

# Low Cost, Bifunctional Electrocatalyst for Water Splitting

Stanford researchers have developed and tested a low cost, bifunctional water splitting catalyst that outperforms conventional catalysts. The inexpensive  $\text{Ni}_3\text{FeO}_x$  nanoparticle facilitates both the oxygen **and** hydrogen evolution reactions, simplifying electrolysis deployment and scale up. The approach improves transition metal oxides/chalcogenides performance in reactions crucial to renewable energy production such as hydrogen production,  $\text{CO}_2$  reduction, and methane oxidation. This inexpensive catalyst could make water splitting, renewable energy production, rechargeable metal-air batteries and fuel cells commercially viable.

## Stage of Research

Researchers tested various nanoparticle morphologies of the bifunctional electrocatalyst (applied to carbon fiber paper) against conventional catalysts, Pt and Ir. With the input of a 1.5V battery the bi-functional catalyst split water continuously for a week at 82% efficiency. The conventional catalyst performance degraded to 65% efficiency after only 24 hours.

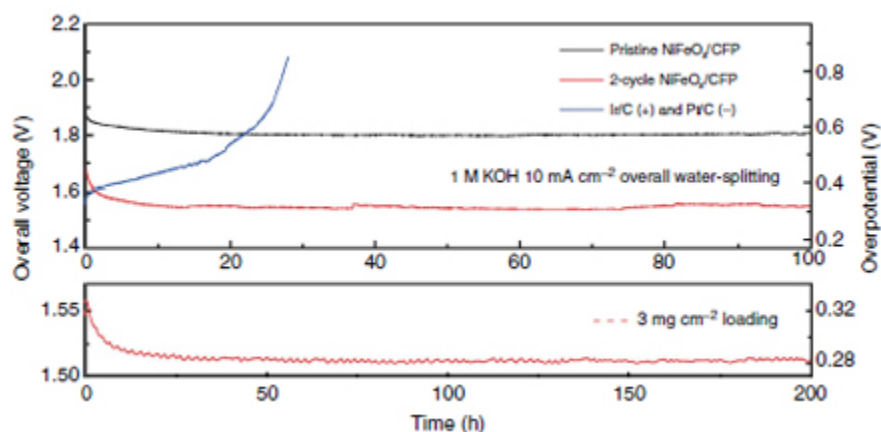


Figure 1 Catalyst performance comparison of conventional Ir and Pt, and  $\text{Ni}_3\text{FeO}_x$  catalysts.

The 2-cycle catalyst has more grain boundaries, more active reaction sites.

# Applications

- Catalysts for end user applications in:
  - Water splitting / hydrogen production
  - Oxygen and hydrogen reduction reactions - fuel cells, supercapacitors
  - CO<sub>2</sub> reduction - recycling CO<sub>2</sub> into reusable fuels
  - Methane oxidation - reducing greenhouse gas emission

# Advantages

- **Low cost** - inexpensive single catalyst, readily available, easy to deploy and scale up
- **Efficient** - 82% efficiency (at a constant 1.5V) for over a week

# Publications

- H. Wang, H.-W. Lee, Y. Deng, Z. Lu, P.-C. Hsu, Y. Liu, D. Lin, and Y. Cui, "[Bifunctional non-noble metal oxide nanoparticle electrocatalysts through lithium-induced conversion for overall water splitting.](#)" Nature Comm. 6, 7261 (2015) doi:10.1038/ncomms8261
- Stanford University. "[Single-catalyst water splitter produces clean-burning hydrogen 24/7.](#)" ScienceDaily. ScienceDaily, 23 June 2015.

# Innovators

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