High-yield hydrogen and methane production via supercritical water gasification of glucose using Ni/Cu-doped CeO_2 catalyst: Synthesis process optimization utilizing RSM

Author links open overlay panelHakim S. Sultan Aljibori [a], Murtadha M. Al-Zahiwat [b], Abdul Amir H. Kadhum [c], Dheyaa J. Jasim [d], Heba A. El-Sabban [e f g], Young Gun Ko [e], Mumtaj Shah [h], Khursheed B. Ansari [h]

https://doi.org/10.1016/j.cep.2024.110144

Abstract

This study investigates the synthesis and performance of a nickel/copper-doped cerium oxide catalyst for hydrogen and methane production during the supercritical water gasification of glucose, which is important for producing clean fuel. The effects of key synthesis parameters—cerium molar concentration, nickel salt to cerium salt, and copper salt to cerium salt weight ratios—on catalyst activity were optimized using Response Surface Methodology. The catalyst demonstrated significant improvements in hydrogen and methane yields compared to supercritical water gasification without a catalyst, achieving increases of 181 % and 226 %, respectively. The optimal synthesis conditions yielded 5.46 mmol.g-feed^{-1} hydrogen and 2.45 mmol.g-feed^{-1} methane with minimal error between experimental and predicted results. Characterization techniques, including XRD, TEM, and EDS-Mapping, confirmed the catalyst's uniform dopant dispersion. Reusability studies revealed deactivation due to coke deposition, but performance was partially restored via regeneration. This work highlights the potential of aforementioned effective catalyst for clean fuel production.