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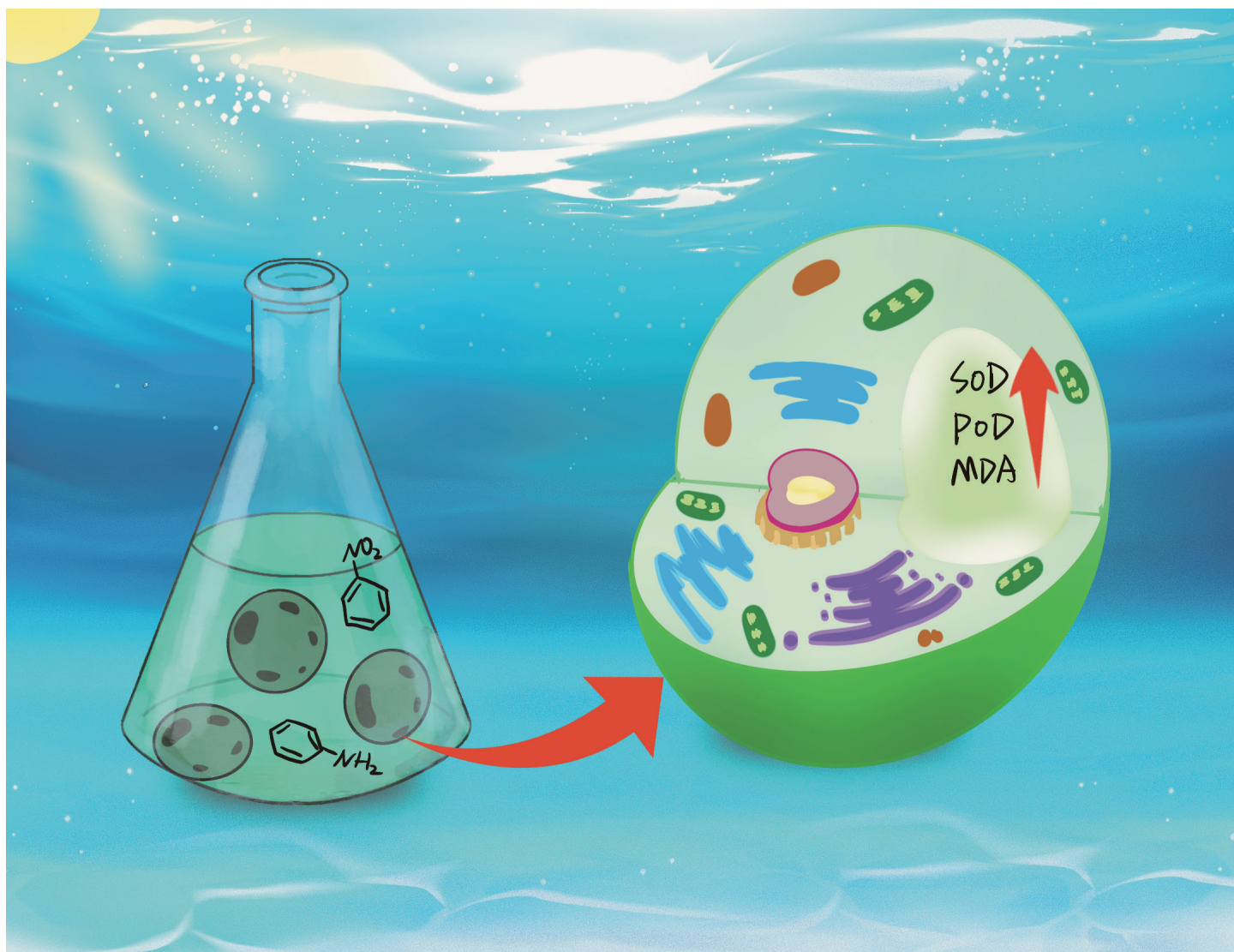
石油学报  
(石油加工)

# 石油学报 (石油加工)

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# 石 油 学 报

## (石油加工)

第 39 卷 第 1 期 2023 年 1 月

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#### \* 封面文章

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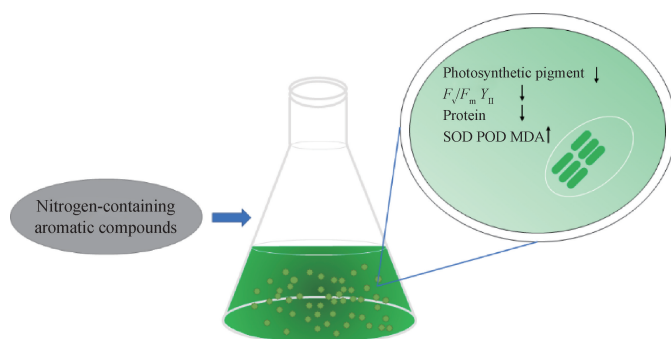
**Research Articles**

*Acta Petrolei Sinica (Petroleum Processing Section)*, 2023, 39(1): 0001-0010 doi: 10.3969/j.issn.1001-8719.2023.01.001

**Effects of Nitrogen-Containing Aromatic Compounds on the Growth and Metabolism of *Chlorella Pyrenoidosa***

GUO Baowen ZHU Junying LI Xu RONG Junfeng  
ZONG Baoning

Through the toxicity experiments of aniline and nitrobenzene, it is found that high concentration of aniline and nitrobenzene can produce oxidative stress, inhibit the growth of *Chlorella pyrenoidosa*, affect photosynthesis and reduce the content of protein, and antioxidant systems cannot completely eliminate the above stress. In addition, *C. pyrenoidosa* also contributes to the reduction of aniline content.



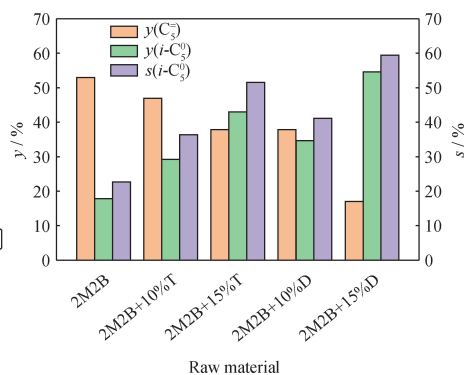
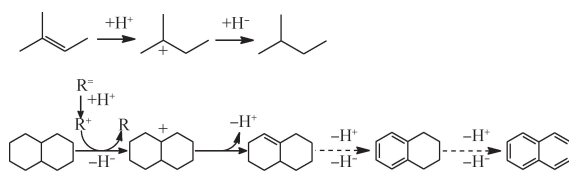
$F_v/F_m$ —The maximum optical quantum yield;  $Y_{II}$ —The actual light quantum yield;  
SOD—Superoxide dismutase; POD—Peroxidase; MDA—Malondialdehyde

*Acta Petrolei Sinica (Petroleum Processing Section)*, 2023, 39(1): 0011-0022 doi: 10.3969/j.issn.1001-8719.2023.01.002

**Effect of Negative Hydrogen Ion Releaser on the Hydrogen Transfer Reaction of 2-Methyl-2-Butene**

GUO Xiukun WANG Xin XU Youhao

Tetralin and decalin as the negative hydrogen ion releasers can release a large number of hydrogen ions, and effectively promote the selective hydrogen transfer reaction of 2-methyl-2-butene. Decalin has better hydrogen supply capacity than tetralin. As compared with tetralin, the same concentration of decalin has a greater influence on the decrease of olefin yield, the increase of iso-alkanes yield and selectivity, and has a stronger inhibition on coke yield.

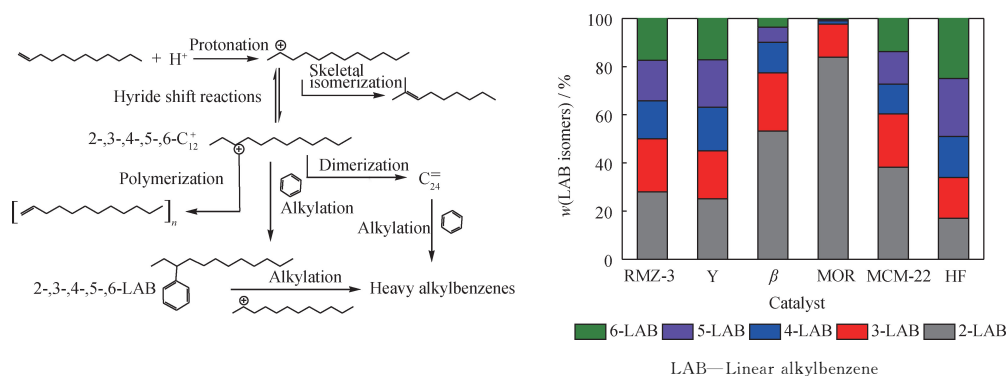


2M2B—2-Methyl-2-Butene; T—Tetralin; D—Decalin

### Structure-Activity Relationship Between Zeolite Structure and Catalytic Synthesis of Linear Alkylbenzene

LIU Chuangxin ZHANG Chengxi REN Kui LI Yongxiang

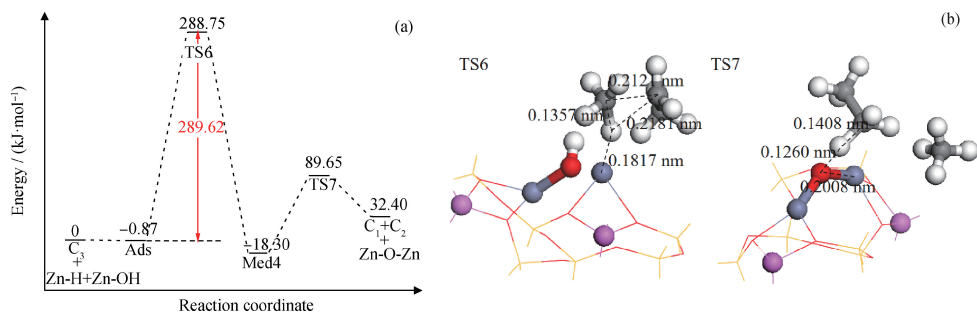
The distribution of alkylation products of benzene with 1-dodecene on zeolites with different topologies is quite different. The zeolites with small pore size are conducive to shape selectivity, and the mass fraction of 2-LAB in LAB products is high. Supercage structure is not conducive to shape selectivity. Y zeolite with high medium-strong acid content and 12-ring multidimensional pore structure is most suitable for alkylation. Increasing mesopore ratio of Y zeolite can significantly improve its stability.



### Conversion Mechanism of *n*-Hexane for High Yield of Aromatics and Concurrent Yield of Micromolecular Alkanes

WU Bingfeng YU Zhongwei WANG Zijian WANG Lixin MA Aizeng DAI Zhenyu

The aromatization pathway is dominated by dehydrogenation reaction when the residence time of *n*-hexane on the ZnO/ZSM-5 catalyst is short. However, the aromatization pathway is changed from dehydrogenation to hydrogen transfer reaction under the condition of long residence time, which is attributed to the occurrence of propane dehydrogenation reaction.

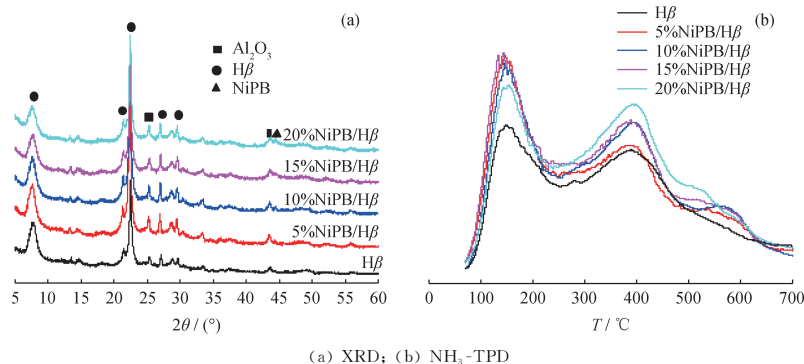


Ads—Adsorbed state; TS6, TS7—Transition state of hydrogenolysis of propane; Med4—Medium of hydrogenolysis of propane  
 (a) Potential energy surface of propane hydrogenolysis reaction; (b) Transition state structure of propane hydrogenolysis reaction

### Isomerization Reaction of *n*-Hexane Catalyzed by Boron-Doped NiPB/H $\beta$ Catalyst

YANG Lingbin LI Zihan ZHANG Chao ZHU Lijun XIA Daohong

A novel NiPB/H $\beta$  catalyst was prepared and used to catalyze the isomerization reaction of *n*-hexane. The results show that the NiPB/H $\beta$  catalyst exhibits better performance in catalyzing the isomerization of *n*-hexane. In addition, high-temperature coking can effectively remove the coke deposits on the catalyst surface, and achieve the regeneration of the catalyst.

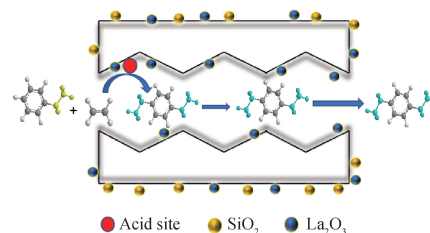


### Effects of Hydrothermal Treatment on the Catalytic Performance of HZSM-5 Molecular Sieve for Ethylbenzene/Ethylene Alkylation

REN Yinteng ZHANG Anfeng HAN He ZHANG Jiaying

GUO Xinwen

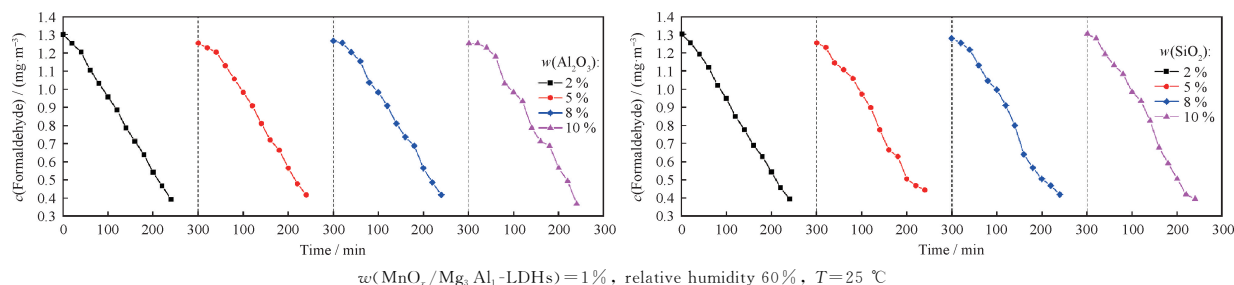
Hydrothermal treatments effectively tune the acid properties and pore structure of HZSM-5 molecular sieve which inhibits various side reactions and greatly improves the stability of the catalyst for ethylbenzene and ethylene alkylation.



### Preparation of Manganese-Based Catalyst Supported by Aluminum Honeycomb and Its Removal Performance for Low Content Formaldehyde at Room Temperature

TIAN Jingchen WU Gongde LIU Yanjun WAN Jie WANG Xiaoli DENG Lin

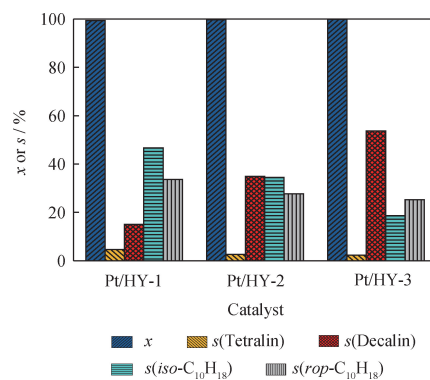
The MnO<sub>x</sub>/Mg<sub>3</sub>Al<sub>2</sub>(OH)<sub>6</sub> LDHs catalyst supported by aluminum honeycomb presents excellent formaldehyde removal ability, which can reduce the mass concentration of formaldehyde from 1.3 mg/m<sup>3</sup> to below 0.10 mg/m<sup>3</sup> after 4 h reaction at room temperature, and its formaldehyde removal performance remains nearly unchanged after 8 times of actual testing for 15 consecutive days.



### Effect of the Acidity of Y Zeolite on the Catalytic Performance of Naphthalene Hydroconversion Over Pt-Supported Catalysts

ZHAO Jiaxin ZHANG Xuelian LU Ningyue FAN Binbin  
LI Ruifeng

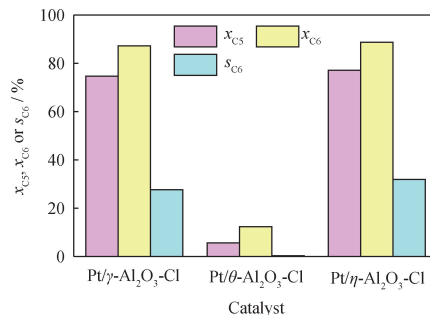
The acidity of the carrier in the bifunctional catalyst Pt/HY has no significant effect on the hydrogenation performance of naphthalene, and mainly affects the isomerization performance of the hydrogenation product of decalin.



### Effect of Al<sub>2</sub>O<sub>3</sub> Crystal Phase on Physicochemical Properties of Pt/Al<sub>2</sub>O<sub>3</sub>-Cl Catalyst and Its Catalytic Property for C<sub>5</sub>/C<sub>6</sub> Isomerization

TANG Jun YU Zhongwei LIU Hongquan

The C<sub>5</sub>/C<sub>6</sub> isomerization properties of Pt/Al<sub>2</sub>O<sub>3</sub>-Cl catalysts with different crystal phases were investigated under the following conditions: reaction temperature 150 °C; reaction pressure 3.2 MPa; feedstock mass hourly space velocity 1.5 h<sup>-1</sup>; hydrogen/hydrocarbon molar ratio 1.0. The isomerization activity and selectivity of Pt/η-Al<sub>2</sub>O<sub>3</sub>-Cl catalyst are the highest, followed by Pt/γ-Al<sub>2</sub>O<sub>3</sub>-Cl catalyst, while the activity and selectivity of Pt/θ-Al<sub>2</sub>O<sub>3</sub>-Cl catalyst are awfully low. Therefore, among the three kinds of Al<sub>2</sub>O<sub>3</sub> carriers, γ-Al<sub>2</sub>O<sub>3</sub> and η-Al<sub>2</sub>O<sub>3</sub> are suitable for Pt/Al<sub>2</sub>O<sub>3</sub>-Cl catalyst.



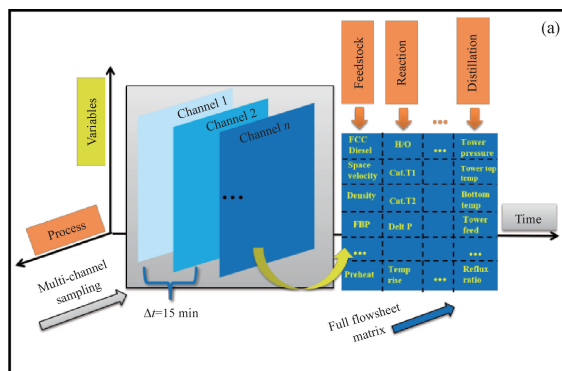
$x_{C_5}$ —C<sub>5</sub> isomerization rate;  $x_{C_6}$ —C<sub>6</sub> isomerization rate;  
 $s_{C_6}$ —C<sub>6</sub> selectivity

Conditions:  $T=150\text{ }^{\circ}\text{C}$ ;  $p=3.2\text{ MPa}$ ;  $MHSV=1.5\text{ h}^{-1}$ ;  
 $n(\text{H}_2)/n(\text{C}_5/\text{C}_6)=1.0$

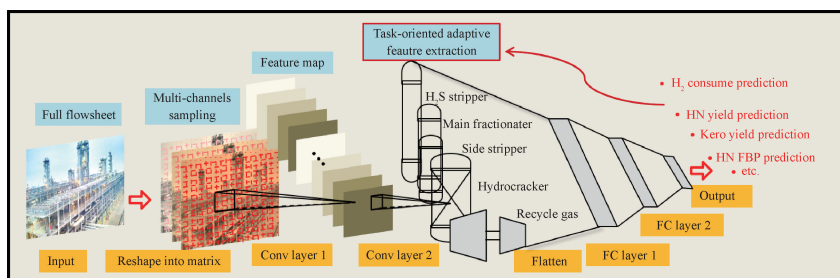
## Prediction of Hydrocracking Product Properties Based on Semi-Supervised Learning-Multichannel Convolutional Neural Network

WANG Chen LUO Wenshan LU Pengfei LI Baoliang CAO Xiaohong YANG Ji

A multi-channel convolutional neural network (MCCNN) was proposed to predict the properties of hydrocracking products, by which local spatial-domain features of hydrocracking process were extracted from a novel designed process matrix with layer-wise convolution, while temporal-domain features were extracted from multi-channel version of the process matrix.



(a)



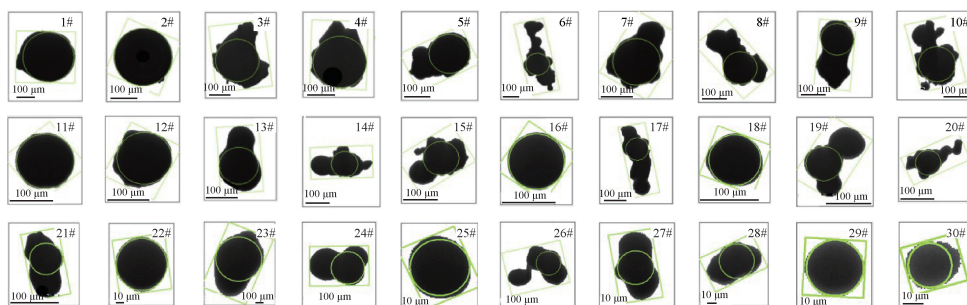
Conv—Convolutional; FC—Full connected; HN—Heavy naphtha; Kero—Kerosene

(a) Schematic diagram of multi-channel sampling; (b) Architecture of MCCNN

## Characterization of Particle Morphology of FCC Catalysts

YIN Xiping LI Ye FAN Hua JIANG Bangkai

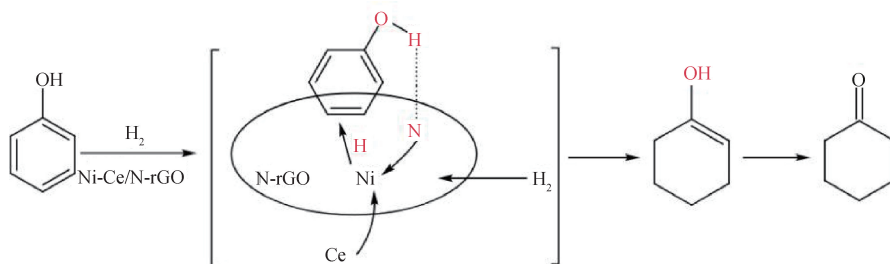
The dynamic imaging method is used to characterize the particle morphology of FCC catalysts, wherein the particle volume should be used as the distribution benchmark. The optimal sample amount is 1.0 g, and the optimal threshold is 90. Roundness can be used to characterize the sphericity of particles, bluntness can be used to characterize the wear resistance of particles, and deformity can be used to characterize the adhesion, fracture resistance and wear resistance of particles.



### Characterization of Ni-Ce/N-rGO Catalyst and Its Catalytic Performance for Hydrogenation of Phenol to Cyclohexanone

XU Haisheng XUE Meiyue HUANG Guoqiang GAO Pengcheng FAN Zheng

The addition of Ce modified by Ni/N-rGO can increase the alkaline sites of the catalyst and promote the adsorption of phenol on the surface of the carrier in a non-planar manner, which can effectively improve the catalytic performance.

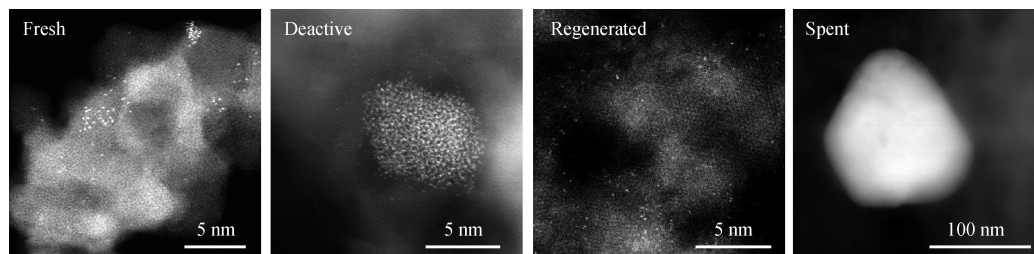


### Research Notes

### Atomic Resolution Characterization of Highly-Dispersive Metal Atoms in Deactivation Process for Commercial Pt-Sn Reforming Catalysts

XIANG Yanjuan ZHENG Aiguo WANG Chunming XU Guangtong MA Aizeng

Through Cs-corrected scanning transmission electron microscopy (Cs-STEM) imaging, the atomic spatial distribution of metal atoms under different industrial Pt-Sn/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalyst was demonstrated. Such atomic scale investigation for the supported metal atoms on the reforming catalyst can establish the relationship between the dispersion and catalytic performance.

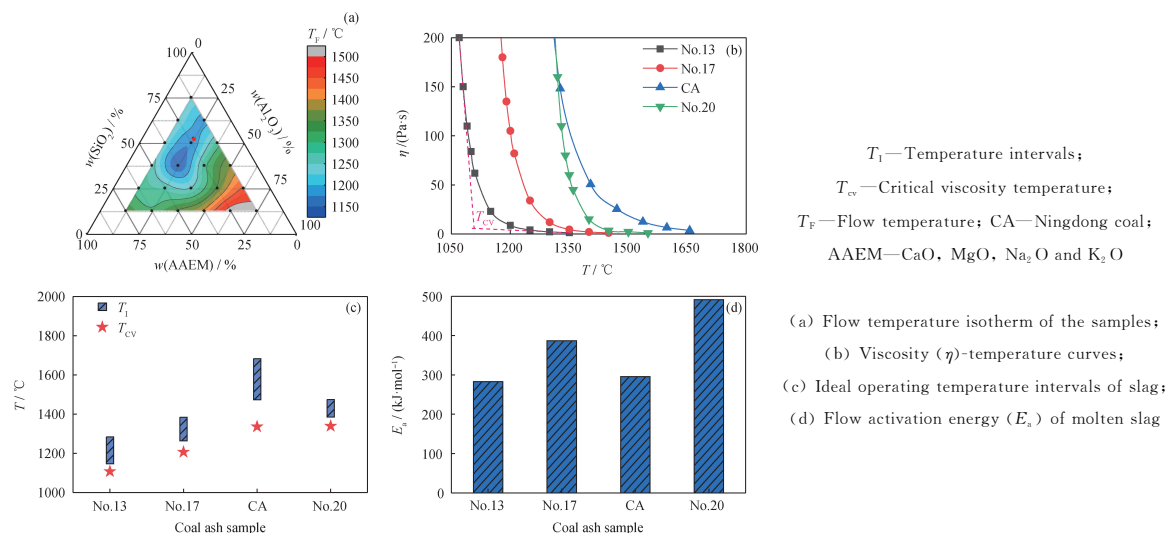




### Study on Melting and Flowing Characteristics of Ningdong Coal Ash at High Temperatures Based on Pseudo-Ternary Isotherm Diagrams

KAN Haoyong LI Ping CHEN Cai NIU Yanqing

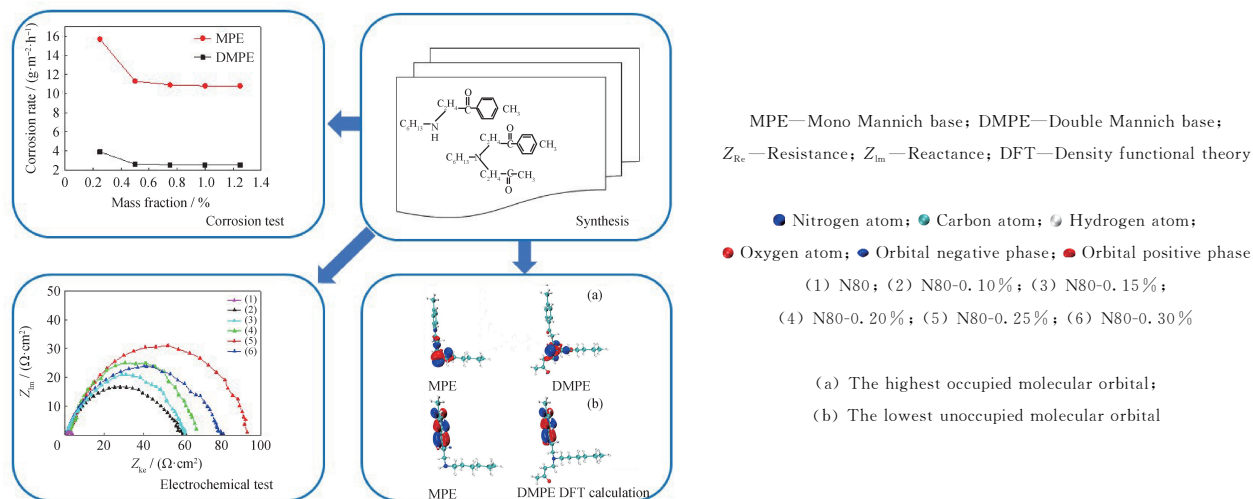
The ash melting temperature presents a U-shaped distribution trend in the SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-AAEM pseudo-ternary isotherm. The reaction between quartz and calcium oxide can produce gehlenite to promote ash melting, and the resulting slag has a critical viscosity temperature 200 °C lower than and a flow activation energy similar with that of raw coal ash.



### Quantum Chemical Study on Corrosion Inhibition Performance of Double Mannich Base

DONG Xiaocheng LIU Guanhao YANG Jingyi XU Xinru

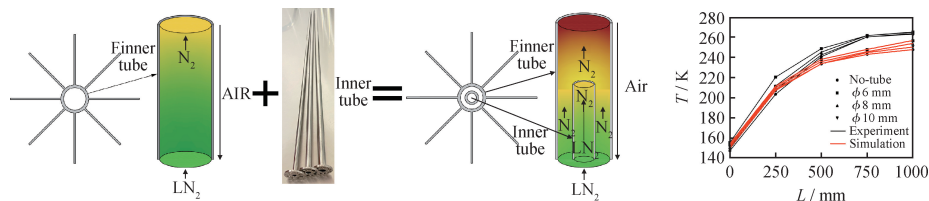
The mass loss experiment results show that the corrosion inhibition of N80 test pieces by DMPE is better than by MPE. Density functional theory (DFT) was used to calculate the highest occupied orbital energy level ( $E_{HOMO}$ ) and the lowest unoccupied orbital energy level ( $E_{LUMO}$ ). Compared with MPE, DMPE is easier to accept and give electrons.



### Effect of Double-Wall Heat Transfer Tube on Heat Transfer of Ambient Air Vaporizer

DONG Chao CHEN Shuping ZHU Ming JIN Shufeng WU Zongli

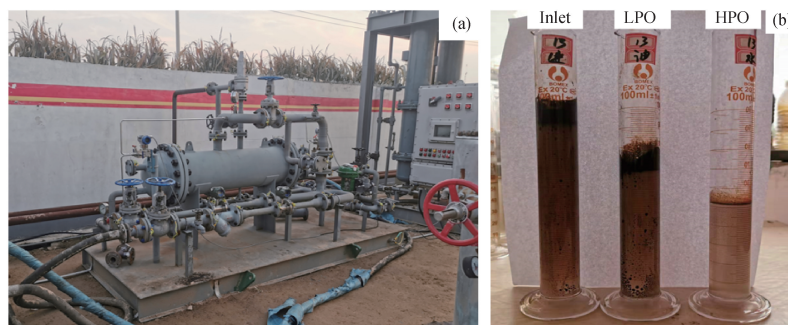
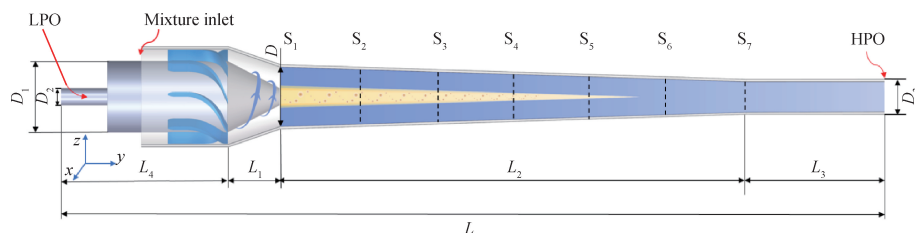
The heat transfer performance is enhanced by adding a double-wall heat transfer tube inside the finned tube of the ambient air vaporizer. It has been proved through experiment and numerical simulation that among the three specifications of double-wall heat transfer tube, the smaller the inner diameter, the better the heat transfer performance.



### Scale-up Design of Inline Swirling Water Pre-Separation Equipment for Produced Liquid

KONG Changyan LIU Meili CHEN Jiaqing BAI Chunlu WANG Qiangqiang PENG Shichang WANG Chunsheng ZHANG Ming SHANG Chao

Among the three methods for scale-up design of the water pre-separation equipment, the flow-oriented similar scale-up design method can achieve not only the largest centripetal acceleration but also the lowest axial attenuation rate. The results of the oilfield test on the equipment with a scale-up capacity of 10 times are almost consistent with those of the indoor test.



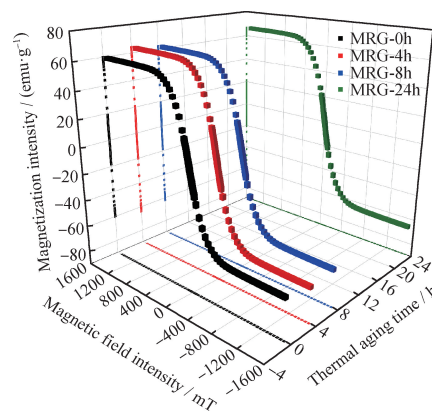
HPO—Heavy phase outlet; LPO—Light phase outlet

(a) Photo of prysstructure of engineering prototype of on-site test; (b) Partial sampling results of the engineering prototype on-site test

### Impact of Thermal Aging Behavior on the Rheological Properties of Magnetorheological Grease

PAN Jiabao YANG Guangxin CHU Tiantian GAO Hong  
WANG Xiaolei

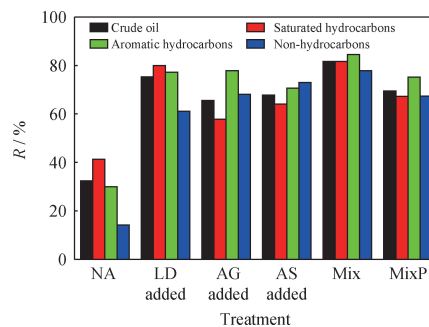
Temperature rise will inevitably occur in magnetorheological devices due to energy consumption. In order to study the impact of thermal effect on the rheological properties of dielectric magnetorheological grease, the thermal aging of magnetorheological grease was simulated by static heat treatment.



### Improvement of the Remediating Effects on Petroleum Contaminated Soil Through Mixing Three Types of Herb Litters

ZHOU Wenxing HU Man WANG Lijie TIAN Shuang  
CHEN Feng HUANG Yanying ZHANG Xiaoxi

The mixing of three types of herb litters has improved their degradation of petroleum contaminants. The overall degradation rate of petroleum is increased by 12.16% as compared with the predicted value, and the degradation rates of saturated hydrocarbons, aromatic hydrocarbons and non-hydrocarbons significantly are increased by 14.43%, 9.24% and 10.52% as compared with corresponding predicted values.

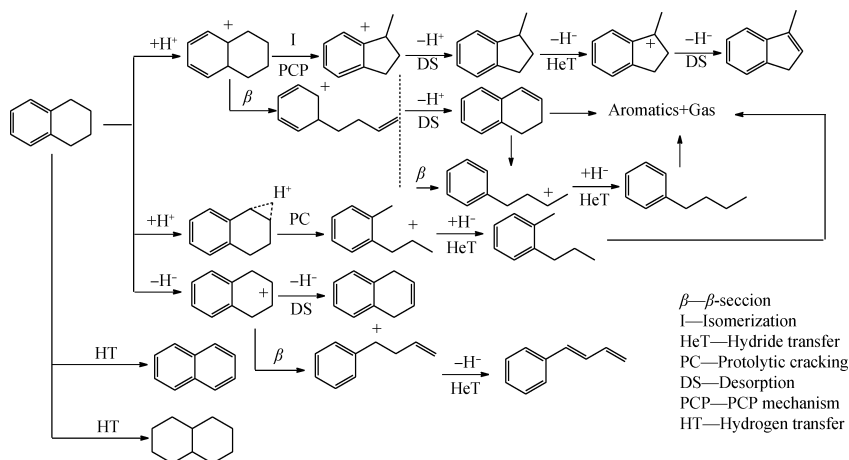


R—Degradation rate; NA—Natural attenuation (without litter addition);  
LD—*Lespedeza davurica* litter; AG—*Artemisia gmelinii* litter;  
AS—*Artemisia scoparia* litter;  
Mix—Mixed litter addition with  $m(\text{LD}) : m(\text{AG}) : m(\text{AS}) = 1 : 1 : 1$ ;  
MixP—Predicted value of mixed litter addition treatment  
Conditions:  $T = 20 - 25\text{ }^\circ\text{C}$ ; 50% of soil saturated water holding capacity

**Research Advances in the Catalytic Cracking of Tetralin**

KAN Renjun DA Zhijian ZHANG Jiushun WEI Xiaoli

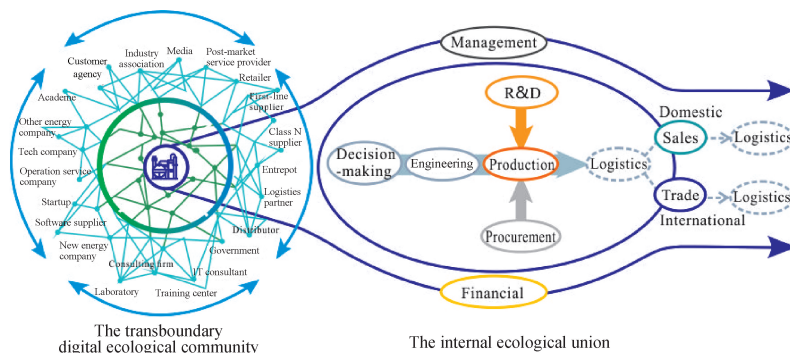
Enhancing the understanding of the catalytic cracking reaction process of tetralin is helpful to strengthening the ring-opening reaction of high ring-number monocyclic aromatic hydrocarbons, so as to produce more light olefins and BTXs.



**Strategy and Practice of International Energy and Chemical Companies in the Context of Digital Transition**

JIA Jingkun ZHU Ying TAN Jie

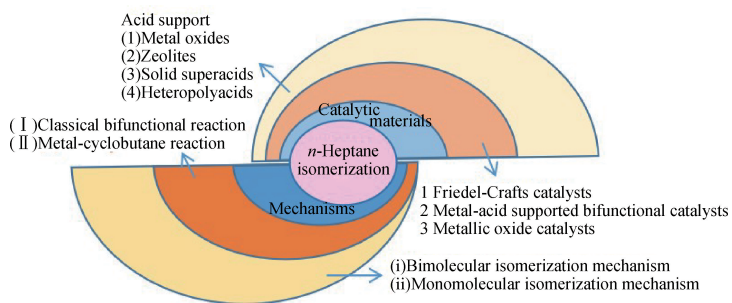
The inherence of digital transition in the energy and chemical industry is to take value creation as the purpose, by driving industrial transition with digital technology, and to build the dual ecosystem of industrialization and digitalization, which includes the internal ecological union and the transboundary digital ecological communities, so as to promote high-quality development.



### Research Progress of *n*-Heptane Isomerization Reaction

GUO Kai MA Aizeng LI Jinzhi

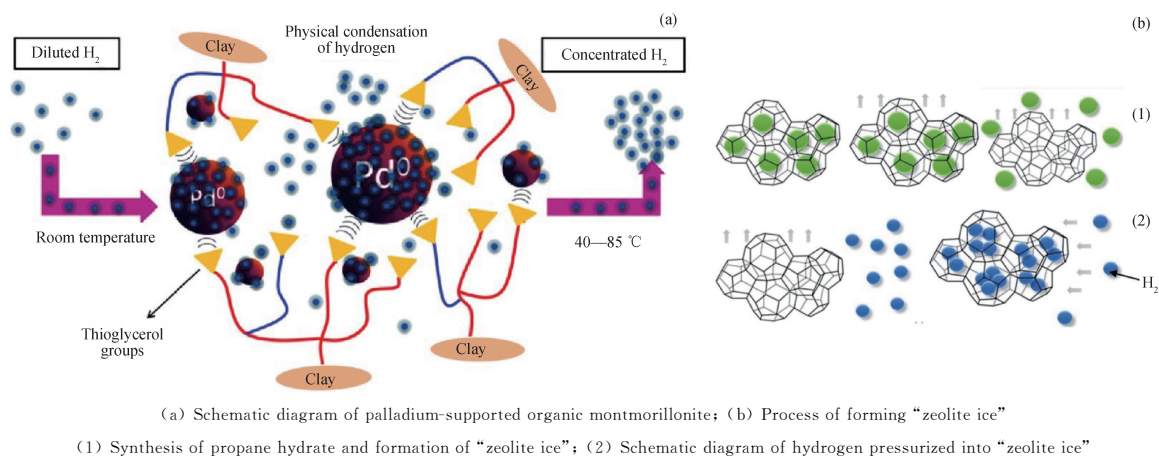
The reaction mechanism and catalytic material of *n*-heptane isomerization reaction were summarized. In terms of reaction mechanism, the representative classical bifunctional isomerization and metal-cyclobutane reaction mechanisms were investigated. In the research of catalytic materials, Friedel-Crafts catalysts, metal-acid supported bifunctional catalysts and metallic oxide catalysts were introduced.



### Research Progress of Several New Types of Solid Hydrogen Storage Materials

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Several new types of solid hydrogen storage materials, such as nanostructured porous carbon, porous carbon synthesized from biomass, natural minerals and processing materials, cage hydrate, and zeolite-ice, are quite promising materials.



### Research Progress in Doped Perovskite Oxides for Catalytic Combustion of VOCs

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A and B-site elements in the perovskite structure can stabilize the structure and improve the activity, respectively. Among them, A-site substitution of perovskite oxides has advantages in the treatment of sulfur-containing and chlorine-containing VOCs, and B-site substitution has a more significant effect on the activity improvement.

