ABSTRACT - ORAL

Aqueous Solution–Gel Synthesis of $CuNb_2O_6$ and $Cu_3Nb_2O_8$ and Exploring Their Potential as Precatalysts for Photothermal CO_2 Hydrogenation

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Abstract: Photothermal CO_2 reduction is a promising strategy for mitigating global carbon emissions. The reverse water-gas shift (RWGS) reaction provides a key pathway for CO_2 conversion into CO, an important feedstock for downstream chemical processes. This motivates the development of new catalysts specifically designed to efficiently drive this transformation. Here, we report the synthesis of $CuNb_2O_6$ and $Cu_3Nb_2O_8$ using a reproducible aqueous citrate-based solution–gel method. Citric acid acts as both a chelating and polymerizing agent, promoting homogeneous mixing of Cu and Nb species and controlled phase formation. The materials were characterized using in situ high-temperature X-ray diffraction (HT-XRD), Raman spectroscopy, scanning electron microscopy (SEM), and UV–vis spectroscopy. Under combined thermal and light irradiation, both materials selectively produced CO through the reverse water–gas shift (RWGS) reaction, with no other reaction products detected under the investigated conditions. Post-reaction characterization revealed copper nanoparticle formation on the oxide surfaces, demonstrating that copper niobates behave as precatalysts that transform in situ to the active catalyst phase under relevant reaction conditions. These findings demonstrate the potential of aqueous citrate-based synthesis for preparing copper niobates and provide insights into their evolution under photothermal reaction conditions.