**附件1**

**资助领域详情**

**下一代碳中和化学过程：从超快机理到催化创新**

**Next-Generation Carbon-Neutral Chemical Processes: From Ultrafast Mechanism to Catalytic Innovation**

**Multi-Pollutant Synergistic Valorization**

To develop catalytic systems for the synergistic conversion of CO₂ with methane, NOx, chemical reagents, or polymers (waste plastics), aiming to produce high-value chemicals and oxygenates by overcoming selectivity limitations in conventional thermal/catalytic routes through innovative reaction network design.

**Transformation under Multi-Physical Energy Fields**

To expand reaction pathways for carbon valorization by utilizing coupled energy inputs, such as light, electricity, heat, and plasma, as well as their hybrid combinations (e.g., photo-thermal, photo-electrochemical), to explore novel activation mechanisms and unique product distributions under unconventional excitation modes.

**Operando Mechanistic Tracking of Chemical Transformation**

To resolve transient intermediates and reaction pathways during catalytic activation using ultrafast X-ray and optical spectroscopies under realistic operating conditions, and to construct machine learning-enhanced multiscale models quantifying kinetic bottlenecks and catalyst degradation mechanisms for carbon-neutral processes.

**Functional Materials Engineering**

To design atomically tailored capture-conversion materials (e.g., frustrated Lewis pairs, redox-active MOFs, ionic composites) via defect/interface engineering, optimizing adsorption kinetics for targeted molecules (e.g. CO2, CH4, NOx) and catalytic conversion efficiency through combinatorial synthesis and in-situ characterization.

**Scalable Catalyst Systems Engineering**

To establish dynamic structure-performance relationships across laboratory-to-pilot scales using operando spectroscopy, aiming to elucidate active-site reconstruction during scale-up transition and develop accelerated aging protocols for industrial reactor implementation.