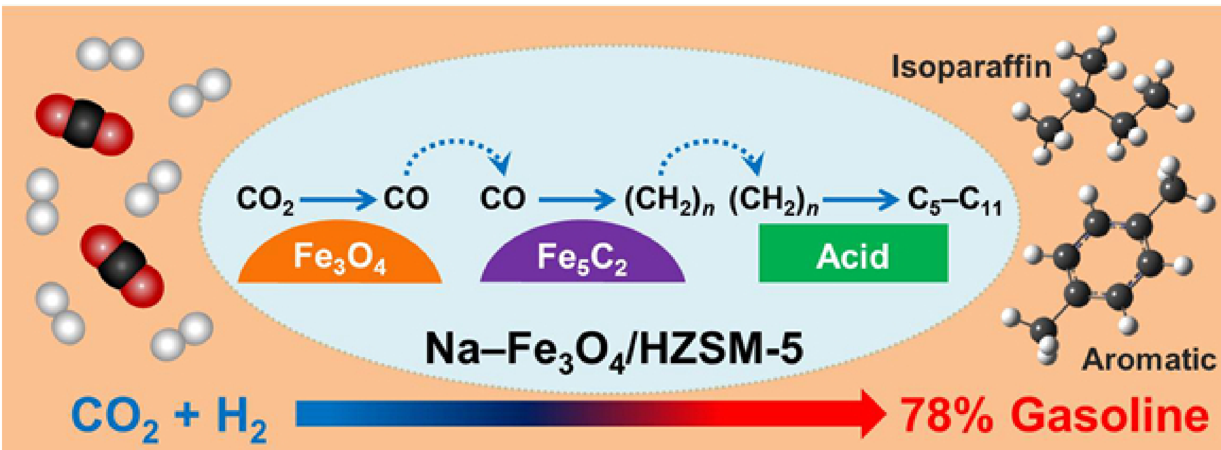
Scientists develop efficient multifunctional catalyst for CO2 hydrogenation to gasoline

May 2 2017



CO2 hydrogenation to gasoline-range hydrocarbons over Na-Fe3O4/Zeolite multifunctional catalyst. Credit: WEI Jian

Converting CO2 from a detrimental greenhouse gas into value-added liquid fuels not only contributes to mitigating CO_2 emissions, but also reduces dependence on petrochemicals. However, since CO_2 is a fully oxidized, thermodynamically stable and chemically inert molecule, the activation of CO_2 and its hydrogenation to hydrocarbons or other alcohols comprises challenging tasks. Most research to date, unsurprisingly, is focusing on selective hydrogenation of CO_2 to short-chain products, while few studies on long-chain hydrocarbons, such as gasoline-range (C_5-C_{11}) hydrocarbons. The key to this process is to search for a highly efficient catalyst.

The research team led by Dr. SUN Jian and Prof. GE Qingjie in Dalian Institute of Chemical Physics has succeeded in preparing a highly efficient, stable, and multifunctional Na-Fe_3O_4/HZSM-5 catalyst for the direct production of gasoline from CO_2 hydrogenation. This catalyst exhibited 78 percent selectivity to C_5-C_{11} as well as low CH4 and CO selectivity under industrial relevant conditions. And gasoline fractions are mainly isoparaffins and aromatics, thus favoring the octane number. Moreover, the multifunctional catalyst exhibited a remarkable stability for 1,000 h on stream, which definitely has the potential as a promising industrial catalyst for CO_2 utilization to liquid fuels.

In-depth characterizations indicate that this catalyst enables RWGS over Fe_3O_4 sites, olefin synthesis over Fe_5C_2 sites and oligomerization/aromatization/isomerization over zeolite acid sites. The concerted action of the active sites calls for precise control of their structures and proximity. This study paves a new path for the synthesis of liquid fuels by utilizing CO2 and H_2. Furthermore, it provides an important approach for dealing with the intermittency of renewable sources (sun, wind and so on) by storing energy in liquid fuels.

This work was published in *Nature Communications*.

More information: Jian Wei et al, Directly converting CO2 into a gasoline fuel, *Nature Communications* (2017). DOI: 10.1038/ncomms15174

Provided by Chinese Academy of Sciences

Citation: Scientists develop efficient multifunctional catalyst for CO2 hydrogenation to gasoline