

Scalable Fluorescent Zn-based Metal-Organic Framework and its Application thereof for CO₂ Fixation

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ABSTRACT

The present invention provides a novel method preparation of scalable fluorescent dual linker zinc-based metal organic framework (MOF) and describes its dual functionality that is catalytic CO₂ fixation and real-time reaction monitoring. The protocol begins with the small-scale synthesis of the MOF using a simple reflux method, during which key parameters such as reaction time, temperature, and solvent amount are optimized. The optimized conditions allow for the successful scale-up to produce the Zn-based MOF in quantities of up to 20 gram feed. This MOF, constructed with dual linkers, exhibits high fluorescence and is employed both as a heterogeneous catalyst for the chemical fixation of CO₂ with epoxides to produce value-added cyclic carbonates and as an in situ agent for monitoring the reaction progress. Under UV light, MOF's fluorescence properties act as a platform for tracking cyclic carbonate formation.

KEY APPLICATION AREAS

1. Carbon Capture, Utilization & Storage (CCUS).
2. Green Chemistry & Sustainable Catalysis.
3. Metal-Organic Framework (MOF) Materials.
4. CO₂ Conversion & Carbon Utilization.
5. Chemical Process Industries.
6. Advanced Functional Materials.

POTENTIAL USE

1. Catalytic CO₂ fixation with epoxides to produce value-added cyclic carbonates.
2. Real-time fluorescence-based monitoring of CO₂ conversion reactions, eliminating the need for expensive NMR analysis.
3. Industrial-scale production of scalable Zn-based MOFs for catalytic applications.
4. Carbon capture and utilization (CCU) by converting CO₂ into commercially valuable chemicals.
5. Sustainable manufacturing of cyclic carbonates for chemical, polymer, and battery electrolyte industries.
6. Dual-function catalyst and sensor for simultaneous chemical synthesis and reaction monitoring.
7. Scalable MOF platform for environmental and industrial catalytic processes requiring high-performance fluorescent materials.