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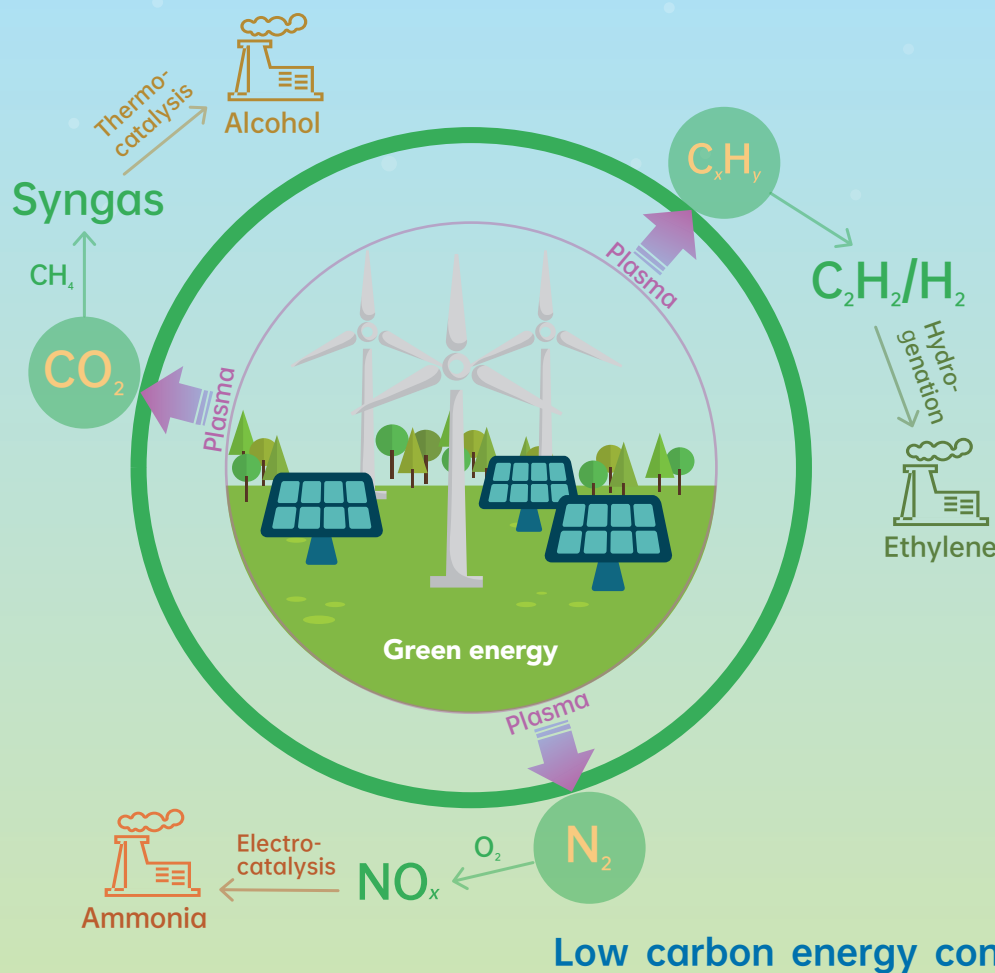
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石油学报
(石油加工)

石油学报 (石油加工)

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等离子体能源转化专刊



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(石油加工)

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ACTA PETROLEI SINICA (PETROLEUM PROCESSING SECTION)

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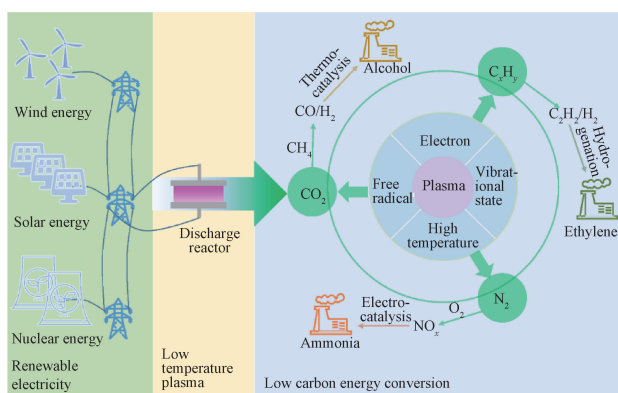
Plasma-enabled C1 conversion and utilization

Acta Petrolei Sinica (Petroleum Processing Section), 2023, 39(5): 0963-0976 doi: 10.3969/j.issn.1001-8719.2023.05.001

Current Status and Challenges of Energy Conversion in Pulsed Spark Discharge Plasma

ZHANG Shuai ZHANG Cheng SHAO Tao

Based on low temperature plasma technology driven by renewable energy, N_2 , CO_2 , CH_4 and other energy sources can be high-efficiently and greenly converted into low-carbon fuel or chemicals under mild conditions.

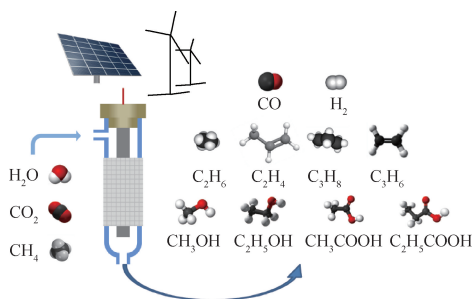


Acta Petrolei Sinica (Petroleum Processing Section), 2023, 39(5): 0977-0986 doi: 10.3969/j.issn.1001-8719.2023.05.002

Investigation on CH_4 Reforming With CO_2 in Dielectric Barrier Discharge in the Presence of Steam

ZHANG Peng MEI Danhua SUN Minjie LIU Shiyun FANG Zhi

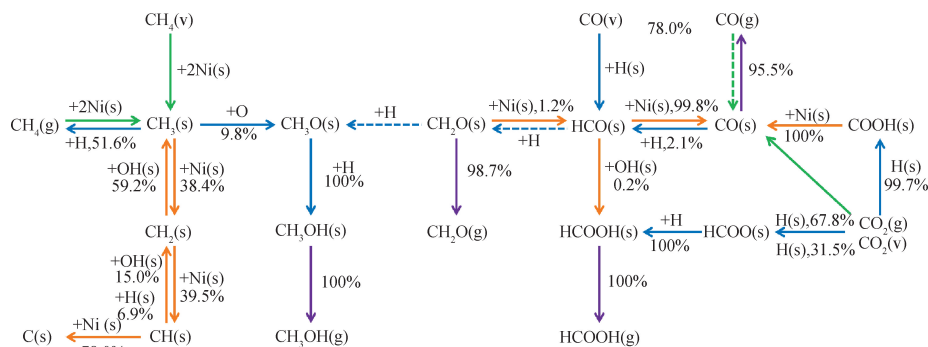
Non-thermal plasma provides a promising approach for greenhouse gas conversion under mild conditions. This work investigates CH_4 reforming with CO_2 using dielectric barrier discharge (DBD) with steam, and it is found that there exists an optimal steam-to-carbon molar ratio for the high reaction performance and the steam can improve the reaction stability.



Kinetic Investigation of Plasma-Enhanced Surface Reaction in Plasma Catalytic CH₄/CO₂ Reforming

SUN Jintao CHEN Qi QIN Wanyue

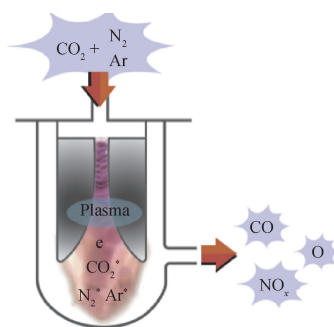
A detailed plasma-catalytic mechanism consisting of plasma reactions and surface reactions was developed and studied. The path flux and sensitivity analysis reveal that surface reaction pathway is mainly dominated by E-R reaction between surface-adsorbed and gas-phase substances in plasma catalytic CH₄/CO₂ reforming, which is different from thermal catalysis.



Influencing Factors of CO₂ Conversion by Gliding Arc Discharge

MENG Xiangyi ZHANG Tinghao LU Na SHANG Kefeng
JIANG Nan

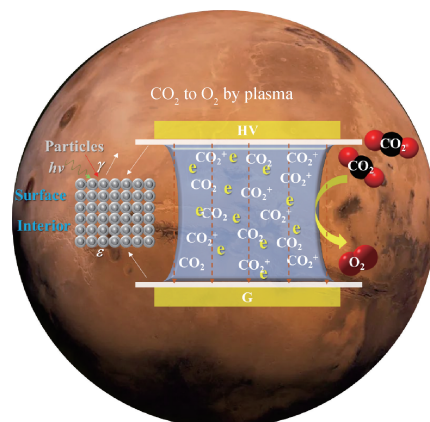
CO₂ conversion by gliding arc discharge has attracted increasing attention. The effect of gliding arc discharge reactor structure is investigated and the energy efficiency of CO₂ conversion is obtained as 52.8%. When the volume fraction of added Ar or N₂ is up to 90%, the CO₂ conversion rate is 2.55 times and 3.05 times the single CO₂ conversion rate, respectively.



Effect of Dielectric Barrier Materials on Conversion Characteristics of Low Pressure CO₂ Dielectric Barrier Discharge

FU Qiang YE Zifan WANG Yufei CHANG Zhengshi

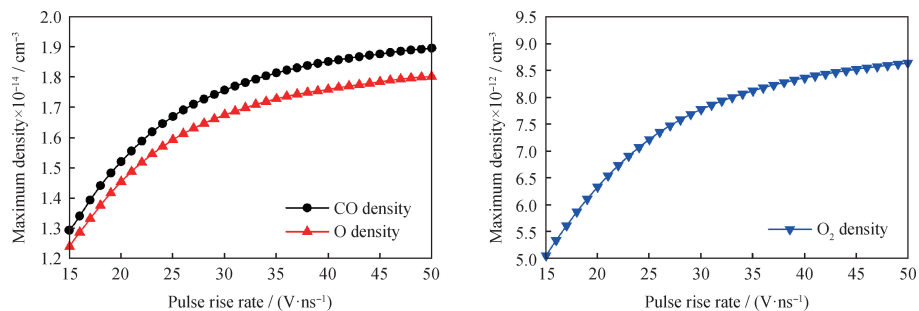
The DBD was driven by kHz sinusoidal voltage under Martian low pressure atmosphere. The characteristics of CO₂ conversion affected by different dielectric barrier materials were studied experimentally, and the mechanism of relative dielectric constant and secondary electron emission coefficient of barrier dielectric on CO₂ conversion was analyzed by simulation analysis.



Study on Atmospheric CO₂ Discharge Driven by Pulsed Voltages Through Introducing Deep Neural Network

WANG Xucheng ZHANG Yuantao

A deep neural network (DNN) is proposed to replace the fluid model with high-cost calculation to investigate the discharge characteristics and plasma chemistry of atmospheric CO₂ pulsed discharges. Based on a relatively limited training dataset, the well-trained deep neural network can rapidly yield sufficient predictions and greatly improve computational efficiency.

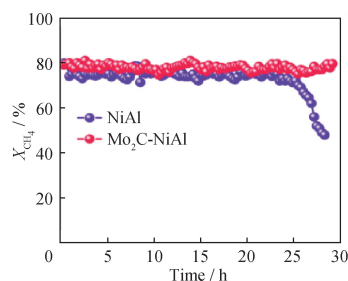
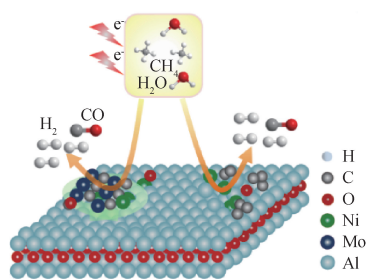


Interactions between plasma and catalysts

Hydrogen Production on Mo_xC-Ni/Al₂O₃ Catalyst Coupled With Cold Plasma for the Steam Reforming of Methane Reaction

DIAO Ya'nan SUO Cong ZHANG Xiao FANG Jiancong SHI Chuan

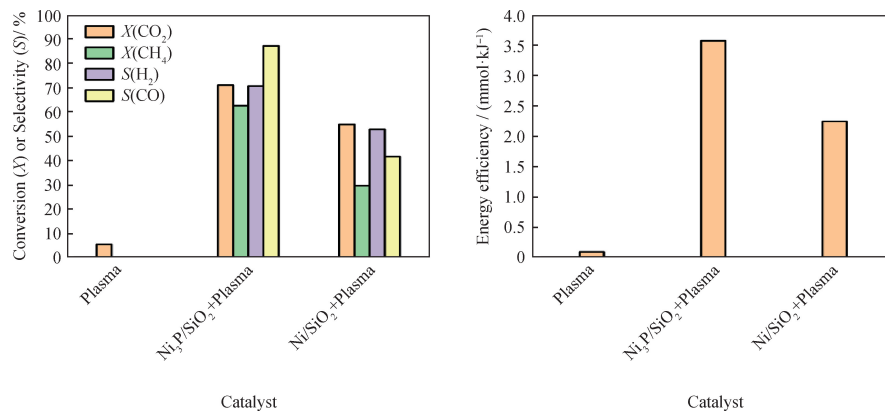
Compared to the NiAl catalyst under plasma condition without any external heating, the Mo₂C-NiAl catalyst exhibits higher activity and better stability due to the promotion effects of β -Mo₂C toward H₂O activation and discharge properties (discharge power and effective capacitance).



Performance of Dry Reforming of Methane Catalyzed by Nickel Phosphide in a Low Temperature Plasma

WANG Rong XU Bo ZHENG Zhaoyu WANG Anjie LIU Yingya SUN Zhichao WANG Yao

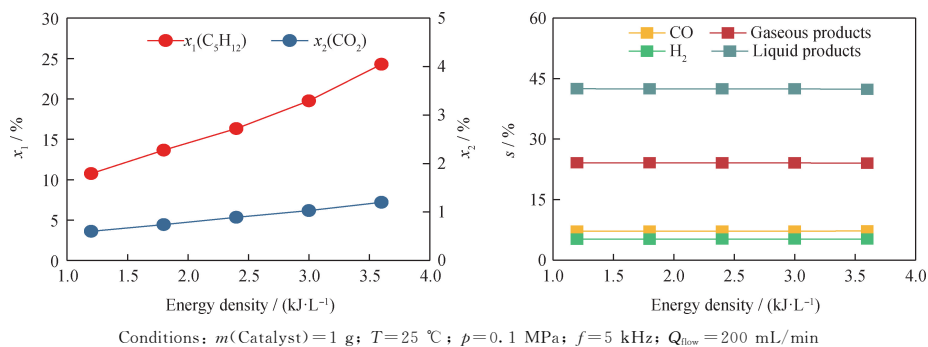
The concerted combination of Ni₃P/SiO₂ catalyst with a low temperature plasma leads to the significantly improved performance and energy efficiency in dry reforming of methane. Ni₃P/SiO₂ is superior to Ni/SiO₂, due to the presence of electron-deficient Ni^{δ+} sites.



Preparation of Plasma-Enhanced Ni-Based Catalyst and Its Catalytic Performance in Reforming of *n*-Pentane

ZHOU Weili ZHANG Xuming XU Shunmiao WU Zuliang REN Yan ZHU Zuchao

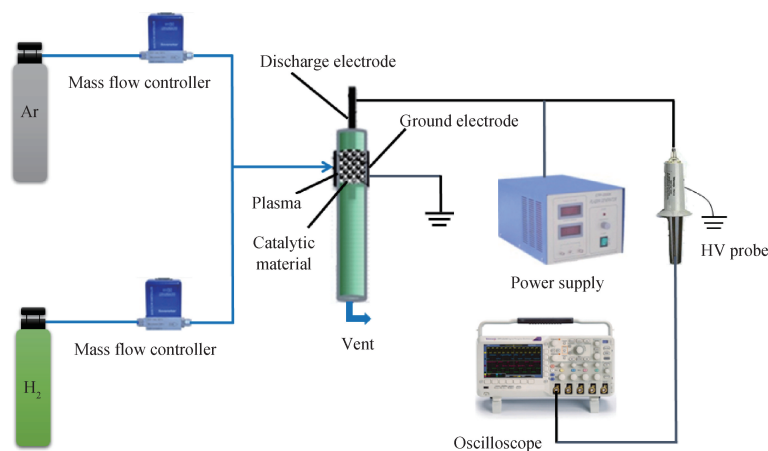
The effect of plasma treatment on the catalyst and the mechanism of plasma catalysis were investigated using a dielectric barrier discharge (DBD) reactor. Plasma treatment was found to improve catalyst performance. Furthermore, it has been found that reactant conversion is influenced by electron-induced chemistry and thermo-chemistry, while product generation is controlled by thermo-chemistry alone with the gas composition.



Hydrogen Plasma Synthesis of Pd/GO-P and its Performance for Catalytic Reduction of *p*-Nitrophenol

ZHAO Lingyu ZHAO Kexin ZHANG Xiuling HUA Yue DI Lanbo

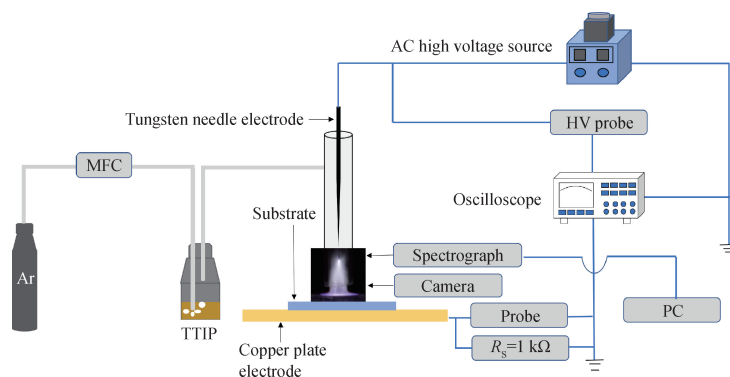
The discharge voltage and discharge time period of plasma play an important role on the defects, oxygen-containing groups, size and dispersion of metal nanoparticles, and metal-supported interaction of graphite oxide-supported palladium (Pd/GO-P). The Pd/GO-P catalysts prepared at optimized conditions display a concentration-normalized rate constant of 1038 L/(min • g), which is about 9.6 times higher than those prepared by conventional thermal reduction method.



Effect of Atmospheric Pressure Plasma Jet Discharge Parameters on the Characteristics of Deposited Titanium Oxide Films

DENG Chengzhi, HAN Ruoyu, LIAN Xiuyun, FENG Juan, ZHANG Tianliang, LI Chen, OUYANG Jiting

By comparing the pulse plasma parameters and the properties of deposited titanium oxide films, the effect of pulse discharge characteristics on the plasma parameters and film growth is illustrated. The results show that the plasma jet plays an important role in the decomposition reaction of titanium tetraisopropanolate (TTIP) and film deposition.

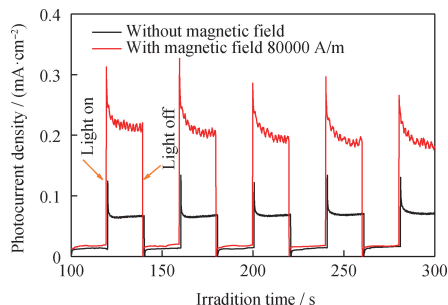


MFC—Gas flowmeter (Seven Star CS200); HV—High voltage side; PC—Process controller; Resistor R_s is used with a low voltage probe to measure discharge current.

Construction of Si Nanowire/ ZnFe_2O_4 /AgBr Photocatalyst and Its Magnetic Field Tunable Performance

ZHANG Shijie SHI Chaojie TANG Jixia QIAN Tu LIANG Lili LI Xuechen TIAN He HE Jie YANG Zhengchun

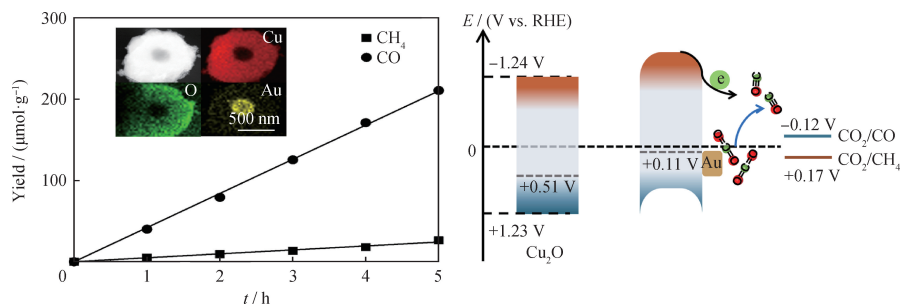
Due to the negative MR effect of Si nanowires/ ZnFe_2O_4 /AgBr composite photocatalyst, the photocurrent density of Si nanowires/ ZnFe_2O_4 /AgBr composite photocatalyst is 2.86 times higher than that without magnetic field at a magnetic field intensity of 80000 A/m.



Photocatalytic CO_2 Reduction of Au/ Cu_2O @Au Photocatalyst Under Visible-Light Irradiation

ZHANG Rui QI Zhong SHI Junjun HE Jie

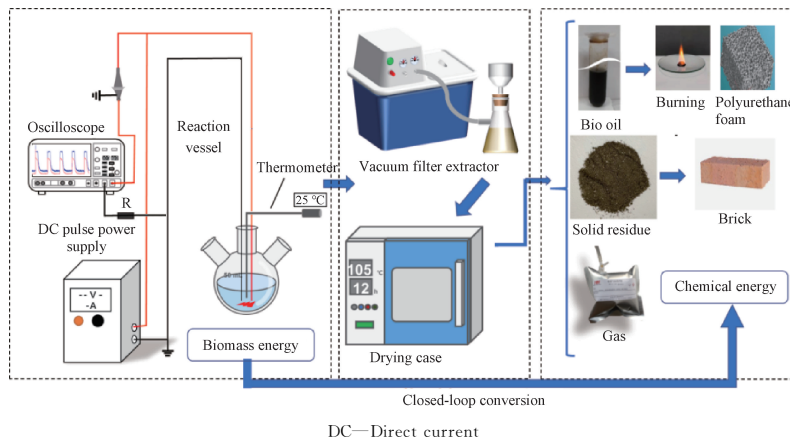
Modification of the surface and inside of cavity Cu_2O with Au particles enhances the product yield and selectivity of photocatalytic reduction of CO_2 . The introduction of Au particles improves the abilities of photocatalyst to absorb visible light, separate and transfer photon-generated carriers, and inhibits the recombination of photon-generated carriers.



Development and Prospect of Plasma-Electrolytic Liquefaction of Biomass

HUANG Ziwei XI Dengke ZHANG Xianhui YANG Size

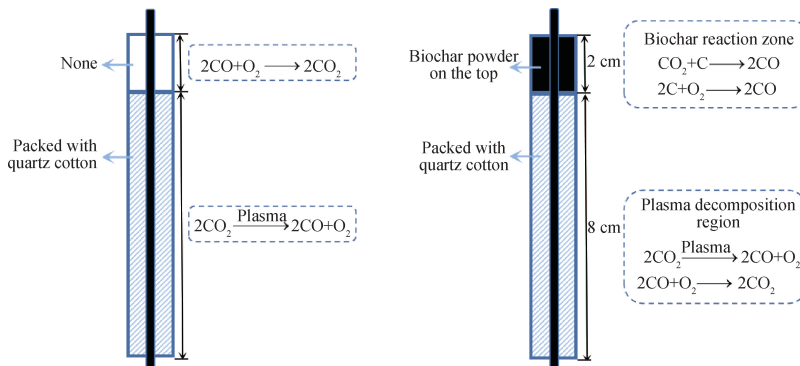
Plasma electrolyte liquefaction of biomass represents a breakthrough in the conversion of biomass energy into chemical energy, capitalizing on the utilization of electrical energy and plasma energy. This remarkable process engenders an exquisite closed-loop transformation, seamlessly intertwining electrical energy, plasma energy, biomass energy, and chemical energy without any discernible losses. The ensuing products encompass bio-oil, solid residue, and gas, exhibit remarkable properties, making them highly suitable for the application of subsequent products.



Synergistic Reaction Characteristics of Low Temperature Plasma Carbon Dioxide and Biochar

ZHANG Yinghao ZHU Min ZHANG Chaohai

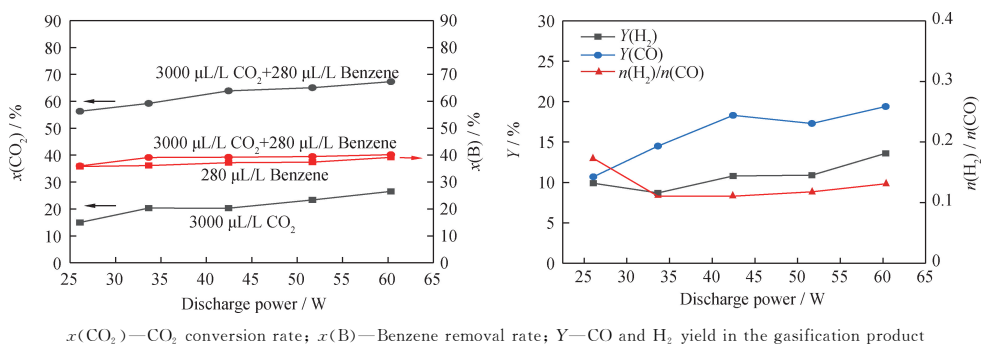
A new method was proposed to enhance the CO₂ low temperature plasma cracking reaction by introducing Boudouard reaction between C and CO₂. The results show that Boudouard reaction has a significant effect on the reaction results, which can greatly reduce the content of O₂, and increase the yield of CO and the conversion of CO₂.



Effect of Local Electric Field Enhanced Dielectric Barrier Discharge on Reforming Biomass Gasification Tar and CO₂ to Syngas

GUO Yafeng CHENG Shiye LU Na TANG Shiya GUAN Yinxia LI Chao

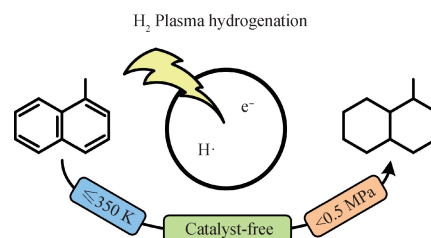
A newly designed local electric field enhanced dielectric barrier discharge reactor lays a foundation for the preparation of synthesis gas from reforming biomass gasification tar using carrier gas CO₂ under mild conditions. The maximum conversion rates of benzene and CO₂ are 40.2% and 67.8%, respectively, while the highest yields of CO and H₂ are 19.4% and 13.6%, respectively, and the molar ratio of H₂/CO can reach 0.132.



Pulsed Dielectric Barrier Discharge Plasma for Methylnaphthalene Hydrogenation Conversion

FAN Zhe SUN Hao ZHANG Shuai DOU Liguang HAN Wei YANG Qinghe SHAO Tao

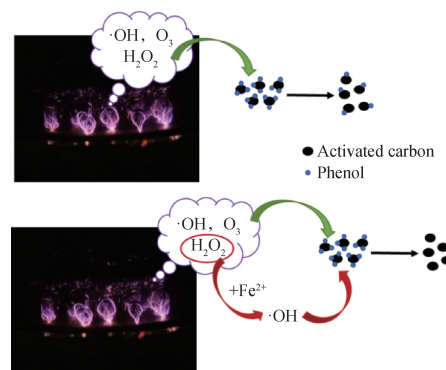
Low-temperature plasma technology provides a new idea for hydrogenation at ambient conditions without catalyst. This work investigates 1-methylnaphthalene hydrogenation by pulsed dielectric barrier discharge plasma at different voltages, frequencies and reaction atmospheres, and it is found that 1-methylnaphthalene is stepwisely hydrogenated by H radicals from electron collisions.



Regeneration of Activated Carbon With Adsorbed Phenol by Gas-Liquid Mixed Pulse Discharge Coupled With Fenton Reaction

JIANG Nan LI Chong LI Na LI Jie LU Na SHANG Kefeng

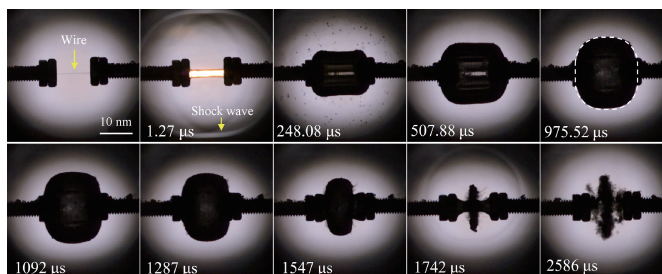
The active substances (such as •OH, H₂O₂ and O₃) produced by pulse discharge can act on phenol adsorbed on activated carbon to achieve the purpose of regenerating activated carbon. Introducing Fe²⁺ into pulse discharge can cause Fenton reaction between H₂O₂ and Fe²⁺ to generate •OH with strong oxidation-reduction ability, thus improving the utilization rate of H₂O₂ and the regeneration rate of activated carbon.



Experimental Study on the Characteristics of Electrical Wire Explosion and Plasma Bubbles in Pure Water and Liquid Nitrogen

FENG Juan BAI Jie YUAN Wei WANG Zhi HAN Ruoyu

The process of electrical wire explosion in liquid is accompanied by bubble pulsation. After discharge, the plasma bubble evolves from cylindrical to spherical morphology. Initial stored energy, load specification and medium environment have significant effects on bubble pulsation characteristics.



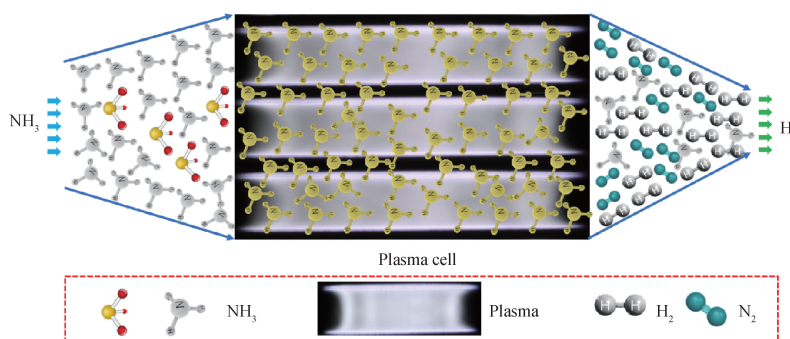
Bubble pulsation process in water

Plasma-enabled N₂ fixation and hydrogen utilization

Characteristics and Product Distribution of Zirconia Dielectric Barrier Discharge in Ar-NH₃ Mixture at Atmospheric Pressure

ZHAO Ni TIAN Hao FU Qiang CHANG Zhengshi

The dielectric barrier discharge plasma possesses the advantages of non-thermal and high efficiency, rendering it a promising candidate for hydrogen production from ammonia. The utilization of a dielectric with high permittivity can adjust the discharge mode and intensity, thereby enhancing the efficacy of hydrogen production.



Catalytic Performance of Plasma-Assisted Ceria-Based Catalysts for Hydrogen Generation From Ammonia

GAO Yibo HU Erjiang YIN Geyuan HUANG Zuohua

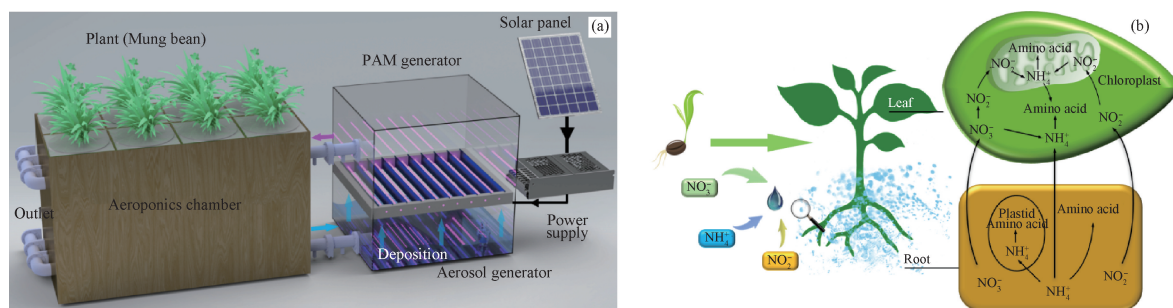
In the plasma-assisted catalyst ammonia decomposition reaction, the breakdown of mixed gases produces high-energy electrons and shows clear discharge with a purple glow.



Non-Thermal Plasma Nitrogen Fixation Based on Micron Droplets and Its Application in Aeroponics

GAO Haotian LIU Dawei

A novel artificial nitrogen fixation scheme is proposed based on micron droplets and nanosecond pulsed plasma technology. The device has an energy consumption of 48.67 MJ/mol for nitrogen fixation and can be driven by 200 W solar panels. Combined with the self-designed aeroponics system, it can effectively promote the growth of crops.

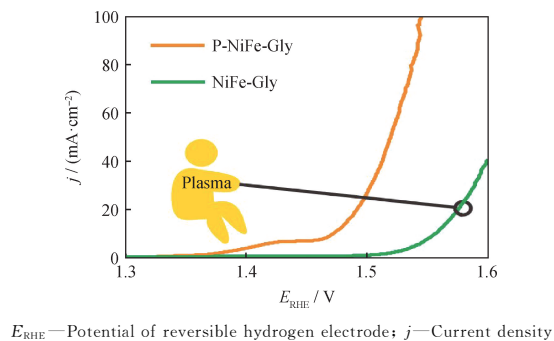


(a) Non-thermal plasma-aeroponics system; (b) Schematic diagram of plant growth promotion by non-plasma nitrogen fixation technology

Enhanced Oxygen Evolution Reaction Performance of N₂ Plasma-Activated NiFe-Glycerate Microspheres

SHI Jingyi YAN Ping YU Xinyao

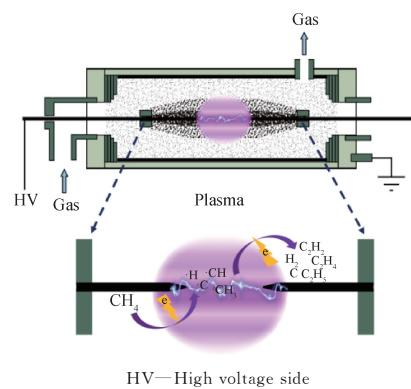
N₂ plasma is employed to activate the oxygen evolution reaction activity of NiFe-Gly microspheres. The NiFe-Gly is quickly converted into hollow microspheres (P-NiFe-Gly), which are composed of elemental nickel, nickel nitride, and a few iron species at low temperatures, exhibiting a small overpotential of 230 mV at the current density of 10 mA/cm².



Study on the Influencing Factors of Hydrogen and Carbon Production From Methane Plasma Cracking

WU Zuliang CHENG Yulian GAO Erhao LI Jing ZHU Jiali
YAO Shuiliang WANG Jianxin JIANG Jie

The needle-needle nanosecond pulse spark discharge for CH_4 cracking is strong, and the problem of electrode carbon deposition is greatly alleviated. It not only achieves efficient decomposition of methane, but also generates highly selectivity hydrogen (H_2) and nano carbon (C), making it a promising method for hydrogen production.



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