New catalyst method promises better use of syngas, coal

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The world's first project to industrially synthesize 25 kt/a of higher alcohols from syngas passed a continuous 72-hour catalyst performance test on 3rd November, 2019 in Yulin, Shaanxi province, china.

The project, developed by researchers from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences, offers a

new method for directly synthesizing high value-added fine chemicals from syngas and suggests new ways to cleanly convert and utilize coal resources.

Results of the catalyst test showed that at 30% of catalyst loading, total conversion of syngas exceeded 84%; selectivity of methane was less than 6%; and selectivity of alcohols/aldehydes/olefins exceeded 60%.

Higher alcohols—the key products of this process—are often used as intermediates in the synthesis of plasticizers, detergents and lubricants, and are generally produced through the Ziegler and Oxo processes. However, these processes involve drawbacks, such as cumbersome steps as well as the use of dangerous catalysts in the Ziegler process.

DICP scientists and their collaborators have been conducting basic research and industrial testing on high-selectivity production of higher alcohols from syngas over Co-based catalysts since 2004. As part of their research, they designed a series of novel Co-based catalysts, namely, activated carbon supported Co-Co_2C catalysts. The active site of these catalysts is supposed to be the interfacial sites between metallic Co and cobalt carbide (Co_2C).

The researchers also proposed the mechanism by which alcohols are formed on the interfacial sites between Co and the Co_2C sites. That is, CO molecules are associatively adsorbed on the surface of the Co_2C sites and then inserted into the alkyl chain formed on the adjacent metallic Co sites.

The new catalytic method may make Fischer-Tropsch synthesis (FTS) more practical. FTS is one of the most versatile processes for converting syngas ($CO+H_2$) derived from coal, natural gas, and biomass into various chemical products. FTS is notable for producing high-quality paraffins. In addition, using FTS to directly synthesize olefins and oxygenates

(mainly linear α- alcohols) from syngas is a promising "one-pot-one-step" method due to the high added-value and large potential demand for these olefin and oxygenate products. However, no catalytic system has performed sufficiently well for industrial implementation to date.

The results of the current catalyst test suggest that the direct conversion of syngas into high value-added fine chemicals can now be accomplished at industrial scale, thus suggesting many more opportunities for cleanly and efficiently utilizing coal resources.

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