

# Microwave-assisted catalytic dehydrogenation of propane to propylene

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The catalytic dehydrogenation of propane (PDH) to propylene is an endothermic process that requires high operating temperatures<sup>1</sup>. The heat transfer to the catalytic volume is a critical aspect that could be overcome by replacing the traditional heating method with the microwave (MW) heating. Since the MW heating capacity depends only on the dielectric properties of the materials<sup>2</sup>, this technique allows to obtain a direct, selective and fast heating of the catalyst. Furthermore, the application of MWs can be a promising path for the electrification of chemical processes, aiming at more sustainability and lower carbon footprint<sup>3</sup>.

In this work, a novel approach for PDH process through MW-assisted catalysis was developed with the purpose of exploiting the reverse thermal profile assured by MW heating nature.

A Pt-Sn-based catalytic formulation was deposited over a silicon carbide (SiC) honeycomb monolith, excellent MWs absorbing medium, layered with a MgO modified Al<sub>2</sub>O<sub>3</sub>-based washcoat. The structured catalyst was tested by using both the MW-heating method and the conventional one with the aim of investigating the feasibility of the innovative system. The performance of the system was evaluated in terms of propane conversion and selectivity to propylene in a temperature range of 450-550 °C, at different weight hourly space velocity (WHSV) values, by feeding a gaseous stream containing 80 vol% of propane in helium.

The MW assisted PDH reaction over the Pt-Sn/MgO/Al<sub>2</sub>O<sub>3</sub>/SiC exhibited considerably high propylene selectivity results (99.2% – 99.8%), with propane conversion values between 5.3% and 18.5% (Figure 1) in the investigated temperature range. Moreover, notably higher selectivity values were exhibited from the MW assisted PDH with respect to the conventional one (Table 1).

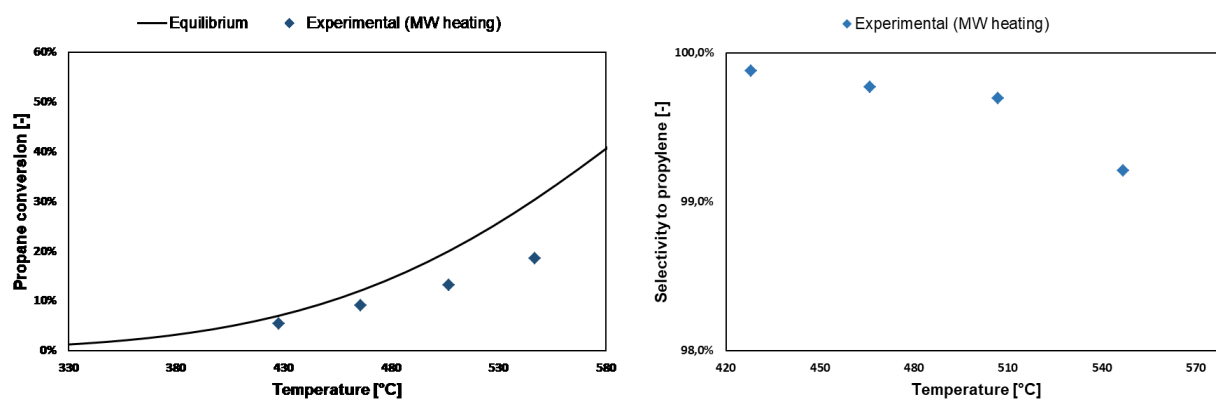


Figure 1 MW-assisted PDH over Pt-Sn/MgO/Al<sub>2</sub>O<sub>3</sub>/SiC.

T <sub>out</sub> °C	Propane conversion		Selectivity to propylene	
	MW	Traditional	MW	Traditional
430 °C	5.3 %	3.6 %	99.8 %	96.6 %
510 °C	13.2 %	13.1%	99.7 %	80.7 %

Table 1 Comparison between microwave and conventional heating.

## References.

1. Deng, L. et. al, *Appl. Cata. A*, 606 (2020), 117826.
2. Meloni, E. et. al, *Inte. Jour. of Hydr. Ener.* 46 (2021), 13729-13747.
3. Amiri a. et. al, *Appl. Ther. Engi.* 193 (2021), 117003.