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Large Scale Production of Molybdenum Oxide Particles by Ultrasonic Spray Pyrolysis and their Partial Oxidation Activity

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Extended Abstract

Molybdenum oxides exist mainly in two forms: MoO_2 and MoO_3. MoO_3 has been used as a semiconductor, a field-emitter, an electrochromic material, photochromic material, and a gas sensor. MoO_2 exhibits metal-like electronic conductivity because of the existence of delocalized electrons in its valence band. Both MoO_3 and MoO_2 have been used as a catalyst in hydrocarbon reforming processes. In particular, MoO_2 has attracted a lot of attention due to coke resistance and sulphur tolerance during the partial oxidation of hydrocarbons. Although commercial MoO_2 has a very small BET surface area (< 10 m^2/g), some researchers reported solvothermal synthesis of MoO_2 nanoparticles with a high BET surface area of about 50 m^2/g. However, the yield of MoO_2 nanoparticles by solvothermal synthesis was less than 1 g/batch. In this study, we developed a large scale production process for molybdenum oxides by ultrasonic spray pyrolysis. The particle size and phase structure of the product molybdenum oxides were affected by precursor concentration, pyrolysis temperature, carrier gas flow rate, etc. As-synthesized MoO_2 particles were analyzed by BET, XRD, EDX, TGA, and FT-IR. Partial oxidation reaction was studied to test the catalytic performance of the as-synthesized MoO_2 using n-dodecane as a fuel which is a model compound of bio-diesel. The effect of O_2/C ratio, reaction temperature, and weight-hourly space velocity (WHSV) on the conversion and H_2 production were systematically investigated. H_2 and CO yields, and carbon conversion over as-synthesized MoO_2 were calculated and compared with those over commercial one. The as-synthesized MoO_2 particles showed promising reforming performance without any coke formation.