

Platinum promoted cobalt based Fischer-Tropsch thin-film catalysts

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The Power-to-Liquids (PtL) approach can produce sustainable fuels by utilizing Fischer-Tropsch (FT) processes to convert green hydrogen and sustainable carbon dioxide. While FT is a promising technology for producing sustainable fuels, high-performance catalysts are crucial to its success. Thin film catalysis offers opportunities to tailor the catalysts properties by design that are pre-adapted to specific chemical environment for their targeted application. Fischer-Tropsch synthesis (FTS) benefits from thin film catalysts by reducing the amount of active materials, streamlining activation phase and enhancing selectivity toward desired end products. We report a cobalt-based thin-film FTS catalyst synthesized by a combination of different deposition techniques including atomic layer deposition (ALD), plasma enhanced chemical vapour deposition (PECVD), magnetron sputtering and successive ionic layer adsorption and reaction (SILAR). Mn/MnO_x and Pt are studied as promoters and enhancers toward FTS while considering cobalt as the FTS active material. The size of platinum particles is controlled by number of ALD cycles. An ultra-low amount of Pt grown by 5ALD cycles is loaded onto the stack of cobalt based heterostructures (Mn-Co-SiO_x/Al) to study the effect of platinum as reduction promotor. The reduction behaviour of cobalt in the presence of Mn and Mn-Pt in oxidation-reduction conditions is investigated using *in-situ* synchrotron grazing incident X-ray diffraction. It is revealed that platinum promotes the reduction of cobalt species (spinel-Co₃O₄ to Co⁰) as indicated by a significant lowering of the reduction temperature to 350 °C while the addition of Mn retards the reduction of CoO to Co⁰. Temperature-programmed reduction (TPR) studies further confirm the effect of Pt on promoting the reduction of Co₃O₄ at lower temperatures to FTS active phase. These well-defined Pt-Mn-Co-SiO_x/Al hierarchical heterostructures represent a promising thin film FTS catalyst system with significantly enhanced FTS activity. Clear structure–property relationships required to insight-driven scale up the process, will be presented.