

Synthesis, XANES/EXAFS Fine Structure Characterization, and N₂/CO₂ Adsorptive Selectivity of Cobalt Metal Azolate Frameworks

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CO₂ is an abundant carbon source and one of the major green-house gases, which is produced from chemical industry, energy supply industry, power plant and transportation sector that use fossil fuels as their resources. Therefore, the control of its emission represents a challenging task that requires new ideas and new technologies. Gas capture materials become one of ideal options for solving GHG emission problem. One of the best materials is metal azolate frameworks (MAFs) due to its excellent stability and active interaction with gases. In this study, all MAFs were synthesized by green processes including aqueous solution mixing and acid catalyzed method.

Crystal structures and morphologies were confirmed by XRD and FE-SEM respectively. Furthermore, FTIR and TGA analyses were also used for investigation of bonding phenomenon and thermal stabilities. Valent of Co atom and their bond distances in cobalt MAFs were investigated by XANES and EXAFS. The Co atoms in ZIF-67 and dia-Co(mim)₂ existed by two oxidation states (Co²⁺ and Co³⁺). Bond distance of Co-C in ZIF-67 and dia-Co(mim)₂ were 1.3 and 1.5 Å respectively. The BET surface area, N₂, and CO₂ adsorption amount of MAFs were measured by micrometrics ASAP 2020. N₂ adsorption curves of ZIF-67 and dia-Co(mim)₂ (mim: 2-methylimidazole) were Type I (high surface area, micropore structure) and Type III (low surface area, mesopore and macropore structure). In addition, the pore arrangement of ZIF-67 and dia-Co(mim)₂ could be identified by comparing the N₂ adsorption curves to IUPAC standard patterns that displayed cylinder and slit-plane arrangement respectively. These result revealed that synthesized cobalt MAFs had the highly potential to separate CO₂ from mixed gases for the industrial air pollution control application.

Keywords: Carbon Dioxide Capture, Cobalt MAFs, Green Synthesis Method, XANES/EXAFS, N₂/CO₂ Adsorptive Separation.

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