Platinum Nanoparticles Embedded in MOF-derived Carbons as Robust Bifunctional Catalysts for Tandem Catalysis

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Abstract

Sustainable chemistry encourages the development of environmentally friendly technology to minimize waste chemicals produced in individual procedures. To this end, tandem catalysis, which combines multiple catalytic processes in one step, allows the reaction sustainability by circumventing the intermediate separation and purification steps. Knoevenagel condensation is a powerful tool for the production of α, β-unsaturated carbonyl compounds, which are key products in therapeutic, cosmetic and agrochemical industry. Usually, Knoevenagel condensation and hydrogenation take two steps to complete. The rational design of robust bifunctional catalysts for tandem catalysis, in which multiple reactions occur in one pot, is highly desirable from the viewpoint of atom economy and environmental sustainability. Herein, we develop a new bifunctional catalyst by encapsulating platinum (Pt) nanoparticles into metal-organic frameworks (MOFs)-derived carbons for efficient tandem catalysis. The facile pyrolysis of amino-functionalized MOFs, UiO-66-NH_2, gives rise to a robust nitrogen-rich carbons (Cz-UNH_2), which catalyzed the Knoevenagel condensation efficiently. A new bifunctional catalyst (Pt/Cz-UNH_2) was further fabricated by assembling hydrogenation sites endowed by Pt nanoparticles and the Cz-UNH_2 support possessing rich basic sites. The resultant Pt/Cz-UNH_2 catalyst exhibits high activity, selectivity in a one-step tandem Knoevenagel condensation-hydrogenation reaction.

Image

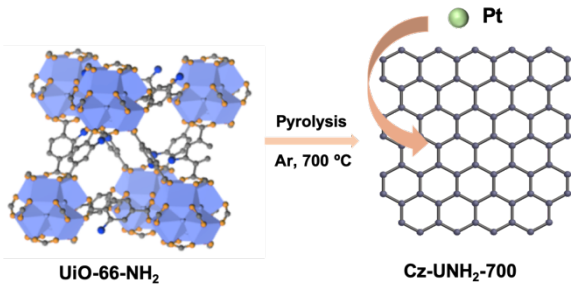


Figure 1. The synthesis of Pt NPs supported on the nitrogen-doped carbon derived from UiO-66-NH_2.

Recent Publications

1. Jingwen C, Minda C, Biying Z, Renfeng N, Ao H, Tian Wei G, Alexander V, Zhiguo Z, Qilong R and Wenyu H * (2019) Allylic oxidation of olefins with a manganese-based metal-organic framework. Green Chemistry 21, 3629–3636.
2. Yang L, Chengjie X, Qi W, Lei Z, Ao H, Ming K* and Zhaozheng S (2018) Direct dehydrogenation of isobutane to isobutene over Zn-doped ZrO_2 metal oxide heterogeneous catalysts. Catalysis Science & Technology 8, 4916–4924.
3. Xiaobin L, Zhenyu X, Ao H, Wen W, Liangliang Z,* Rongming W* and Daofeng S (2016) Crystal structures, topological analysis and luminescence properties of three coordination polymers based on a semi-rigid ligand and N-donor ligand linkers. New Journal of Chemistry 40,5957-5965.
4. Rongming W, Xiaobin L, Ao H, Wen W, Zhenyu X, Liangliang Z, Fangna D, and Daofeng S* (2016) Unprecedented Solvent-Dependent Sensitivities in Highly Efficient Detection of Metal Ions and Nitroaromatic Compounds by a Fluorescent Barium Metal–Organic Framework. Inorganic Chemistry 355, 1782−1787.
5. Xiaobin L, Huan L, Zhenyu X, Weidong F, Ao H, Rongming W,* Liangliang Z, and Daofeng S* (2016) Multifunctional lanthanide–organic frameworks for fluorescent sensing, gas separation and catalysis. Dalton Trans 45, 3743–3749.

Photograph



Biography

Ao Huang is passionate about chemical catalysis and has a certain amount of professional knowledge. Based on her research on MOFs, she discovered and created a more active catalyst to achieve a more outstanding activity. After years of research in this area, she builded a reaction that can be made two steps into one step at a time. The catalyst increases efficiency and can be recycled.

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Notes/Comments:

This work will continue to be researched and finally officially published.