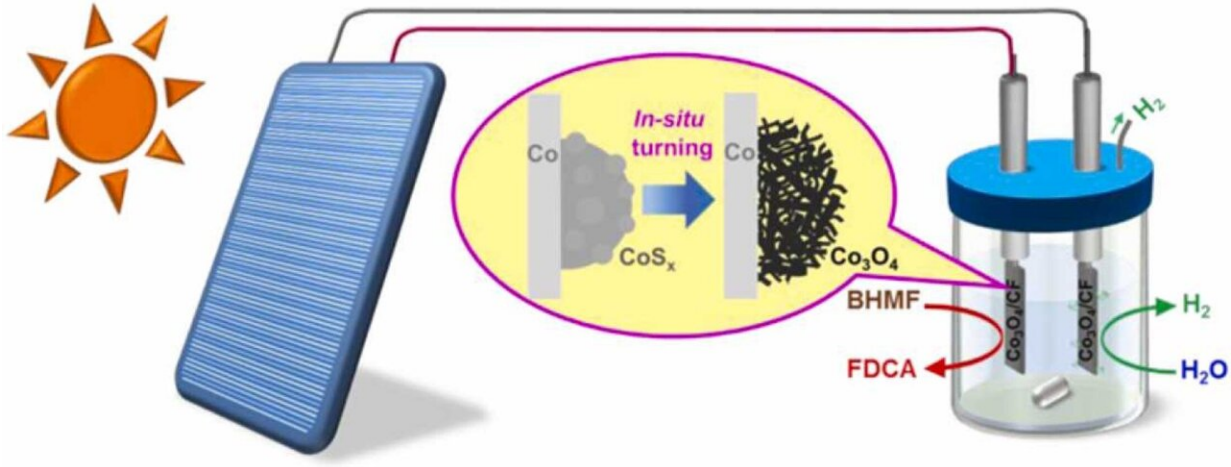
Novel electrocatalyst developed for biomass upgrading and hydrogen generation

April 7 2022, by Zhang Nannan



The photovoltaic electrocatalysis for biomass upgrading and hydrogen generation. Credit: NIMTE

Prof. Zhang Jian's team at the Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences (CAS) has developed a highly effective cobaltosic oxide (Co_3O_4) electrocatalyst for furan upgrading coupled with hydrogen generation. The study was published in *Applied Catalysis B: Environmental*.

Biomass is one of the most abundant renewable resources on earth. Through catalytic conversion, biomass can be upgraded to a range of fuels and chemicals that can replace traditional fossil resources, thus

playing a crucial role in achieving the goal of "carbon peak and carbon neutrality."

As the ultimate source of most energy on earth, solar energy can shorten the energy utilization path and improve the sustainability of the reaction process dramatically when introduced into catalytic reactions.

By virtue of sulfuration and in-situ electrochemical oxidation, researchers at NIMTE developed a hydrangea-like Co_3O_4 on cobalt foam as an efficient electrocatalyst.

A commercial solar cell was used to provide a roughly stable voltage of 1.60±0.02 V by adjusting brightness. Under natural sunlight, the developed Co_3O_4 catalyst can completely convert biomass 5-hydroxymethylfurfural (HMF) into 2,5-furandicarboxylic acid (FDCA) with a yield of 93.2%, faradaic efficiency (FE) of 92.9% and hydrogen yield of 99.8%.

Compared with the traditional thermally driven method to convert HMF to FDCA, which usually requires high temperature, high pressure, harsh reaction conditions, and even expensive precious metal catalysts, the photovoltaic electrocatalytic technology proposed in this study based on earth-abundant biomass shows many advantages, such as mild reaction conditions, low production cost, high energy efficiency and superior operating safety.

In addition, the researchers have applied for eight invention patents on related technologies and one patent has been issued. This study provides a sustainable development path for bio-based high-value chemical production and hydrogen production.

More information: Chunlin Chen et al, Sustainable biomass upgrading coupled with H2 generation over in-situ oxidized Co3O4

electrocatalysts, *Applied Catalysis B: Environmental* (2022). DOI: 10.1016/j.apcatb.2022.121209