Title: Designing a Novel Catalyst for the Haber-Bosch Process Under Mild Conditions

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Cu holds great potential as a catalyst for the Haber–Bosch process. This study explored the impact of a catalytic support on the fundamental capabilities of Cu and its ability to maintain ammonia yield during repeated use. Initially, experiments were conducted using various potential metals and their combinations with catalytic supports prepared from nitrate solutions. Although the ammonia yields increased compared to previous experiments, the presence of the catalytic support did not significantly inhibit the decline in performance of the Cu catalyst. This discrepancy was attributed to the incomplete decomposition of nitrogen oxides during preparation. To address this, the subsequent experiment focused on precisely confirming the effect of the catalytic support by eliminating nitrate species in the prepared catalysts to the greatest extent possible. The catalysts were prepared using nitrate solutions and heated to a higher temperature to remove the nitrate species. When these supported catalysts were used, the ammonia yield in the first attempt was lower than that in previous experiments. However, no substantial decline in the catalytic capability was observed. These results suggest that employing a catalytic support for Cu catalysts can improve their long-term performance. Further experiments will clarify the optimal catalytic support and preparation method to enhance the efficiency and stability of Cu catalysts.