Docket #: S20-107

Nanoscale Three-phase Electrochemical Pathway to Promote Pt-catalyzed Formaldehyde Oxidation

The Cui group has designed a new method for heterogeneous catalytic reactions with a gaseous reactant. By encircling the catalyst in a thin layer of liquid electrolyte, reactions like formaldehyde oxidation are no longer constrained by surface adsorption but instead proceed through an electrochemical pathway. This three-phase system consists of a certain catalyst coated on a nanostructured polyethylene (nano-PE) film, NaOH electrolyte, and reactant gas. The nano-PE film both behaves as a solid support for the catalyst and its porous nature helps diffuse gas towards the reactive site, an issue fully submerged catalysts face. When tested with formaldehyde oxidation, this three-phase system showed a 25,000-time improvement in turn over frequency for Pt vs conventional heterogeneous catalysts. The low cost of materials and established manufacturing processes make this catalytic system commercially attractive.

Stage of Research

- Proof of concept

Applications

- **Heterogeneous catalytic reactions:** formaldehyde oxidation, ammonia oxidation, methane functionalization

Advantages

- **25,000x enhancement in turn over frequency vs conventional heterogeneous catalysis for formaldehyde oxidation**

- Low cost due to low Pt mass loading and established manufacturing procedures

Publications

- Xu et al. Nano Letters (2020) "Designing a Nanoscale Three-phase Electrochemical Pathway to Promote Pt-catalyzed Formaldehyde Oxidation"

Patents

- Published Application: WO2021226545
- Published Application: 20230211320

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