

Accepted Manuscript



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PII: S2095-4956(17)30660-5  
DOI: [10.1016/j.jechem.2017.08.010](https://doi.org/10.1016/j.jechem.2017.08.010)  
Reference: JECHEM 377

To appear in: *Journal of Energy Chemistry*

Received date: 28 July 2017  
Revised date: 18 August 2017  
Accepted date: 25 August 2017

Please cite this article as: Qiankun Li , Zhuo Wang , Miao Zhang , Pengfei Hou , Peng Kang , Nitrogen doped tin oxide nanostructured catalysts for selective electrochemical reduction of carbon dioxide to formate, *Journal of Energy Chemistry* (2017), doi: [10.1016/j.jechem.2017.08.010](https://doi.org/10.1016/j.jechem.2017.08.010)

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## Communication

# Nitrogen doped tin oxide nanostructured catalysts for selective electrochemical reduction of carbon dioxide to formate

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**KEYWORDS:** CO<sub>2</sub> reduction; Electrocatalysis; Formate; Tin oxide; Nitrogen doping

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**ABSTRACT:** Tin/tin oxide materials are key electrocatalysts for selective conversion of CO<sub>2</sub> to formate/formic acid. Herein we report a tin oxide material with nitrogen doping by using ammonia treatment at elevated temperature. The N doped material demonstrated enhanced electrocatalytic CO<sub>2</sub> reduction activity, showing high Faradaic efficiency (90%) for formate at  $-0.65\text{V}$  vs RHE with partial current density of  $4\text{ mA/cm}^2$ . The catalysis was contributed to increased electron negativity of N atom compared to O atom. Additionally, the N-doped catalyst demonstrates sulfur tolerance with retained formate selectivity. The analysis after electrolysis shows that the catalyst structure partially converts to metallic Sn, and thus the combined Sn/N-SnO<sub>2</sub> is the key for the active CO<sub>2</sub> catalysis.

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