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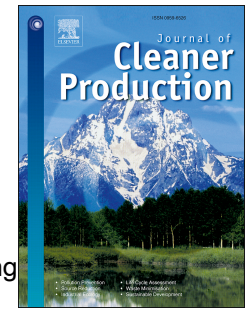

An insight into pathways of solar-driven STEP oxidation of nitrobenzene by an integrated in situ thermoelectrochemical microreactor-analyzer

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An Insight into Pathways of Solar-driven STEP Oxidation of Nitrobenzene by an Integrated *In Situ* Thermoelectrochemical Microreactor-Analyzer

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Abstract:

The solar thermal electrochemical process (STEP) degradation of nitrobenzene has been demonstrated as an alternative and sustainable way for wastewater treatment with both at high solar utilization and increased chemical efficiency enhanced by solar thermoelectrochemistry. This paper presents the first design and study of an integrated *in situ* thermoelectrochemical microreactor-analyzer, called *in situ* TEC-MRA, suitably fitted for an insight into pathways of solar-driven STEP oxidation of nitrobenzene. Based on the high sensitivity and resolution of nitrobenzene and intermediates for identification in the visible and UV range, the *in situ* TEC-MRA was explored and exploited for serving both as a reactor and analyzer, investigating the intermediates generated from the degradation, the critical time point in the progress and the energy consumption during electrolysis. The tests displayed that the device enables the response of real-time and fast chemical progress with high sensitivity and resolution, but without the interference from heat or mass transfer, thus displaying the thermoelectrochemistry of the STEP nitrobenzene oxidation and facilitating the control of energy input. A mechanism of STEP oxidation of nitrobenzene was schematized in detail. In the basis of the analysis of the *in situ* probing data, the oxidation and mechanism were clearly separated into three reaction sectors of decolorization, degradation, and mineralization. Furthermore, the advantage of the STEP was illustrated rather intuitively by a graphical interface for the high rate of STEP mineralization and the substantial savings in energy because of efficient solar utilization.

Keywords: *In situ* TEC-MRA; Solar energy; STEP; Nitrobenzene; Thermoelectrochemistry.