HETEROGENEOUS CATALYSIS

Contains no additives

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Fischer–Tropsch (FT) synthesis is a catalytic process that produces hydrocarbon fuels from a mixture of carbon monoxide and hydrogen. The catalysts used to carry out this reaction are typically composed of cobalt nanoparticles dispersed on a metal oxide support. Often small amounts of precious metals, such as ruthenium or rhenium, are added to the catalyst to enhance its performance, but these also increase its cost. Now, Peter Ellis and colleagues at Johnson Matthey prepare a cobalt-based FT catalyst, supported on alpha alumina, that achieves high performance in terms of activity, selectivity and stability, without the need for any precious metal additives.

Prior to reaction, cobalt-based FT catalysts must typically be reduced in hydrogen to form the active catalytic phase, cobalt metal. The degree to which the cobalt oxides present in the as-made catalyst can be reduced to metal and the size of the resulting metallic nanoparticles play a key role in determining the performance. The researchers select an alpha alumina material as a support that is mechanically and hydrothermally stable, but that also tends to produce large, albeit easily reducible, cobalt particles. However, the researchers are able to produce fine cobalt particles — while maintaining reducibility — by using a deposition method to introduce the cobalt: they add cobalt metal to a solution of ammonium hydroxide and ammonium carbonate and then bubble air through, before adding the alpha alumina and boiling the mixture. In a slurry-phase reactor, the resultant catalyst demonstrates similar activity and improved selectivity to the desired C_{5+} products compared to a commercial cobalt catalyst that also contains ruthenium.

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