

Mixed metal (Mn, Al, Ti) cobalt oxide model systems for optimizing sustainable aviation fuel production via Fischer-Tropsch synthesis

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In the era of energy transition with the goal to lower greenhouse gas emissions and to overcome the impact on climate changes, the Power-to-Liquids (PtL) technology poses as a key potential solution, especially in the hard to abate aviation sector. Sustainable aviation fuel (SAF) may be produced through Fischer-Tropsch (FT) synthesis, the conversion of synthesis gas into long-chain hydrocarbons using cobalt-based FT catalysts. Recently, manganese promotion was demonstrated to efficiently increase the yield of SAF,¹ while modification of metal oxide supports allows for operation at high conversion levels in the FT synthesis.² Herein, model catalysts are prepared and characterized to study the isolated roles of support (modification) and manganese promotion regarding catalyst activity, selectivity, and stability during FT synthesis.

The efficiency of FT catalysts largely depends on the physico-chemical properties of the surface of the catalysts. Manganese promotion of cobalt-based FT catalysts may result in Mn²⁺ on the edge of manganese oxide structure, which interacts with adsorbed carbon monoxide species.³ At a molar Mn:Co ratio of 0.15, the promotional effect of manganese on cobalt-based FT catalysts was amplified.¹ In general, deactivation of cobalt-based FT catalysts via formation of metal-support compounds (MSCs), such as cobalt titanate or aluminate, represents another challenge when operating at high conversation rates.^{4,5} In the present study, we investigate the role of promotion on the formation of cobalt titanate or aluminate in cobalt FT model catalysts. Cobalt oxide and mixed cobalt oxide nanoparticles are prepared separately via the surfactant free benzyl alcohol route.⁴ Subsequent deposition of these nanoparticles on various support materials yield model catalysts, which are thoroughly characterized to advance the development of efficient FT catalysts for SAF production.

References

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