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VIEWS & COMMENTS

Green catalytic engineering: A powerful tool for sustainable development in chemical industry

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Catalysts play critical roles in modern chemical industry and more than 85% of all chemical processes involve the use of catalysts. The sustainable development of chemical industry calls for green catalytic engineering, which refers to the engineering design and development of environment-friendly, high-efficiency and cost-effective catalysts and catalytic processes for the Industrial manufacture of useful products and energy. It may be difficult to predict the future, but we are glad to identify the current trends that are likely to become ever more important, which is green catalytic engineering. To emphasize the latest advances in the exciting field, to explore efficient strategies for the future development, and to address challenges in chemical industry, we presents a Mini-Special Issue in Frontiers of Chemical Science and Engineering that highlights two featured research articles and three reviews on green catalytic engineering.

Hydrocracking, one of the most important petroleum-refining processes, is used to convert feedstock into more usable components, such as cracking gas, light naphtha, heavy naphtha used for catalytic reforming feed or gasoline, jet fuel, diesel and tail oil used for steam cracking to make ethylene. A series of green catalysts and green catalytic processes for hydrocracking of petroleum feedstock have been developed in China. Peng et al. present a review of these state-of-the-art technologies in “Research and development of hydrocracking catalysts and technologies in China” [1].

Light olefins, significant raw materials in chemical industry, are mainly produces by steam thermal cracking of naphtha. In “Effect of crystal size of hierarchical ZSM-5 zeolite on diffusion and catalytic performance of *n*-heptane cracking,” Xu et al. report that hierarchical ZSM-5 zeolites aggregated by smaller nanocrystals had advantages in selectivity of light olefins ascribed to shorter diffusion path lengths and lower diffusion resistance, providing the references to the optimization of catalysts for naphtha catalytic cracking [2].

Water splitting is one of the most promising approaches for the generation of sustainable, clean hydrogen energy. The review paper titled “Structural engineering of transition metal-based electrocatalysts for efficient water splitting” by Wang et al., summarizes recent advances on the development of transition metal-based electrocatalysts to boost the catalytic activities for water splitting, with special emphasis on the structural engineering of nanostructures. Further perspectives on the design of efficient electrocatalysts can also be found in this review [3].

As an alternative to traditional metal-based catalysts, carbon-based metal-free catalysts have found many applications in energy conversion, chemicals manufacture and environmental technology. The use of earth-abundant nanocarbons as metal-free catalysts avoids the consumption of non-renewable metals and opens new routes in

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terms of sustainable chemical industry. In "Recent advances on metal-free graphene-based catalysts for the production of industrial chemicals," Wang et al. present an overview the latest developments in the use of graphene-based metal-free catalysts in industrial organic reactions, such as oxidation, reduction and coupling reactions [4].

Biomanufacturing based on biocatalysts and biological processes for manufacturing, offers another way for green production of chemicals. Hu et al. report on the "Efficient production of D-1,2, 4-butanetriol from D-xylose by engineered *Escherichia coli* whole-cell biocatalysts." With the optimized whole-cell biocatalysts, 28.0 g/L of D-1,2,4-butanetriol was obtained form 60 g/L of xylose with a molar yield of 66.0%, exhibiting a good prospect for industrial applications [5].

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