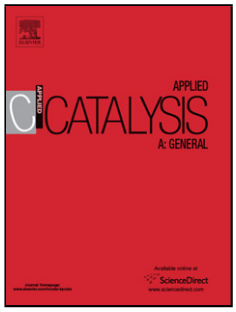

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Authors: James Paterson, Mark Peacock, Ewen Ferguson, Manuel Ojeda, Jay Clarkson

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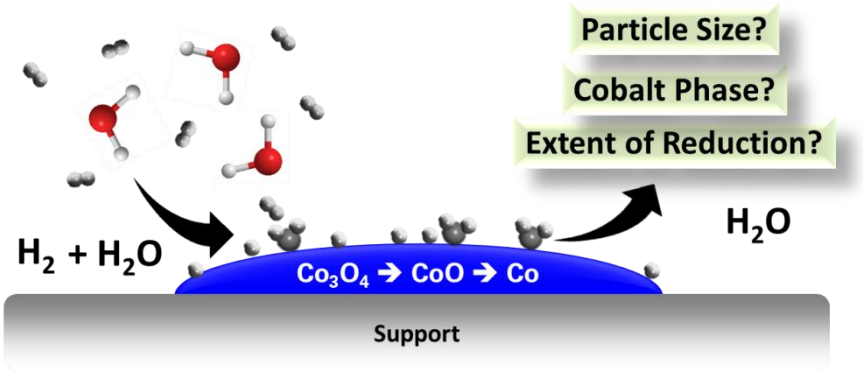
In Situ X-ray Diffraction of Fischer-Tropsch Catalysts – Effect of Water on the Reduction of Cobalt Oxides

James Paterson [a], Mark Peacock [a], Ewen Ferguson [a], Manuel Ojeda [a], Jay Clarkson [b]

[a] BP, Saltend Chemicals Park, Hull, HU12 8DS

[b] JM Process Technologies, Stockton, Teeside

Graphical abstract:



Highlights:

- In situ XRD to evaluate FT catalyst reduction with a water co-feed to understand water profiles in a fixed bed FT catalyst process and tracking changes to the species and temperatures where they form
- By using a range of water co-feed tests with in situ XRD we showed the inhibition of reduction by water for cobalt oxide to cobalt metal
- FT catalysis is shown with 2 different GHSV's during reduction where the water residence time is changed, showing significant changes to FT performance across 4 sections of the bed (top to bottom).
- The finds from this are applied to the BP-JM FT GTL commercial offer, where a decrease in selectivity from poor reductions will impact on commercial viability and catalyst life

Abstract: By using *in situ* X-ray diffraction, we were able to demonstrate the effect of H_2O on the reduction of cobalt oxide particles for Fischer-Tropsch Synthesis. Reduction of Co_3O_4 to Co via CoO in H_2 produces large quantities of water, which was thought to have an impact upon the reduction of the catalyst down a reactor bed. Bed profiles are produced from saturation of the bottom of the catalyst bed from the H_2O produced from the top of the bed. This contribution clearly shows the impact of H_2O on the cobalt crystallites to hinder reduction and facilitate sintering of the cobalt particles. *In situ* X-ray diffraction was used to follow the reduction of the cobalt phase throughout the evolution of the reduction process, while controlled water production and cofeed was used