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New application of mechanical coating process without solvent for Fischer-Tropsch synthesis

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Ultra-clean hydrocarbon fuels produced from syngas by Fischer-Tropsch (FT) synthesis has been applied in industry for decades. However, the FT catalysts are traditionally synthesized via wet-chemical methods, accompanied by solvent waste pollution and large energy consumption. The mechanical coating process, by contrast, applies high mechanical shearing/impacting forces to prepare heterogenous catalysts without any solvent, releases no effluent and needs no drying or post-heating steps. It is more environmental friendly and sustainable than wet methods. In this research, the dry coating process was applied to synthesize Co/Al_2O_3 FT catalysts and catalyst structure was optimized to improve catalytic activity and achieve high long-chain hydrocarbon yield. In the experiments, (2-15 wt%) Co/Al_2O_3 catalysts were prepared by mixing various contents of nanoscale Co_3O_4 and mesoporous spherical γ-Al_2O_3 in a high-shearing mixer Picomix (Hosokawa Micron B.V.) at 5000 rpm for 5 min. The obtained catalysts were characterized by a combination of methods (particle size, specific surface area, SEM and EMP imaging, XRD and H_2-TPR). Fluidization tests were performed to evaluate attrition resistance of the catalysts. FT activity was evaluated in a milli fixed-bed under 20 bars and 250 °C for 24 hours with syngas (H_2/CO=2 v/v). The results show that the prepared Co/Al_2O_3 catalysts possessed uniform Co_3O_4 coating on surface of Al_2O_3 particles and presented strong mechanical resistance ability. Among all the prepared catalysts, the 5 wt% Co/Al_2O_3 catalyst exhibited the highest reaction rate (18.4 mmolCO/s/molCo), with low CH_4 selectivity (13.3%) and high C5+ selectivity (75.1%), therefore cost-effective for FT synthesis application.

Biography

Nouria Fatah has completed her Post-graduation and PhD degree in Chemical Engineering and Powder Technology. Presently she is a full Professor at Ecole Nationale Supérieure de Chimie de Lille and in the Unité de Catalyse et Chimie du Solide, Lille, France. She is also a Group Leader on Process and Powder Technology (powder technology and gas-solid fluidization, mechanosynthesis and coating of solids, characterization of powders (physical properties and flowability), fluidization of cohesive powders and numerical modelization). She is the Director of the Powder Technology and Processes Engineering at PLATFORM. She has published 98 articles, proceedings, patents and communications.

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