

**PROPYLENE COMPLETE OXIDATION OVER MANGANESE OXIDE CATALYSTS: THE IMPACT OF SSA ON CATALYST ACTIVITY****Y. Georgiou<sup>1</sup>, N. Apostolopoulos<sup>1,2</sup> and T. Ioannides<sup>1\*</sup>**<sup>1</sup> Foundation for Research and Technology-Hellas, Institute of Chemical Engineering Sciences (FORTH/ICE-HT), Patras, Greece,<sup>2</sup> Department of Chemistry, University of Patras, Patras, Greece\* [theo@iceht.forth.gr](mailto:theo@iceht.forth.gr)**ABSTRACT**

Complete catalytic oxidation (combustion) is an efficient process for abatement of VOC emissions, typically employing noble metal-based catalysts. These catalysts are high-cost and require the use of scarce metals making the utilisation of transition metal oxides (TMOs) an attractive alternative [1]. TMOs such as Co, Mn, Cr and Cu oxides have been found to be effective catalysts for complete hydrocarbon oxidation [2,3]. It is widely accepted that the preparation method influences the structural characteristics, such as morphology, specific surface area (SSA), and crystallite size of metal-oxide catalysts. In general, a limited number of studies on the effect of SSA and crystallite size of metal oxide catalysts on their intrinsic activity in VOC oxidation have been carried out so far. The current work examines the effect of SSA variation of Mn<sub>2</sub>O<sub>3</sub> catalysts on their performance in catalytic oxidation of propylene (C<sub>3</sub>H<sub>6</sub>). Catalysts with varying surface area were produced by appropriate selection of activation conditions (mainly activation temperature) and, in addition, employment of commercially available samples. The physicochemical characterization of Mn<sub>2</sub>O<sub>3</sub> catalysts was carried out using N<sub>2</sub>-physisorption, Raman spectroscopy, X-Ray Photoelectron Spectroscopy (XPS), Powder X-Ray Diffraction (PXRD) and Scanning Electron Microscopy (SEM). Catalytic performance was evaluated in complete oxidation of propylene. The employed catalysts oxidize propylene fully to CO<sub>2</sub> and H<sub>2</sub>O without formation of any partial oxidation organic byproducts at all conversion levels.

The examined Mn<sub>2</sub>O<sub>3</sub> catalysts had a varying average crystallite size in the range of 35 - 80 nm and SSA in the range of 3.5 - 28.6 m<sup>2</sup> g<sup>-1</sup>. XPS spectra did not show significant differences in the O<sub>ads</sub>/O<sub>lat</sub> and Mn<sup>3+</sup>/Mn<sup>4+</sup> surface ratios among catalysts. The catalytic performance studies showed that the specific activity increases with increase of SSA. Additional kinetic studies were carried out to determine the kinetic parameters of propylene oxidation based on a Mars-van Krevelen redox kinetic model and explore their dependence on the SSA of the catalyst.

**KEYWORDS:** propylene, catalytic oxidation, manganese oxide, specific surface area**REFERENCES**

- [1] M.F.M. Zwinkels, S.G. Jaras, P.G. Menon, T.A. Griffin, Catal. Rev. Sci. Eng., 35 (1993), p. 319. <https://doi.org/10.1016/j.cattod.2005.11.061>,
- [2] E. Finocchio, G. Busca, V. Lorenzelli, J. Chem. Soc., Faraday Trans., 90 (1994), p. 3347.
- [3] E. Finocchio, R.J. Willey, G. Busca, V. Lorenzelli, J. Chem. Soc., Faraday Trans., 93 (1997), p. 175.

**ACKNOWLEDGMENTS**

The research project was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "1st Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment" (Project Number: HFRI-FM17-1876).