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Electro-catalytic degradation mechanism of nitenpyram in synthetic wastewater using Ti-based SnO_2–Sb with rare earth-doped anode

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ABSTRACT

Nitenpyram (NIT), a kind of pyridine-based neonicotinoid insecticide, presents a high threat to water system. This work firstly examined the electro-catalytic (EC) degrading the NIT in synthetic wastewater by using the modified Ti/SnO_2–Sb anode, which was characterized by scanning electronic microscopy, X-ray energy dispersive spectroscopy, X-ray diffraction, and electrochemical measurement. The NIT removal and total organic carbon removal are monitored. The NIT EC treatment was found to obey the pseudo-first-order reaction kinetics within 60 min electrolysis and was controlled by the mass transport, the chemical reaction, and the oxygen evolution. Stable degradation intermediates were detected through electrospray ionization quadrupole time-of-flight tandem mass spectrometry. Experiments indicated that several pyridine derivatives form during the EC process. Furthermore, the cleavage of pyridine ring could be demonstrated, which took place after the hydroxylation of the ring, leading to the complete mineralization of a NIT molecule. $HO^{\bullet}$ and H_2O_2 played the dominant role in the EC degradation of NIT. The in situ-generating H_2O_2 was attributed to the reaction between dioxygen and α-amino radical.

Keywords: Electro-catalysis; Ti/SnO_2–Sb anode; Nitenpyram; Hydroxyl radicals; Wastewater treatment

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