Novel carbon-coated bimetallic catalyst for in-situ aqueous phase hydrodeoxygenation

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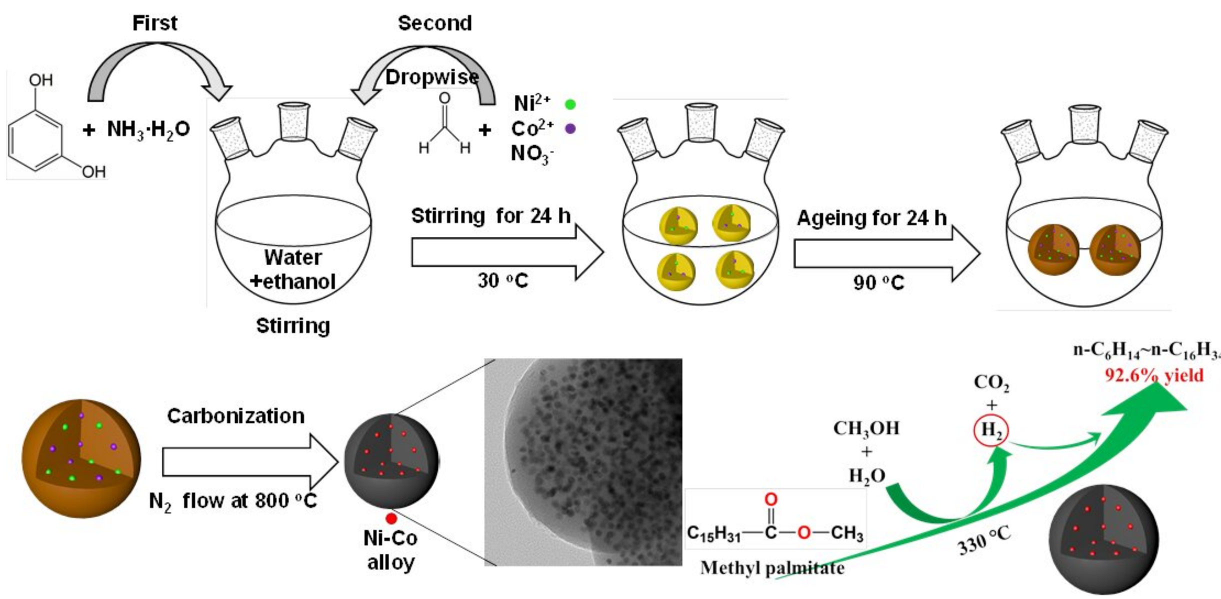

Novel carbon-coated bimetallic catalyst for in-situ aqueous phase hydrodeoxygenation. Credit: Jixiang Chen

The excessive consumption of fossil fuels causes serious energy and environment issues. As an ideal alternative to fossil fuels, renewable biomass can be converted to fuels and chemicals. Thereinto, lipids, mainly containing 16 and 18 carbons in fatty acids, are very suitable for preparing diesel-like hydrocarbons via hydrodeoxygenation. The traditional hydrodeoxygenation is carried out under external hydrogen supply at a high-pressure. However, there is a potential safety problem in the transportation and storage of H_2. Moreover, commercial H_2 is mainly produced from fossil resources. Recently, the in-situ hydrogen supply through the aqueous phase reforming has attracted great attention. To achieve this, a challenge is to design the catalysts with high resistance to sintering and leaching under harsh hydrothermal condition. Now, the researchers at Tianjin University have designed a carbon-coated metallic catalyst, which is published online in *Frontiers of Chemical Science and Engineering* on September 23, 2021.

In this work, Professor Chen's laboratory coupled the hydrodeoxygenation of methyl palmitate (a model compound of lipids) with the aqueous reforming of methanol. Significantly, they prepared a novel carbon-coated Ni-Co alloy catalyst via a one-pot extend Stöber process followed by carbonization under N_2 atmosphere. In the as-prepared catalysts, the alloy particles uniformly distribute in the carbon microspheres, exhibiting a "watermelon"-structure. This carbon coating structure limits the sintering and leaching of alloy particles. Interestingly, the presence of Co reduced the size of carbon microspheres, accelerating the mass transfer. Meanwhile, the electronic structure of Ni-Co alloy contributes to the efficient hydrodeoxygenation. The hydrocarbon yield can reach 92.6% on this carbon-coated Ni-Co alloy catalyst.

Chen said that they "consider that the carbon-coated metal catalysts are very promising for the in-situ aqueous phase hydrodeoxygenation. Even so, many problems are still required to conquer. For instance, the micro-pore structure in carbon microspheres and the carbon affinity to organic reactants easily cause the pores block and subsequently lead to the catalyst deactivation. Constructing more meso-pores in carbon microspheres is urgently needed in the future work. "

In Professor Chen's work, a novel facile route was proposed to prepare carbon-coated bimetallic catalyst. Carbon-coated methodology was found to improve the hydrothermal stability remarkably. This work enriches the catalyst development for the biomass upgrading in aqueous system and push the biomass valorization forward.

More information: Yinteng Shi et al, Carbon-coated Ni-Co alloy catalysts: preparation and performance for in-situ aqueous phase hydrodeoxygenation of methyl palmitate to hydrocarbons using methanol as the hydrogen donor, *Frontiers of Chemical Science and Engineering* (2021). DOI: 10.1007/s11705-021-2079-1

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