Ru- and Rh- based Catalysts for CO_2 Methanation Assisted by Non-Thermal Plasma

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Key words: non-thermal plasma; methanation; sustainability; electrification

The need to reduce the concentration of CO_2 in the atmosphere is becoming increasingly necessary since it is considered the main factor responsible for climate change. Carbon Capture and Utilization (CCU) technology offers the opportunity to obtain a wide range of chemicals using this molecule as a raw material. In this work, the catalytic Non-Thermal Plasma (NTP)-assisted hydrogenation of CO_2 to CH_4 (methanation reaction) in a Dielectric Barrier Discharge (DBD) reactor was investigated. Four different Ru- and Rh-based catalysts were prepared starting from γ-Al_2O_3 spheres, characterized and tested in both thermal and NTP-assisted methanation under different operating conditions. The experimental tests evidenced the very positive effect of the NTP application on the catalytic performance, highlighting that for all the catalysts the same CO_2 conversion was reached at a temperature 150 °C lower with respect to the conventional thermal reaction. Among the prepared catalysts, the bimetallic ones showed the best performance, reaching a CO_2 conversion of 97% at about 180 °C with a lower energy consumption with respect to similar catalysts present in the literature.

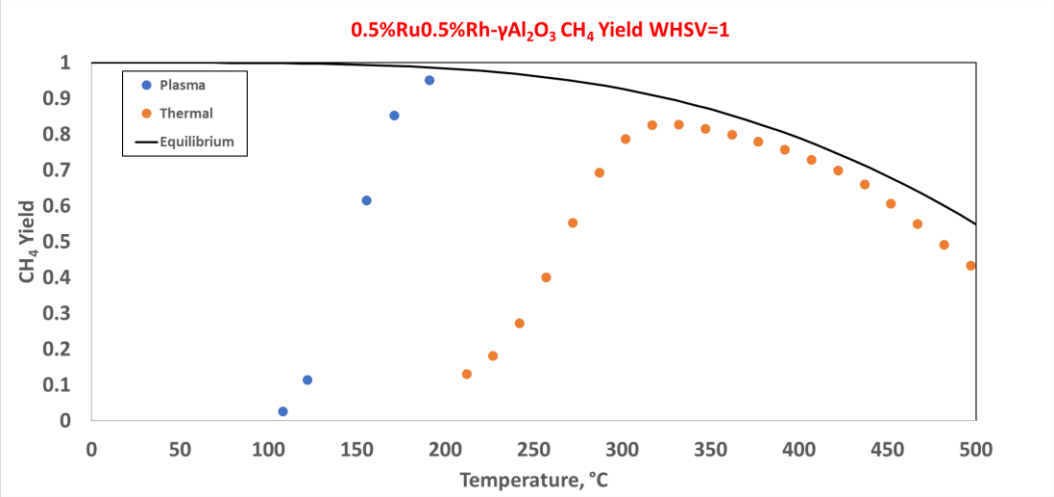

Figure 1. RuRh-γAl_2O_3 CH_4 yield comparison for both thermal and non-thermal-plasma-assisted tests at WHSV = 1 NL/g_{cat}h.

The ability to activate the CO_2 molecules at lower temperatures results in the possibility of reaching yields that would be impossible to reach due to thermodynamic limitations. Furthermore, it is also fundamental to note that it is possible to obtain CH_4 yields similar to the thermal ones at temperatures about 100 °C lower, which would result in a considerably lower energy expense.