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MULTIFUNCTIONAL CATALYTIC SYSTEMS FOR SYNGAS CONVERSION INTO HIGHER ALCOHOLS

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Project Summary: The development of catalysts showing satisfactory performance to realize the synthesis of higher alcohols (HA) from syngas at a large scale, which promises greater sustainability than current industrial routes, is hindered by limited fundamental understanding. This PhD study aimed to elucidate the function of active metals, carriers, and promoters in CoMo- and CuFe-based modified Fischer-Tropsch synthesis catalysts, to guide the design of superior systems. Property-function relationships were established combining precision synthesis, controlled activation, in-depth characterization, and detailed catalytic and kinetic tests. Specifically, carbon nanofibers were uncovered as a support enabling optimal active metals' size and proximity through confinement in their channels and the addition of K as a promoter further fostered the metals' vicinity, improving the HA selectivity. The use of zeolites as an alternative support showed that adding an acidic functionality permits to tune the nature of the HA obtained. Paving the road toward a practical application, a cascade process with unrivalled productivity was conceived by exploiting the promotional effect of CO2 as a co-feed on HA synthesis and the ability of zeolites to valorize methanol and olefins byproducts to additional HA.

CV. H.T. Luk received his BSc in Chemical Engineering at the Hong Kong University of Science and Technology in 2013. After an exchange program at DTU Denmark, he moved to ETH Zurich and obtained his MSc in Chemical and Bioengineering in 2015. In the same year, he started his PhD in the advanced Catalysis engineering group led by Prof. J. Pérez-Ramírez.