was fabricated via the insertion of TiONC interlayers.
- The interlayer enhanced the crystallinity, current density, and oxygen evolution potential.
- Complete 1,4-dioxane mineralization was achieved at a rate constant of 1.91×10^{-2} min^{-1}.
- The accelerated life of Ti/TiONC/Sb-SnO_2 was ~25 times longer than that of Ti/Sb-SnO_2.
- Enhanced durability resulted from blocking oxidants and corrosive ions using the interlayer.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Sb-SnO_2
Electrode stability
Interlayer
Service life
1,4-Dioxane

ABSTRACT

Ti-based Sb-SnO_2 electrodes are attractive due to their excellent catalytic activity but have a short service life. Here, we report a highly stable and efficient Ti/TiONC/Sb-SnO_2 electrode, which was fabricated through hydrothermal reactions using urea to form TiONC interlayers and electrodeposition-annealing to coat the active Sb-SnO_2 catalysts. The triple-layered anode was characterized by highly crystalline structures, high oxygen evolution potentials, and corrosion-resistance properties. The structural arrangement yielded better electrocatalytic performances than that using the control electrode (Ti/Sb-SnO_2), showing enhanced organics degradation efficiencies. This new electrode's lifetime was significantly (~25 times) longer than that of either the control or any Sb-SnO_2 electrode modified with non-precious materials reported in the literature. The electrode's enhanced stability was attributed to the insertion of the mixed C and N interlayers that are resistant to oxidants and corrosive ions. The Ti/TiONC/Sb-SnO_2 anode holds promise for use in electrochemical water treatment.

* Corresponding author at: Department of Environmental Engineering, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu 41566, Republic of Korea.
E-mail address: chookh@knu.ac.kr (K.-H. Choo).

https://doi.org/10.1016/j.cej.2020.124794
Received 15 November 2019; Received in revised form 3 March 2020; Accepted 16 March 2020
Available online 17 March 2020