Simultaneous Ozone and Hydrogen Peroxide Electrosynthesis via Defect Modulation in Ni, Sb-doped SnO$_2$ Electrocatalysts

Lei Ding$^1$, wenwen Li$^1$, Mingzhe Xue$^1$, Xiaoge Peng$^1$, Huaijie Shi$^1$, Jia Liu$^1$, Xiaosa Wang$^1$, Chenghang Jiang$^1$, Yufeng Xue$^2$, Shibin Wang$^1$, Xing Zhong$^1$, and Jian-guo Wang$^1$

$^1$Zhejiang University of Technology
$^2$Zhejiang University of Technology College of Chemical Engineering

August 24, 2023

Abstract

Electrochemical synthesis of green oxidants O$_3$ and H$_2$O$_2$ is valuable for applications, but challenges persist in enhancing the O$_3$ and H$_2$O$_2$ generation activity and combined application. Herein, we modulate the surface Ni active sites and oxygen vacancy defects content in Ni-Sb-SnO$_2$ electrocatalysts to enhance selectivity for electrochemical ozone generation (EOP) and two-electron electrochemical oxygen reduction reactions (2e- ORR). The Ni active sites and oxygen vacancy defects enriched electrocatalysts resulting in an ozone faradaic efficiency of 48.1%, while non-enriched electrocatalyst obtained 90% selectivity for H$_2$O$_2$. Theoretical calculations revealed that Ni-Sb-SnO$_2$ efficiently captures O$_2$ with defective O$_{\text{vac2}}$ stabilize intermediates, facilitating O$_3$ and H$_2$O$_2$ synthesis. Moreover, concerted EOP and 2e- ORR enable concurrent generation of O$_3$ and H$_2$O$_2$ for efficient synergistic degradation of organic pollutants, while attenuating the energy demands of the electrolyzer. This study provides an appealing strategy for the simultaneous production of O$_3$ and H$_2$O$_2$ with applications in wastewater treatment.

Hosted file