H2 AND/ORC3H6 ASSISTED selective catalytic reduction OF NOx OVER Ir/ACZ CATALYSTS.

g.i. theodoridis1, n.d. Charisiou1, A.I. TSIOTSIAS1, C. DROSOU2, I.V. YENTEKAKIS2,\*, M.a. goula1,\*

1 Laboratory of Alternative Fuels and Environmental Catalysis (LAFEC), Department of Chemical Engineering, University of Western Macedonia, 50100, Kozani, Greece,

2 Laboratory of Physical Chemistry and Chemical Processes, School of Environmental Engineering, Technical University of Crete, 73100 Chania, Greece

\*Corresponding Authors: M.A. Goula ([mgoula@uowm.gr](mailto:mgoula@uowm.gr)); I.V. Yentekakis ([yyentek@isc.tuc.gr](mailto:yyentek@isc.tuc.gr))

Keywords: Selective Catalytic Reduction (SCR), NOx reduction, Ir catalysts

The combustion of fossil fuels, used to meet the ever-growing energy demand, leads to increasing emissions of NOx (NO and NO2). NOx contribute to global warming, and are responsible for the formation of photochemical smog, acid deposition, the depletion of ozone in the atmosphere, as well the degradation of human health. Selective Catalytic Reduction (SCR) technology is currently the most effective method of post combustion NOx reduction for coal-fired generating stations and vehicular emissions.

This work examined the SCR of NO in a wide temperature range (150-500oC), using low loading Ir (1 wt.%) catalysts based on Al2O3-CeO2-ZrO2 (ACZ) supports with different Al-Ce-Zr molar composition. The following reactions were studied: NO + C3H6 + O2 (R#1), NO + H2 + O2 (R#2) and NO + C3H6 + H2 + O2 (R#3). Two groups of catalysts were prepared and studied. For the first group, the ACZ supports were synthesised using a hydrothermal synthesis method at **100 oC** for 20h. For the second group, the ACZ supports were synthesized using the typical co-precipitation method at room temperature under controlled pH-value at 10. The precursors used in both methods were Al(NO3)3·9H2O, Ce(NO3)3·6H2O and Zr(NO3)2·H2O nitric salts, which were diluted in distilated water with the appropriate quantities in order to lead to a final ACZ support comprised of 60 wt.% Al2O3 and 40 wt.% CeO2-ZrO2 (the CZ molar ratio was designed to be 0.75:0.25, 0.5:0.5 and 0.25:0.75); later, the obtained precipitates were dried at 110 oC overnight and then calcined at 800 oC for 2 h. The as prepared ACZ mixed oxides were impregnated by IrCl2 solution with the appropriate amount of Ir in order to lead in 1wt% of Ir-content catalysts. The obtained suspensions were dried at 110 oC, overnight, then directly reduced at 400 oC under 25 % H2/Ar flow for 3 h to avoid the formation of large Ir crystallites.

Complementary characterization studies involved N2 physisorption (BET method), H2-Temperature Programmed Reduction (H2-TPR), H2-chemisorption, X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM).

From the results obtained herein, **it appears that the highest NO conversion was achieved when using the Ir-ACZ (CZ:75-25) hydrothermal catalyst and the Ir-ACZ (CZ:50-50) co-precipitated catalyst, irrespective of reducing agent in the reaction mixture. Increasing the concentration of O2 from 2% to 5% resulted at increased NO conversion, but a decline in the N2 selectivity, for both catalysts. Both catalysts showed a stable performance during 48 h long time-on-stream experiments.**

**Acknowledgements:** Financial support by the *GREEK-CHINESE BILATERAL RESEARCH AND INNOVATION COOPERATION, 2018-2021 programme (Project No: T7ΔΚI-00356) is gratefully acknowledged.*

