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Deep eutectic solvent boosted ruthenium catalysts for acetylene hydrochlorination

Abstract:

The industrial hydrochlorination of acetylene is plagued by the toxicity of the catalyst mercuric chloride (HgCl_2), and many researchers at home and abroad are making great efforts to develop efficient mercury-free catalysts. Ruthenium catalysts, in particular, are appealing and interchangeable alternatives, but they still face the problems of lack of efficient active sites and serious carbon accumulation during the reaction process. This study shows that DESs, novel ionic liquid analogues characterized by low vapor pressure, high polarity, and tunable chemistry, can coordinate with Ru species to form local structural domains. These domains modulate the microchemical environment surrounding the active center Ru, enhancing the dispersion of active components and boosting the catalytic efficiency of the site. Furthermore, DESs possess numerous hydrogen bonding sites that can form a robust hydrogen bonding network to capture HCl gas. The DES phase in Ru-DES/AC catalysts can provide a localized environment with a high concentration of HCl, facilitating the rapid reaction of activated acetylene. This, in turn, inhibits the formation of carbon deposits by polymerisation of acetylene to deactivate the catalysts. In conclusion, as inexpensive “designer” solvents, DESs can regulate the local environment of the metal active center, offering new insights into the development of mercury-free catalysts and advancing the industrialization of green and sustainable production processes for vinyl chloride.

Biography

Dr. Liu Detao is a prominent researcher in the field of renewable energy and environmental engineering, affiliated with the South China University of Technology in China. With a focus on addressing global energy crises and environmental concerns, Dr. Liu's work centers on developing innovative solutions for sustainable energy generation and pollution mitigation. In his research, Dr. Liu explores the potential of harnessing hygroelectric and thermoelectric energy from natural sources such as moisture in the air and waste heat, offering cost-effective and environmentally friendly alternatives to traditional fossil fuels. His groundbreaking work on solid ionic woods, inspired by the natural processes of water and ion uptake in trees, has garnered significant attention for its potential to revolutionize energy harvesting and environmental remediation.