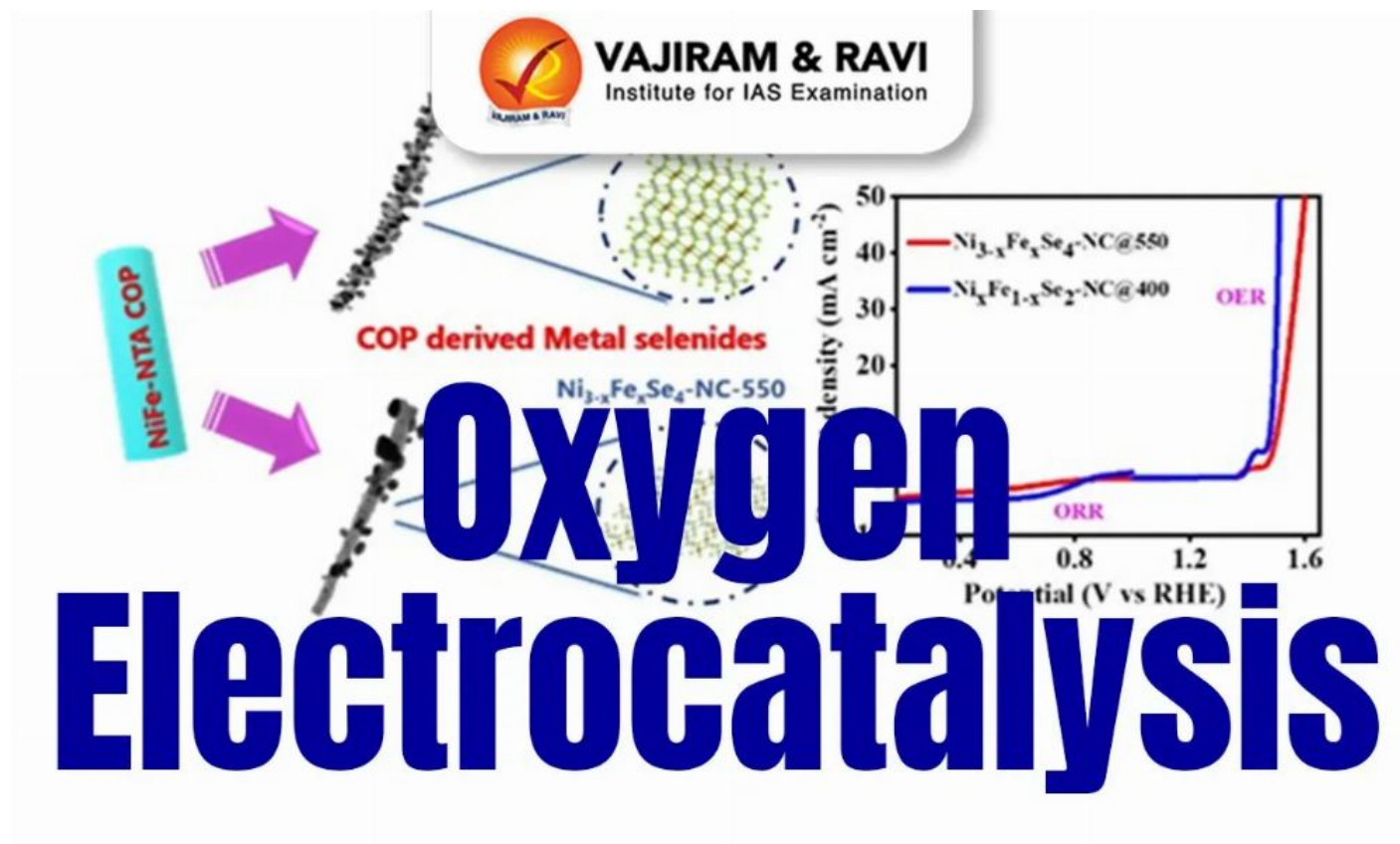


Oxygen Electrocatalysis

May 15, 2025 • vajiramandravi.com



Oxygen Electrocatalysis Latest News

Researchers from the Centre for Nano and Soft Matter Sciences (CeNS), an autonomous institute under the Department of Science and Technology (DST), have developed a novel iron-doped catalyst aimed at improving oxygen-related electrocatalytic reactions.

About Oxygen Electrocatalysis

- **Oxygen electrocatalysis** is a fundamental process in **clean energy technologies** such as:
 - **Water splitting** for **hydrogen production**,
 - Generation of **clean fuels**,
 - Synthesis of **hydrogen peroxide** (H₂O₂).
- These technologies face major challenges like **slow reaction kinetics**, **high energy consumption**, and **high material costs** due to reliance on **precious metals** like **platinum (Pt)** and **ruthenium (Ru)**.

Catalyst Composition and Functionality

- After **selenium (Se) incorporation**, the researchers created two main catalyst variants:
 - **NixFe_{1-x}Se₂-NC**
 - **Ni_{3-x}FexSe₄-NC**
- The most efficient variant, **NixFe_{1-x}Se₂-NC@400**, showed **outstanding bifunctional catalytic performance** for:
 - **Oxygen Evolution Reaction (OER)** – production of oxygen gas,
 - **Oxygen Reduction Reaction (ORR)** – conversion of oxygen into useful chemicals like hydrogen peroxide.
- For **OER**, this catalyst exhibited **lower overpotential** and **high durability over 70 hours**, surpassing conventional **ruthenium-based catalysts**.
- For **ORR**, especially for **H₂O₂ production**, it outperformed **platinum-based catalysts** in terms of **reaction speed, efficiency, and stability**.

Innovation in Catalyst Design

- The CeNS team developed a **low-cost and efficient catalyst** using **nickel selenide** enhanced with **iron (Fe) doping**, which significantly improves performance while **reducing reliance on expensive precious metals**.
- The catalyst was synthesised starting from a **metal-organic framework (MOF)**, known for its **high porosity** and **catalytic potential**, but limited by **poor electrical conductivity**.
- **Iron (Fe) doping** was used to **modify the MOF's electronic structure**, enhancing its **catalytic activity** by creating more **active sites** and improving **reaction intermediate binding**.
- The MOF was further **converted into a carbon-rich material** using **pyrolysis**, a high-temperature process that enhanced the **material's electrical conductivity**.

Oxygen Electrocatalysis FAQs

Q1: What is Oxygen Electrocatalysis?

Ans: Oxygen Electrocatalysis refers to the acceleration of electrochemical reactions involving oxygen molecules, particularly the oxygen evolution reaction (OER) and oxygen reduction reaction (ORR) in energy devices like fuel cells and water electrolyzers.

Q2: Why is Oxygen Electrocatalysis important in energy storage?

Ans: It is crucial for improving the efficiency of renewable energy storage systems, especially in metal-air batteries, hydrogen production, and fuel cells.

Q3: What materials are used as oxygen electrocatalysts?

Ans: Catalysts include noble metals like platinum and iridium, and newer research focuses on non-noble materials such as transition metal oxides, nitrides, and single-atom catalysts.

Source: PIB

Source: <https://vajiramandravi.com/current-affairs/oxygen-electrocatalysis/>

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