



Combination of non-thermal plasma and heterogeneous catalysis for methane and hexadecane co-cracking: Effect of voltage and catalyst configuration



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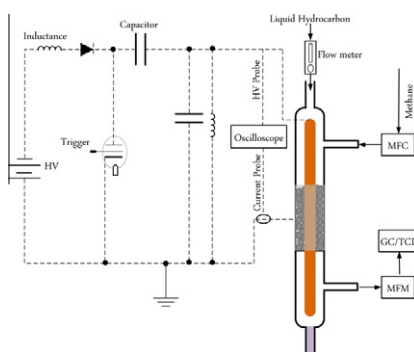
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HIGHLIGHTS

- ▶ Catalytic plasma co-cracking of methane and *n*-hexadecane is investigated through pulsed DBD reactor.
- ▶ Effects of voltage, amount of catalyst and plasma-catalyst configuration are examined.
- ▶ Applied voltage has dominant and direct effect on process energy efficiency.
- ▶ Maximum catalyst content as in-plasma configuration obtains maximum efficiency.
- ▶ In-plasma catalyst configuration increases the process efficiency up to 194.44 l/kW h.

GRAPHICAL ABSTRACT



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ABSTRACT

Co-cracking of methane and *n*-hexadecane is investigated over Mo–Ni/Al₂O₃ catalyst in a packed bed dielectric barrier discharge (DBD) plasma reactor. The effects of applied voltage and plasma-catalyst configuration are experimentally studied in terms of process energy efficiency and product composition. Hydrogen and gaseous hydrocarbon (methane, C₂, C₃ and C₄ components) are obtained as the cracking product. Results show that combination of catalyst and plasma improves energy efficiency of hydrocarbons plasma conversion. The applied voltage has dominant effect on the catalytic-plasma cracking process and in-plasma catalysis configuration is more efficient compared with post-plasma catalysis. The highest energy efficiency is achieved the value of 194.44 l/kW h for in-plasma configuration under highest applied voltage condition (11 kV). In these conditions, the production rate and mole percent of hydrogen are obtained 107.66 ml/min and 63.7%, respectively. The effect of catalyst deactivation is also investigated on the process variables.

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1. Introduction

Catalytic cracking is the process whereby complex long chain hydrocarbons are broken down into lighter and more valuable

products in the presence of proper catalyst. This process is further introduced as the decomposition of hydrocarbon molecules in a selective manner to produce mixture of smaller and mostly unsaturated hydrocarbons (like ethylene, propylene, etc.) [1]. Besides cracking reactions, hydrogen is generated as a main component and if it is produced in situ, it can be particularly used in fuel cell system for transportation (on-board application). It is clear that replacing traditional engine of vehicles by fuel cell system is one

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