Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA20126

Grantee name: JANA PISK

Details of the STSM

Title: Application of porous and nonporous materials based on transition metal oxides in oxidation reactions

Start and end date: 23/10/2022 to 29/10/2022

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

The carried activities considered catalytic testing of the materials containing transition metal oxides previously prepared and characterised. Altogether, seven samples were tested in the oxidation reaction of cyclooctene:

- $35Na_2O$-$10V_2O_5$-$35P_2O_5$-$20Nb_2O_5$,
- $35Na_2O$-$25V_2O_5$-$20P_2O_5$-$20Nb_2O_5$,
- $35Na_2O$-$55V_2O_5$-$10P_2O_5$,
- $35Na_2O$-$45P_2O_5$-$20Nb_2O_5$,
- $35Na_2O$-$10Al_2O_5$-$35P_2O_5$-$20Nb_2O_5$,
- $70V_2O_5$-$10P_2O_5$-$20Nb_2O_5$,
- $70V_2O_5$-$10P_2O_5$-$20Na_2O$.

The samples (glass and glass ceramics) were prepared by mixing Na_2O-V_2O_5-P_2O_5-Nb_2O_5 in different molar ratios. Oxidizing agents used were TBHP in decane and TBHP in water, and the reactions were done at 80 °C. *n*(cyclooctene):*n*(oxidant) = 0.02mol:0.04 mol, while the *n*(catalyst) was either 0.0018 mol or 0.0009 mol. Results are summarized in Fig.1.-3.

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

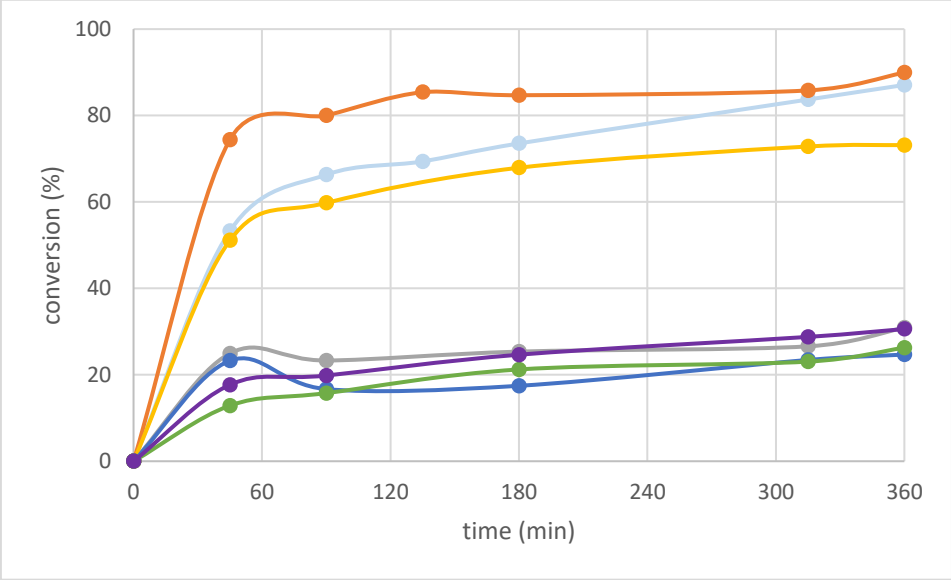

Fig 1. Converted cyclooctene vs. time with tested catalysts, from up to down: $70V_2O_5$-$10P_2O_5$-$20Nb_2O_5$ orange curve, $70V_2O_5$-$10P_2O_5$-$20Na_2O$ light blue curve, $35Na_2O$-$55V_2O_5$-$10P_2O_5$ yellow curve, $35Na_2O$-$10V_2O_5$-$35P_2O_5$-$20Nb_2O_5$ grey curve, $35Na_2O$-$45P_2O_5$-$20Nb_2O_5$ purple curve, $35Na_2O$-$10Al_2O_5$-$35P_2O_5$-$20Nb_2O_5$ green curve, and $35Na_2O$-$25V_2O_5$-$20P_2O_5$-$20Nb_2O_5$ dark blue curve. *n*(catalyst)=0.0018 mol. TBHP in decane was used as oxidizing agent.

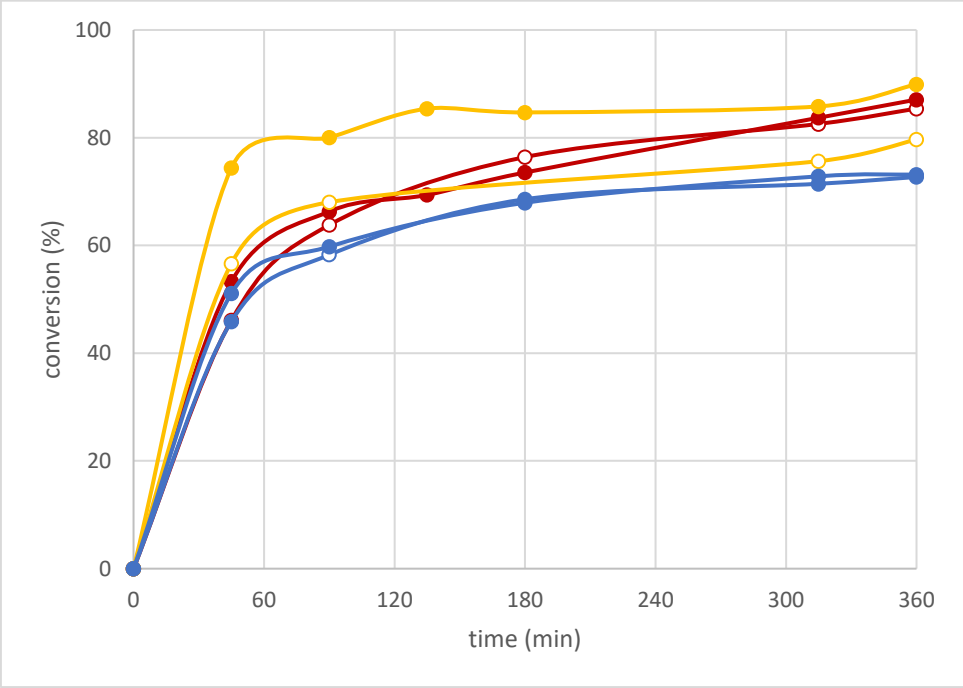

Fig 2. The influence of catalyst loading. Converted cyclooctene vs. time with tested catalysts: $70V_2O_5$-$10P_2O_5$-$20Nb_2O_5$ yellow curve, $70V_2O_5$-$10P_2O_5$-$20Na_2O$ red curve, $35Na_2O$-$55V_2O_5$-$10P_2O_5$ blue curve. Coloured dots present the samples where *n*(catalyst)=0.0018 mol, while empty dots present samples where *n*(catalyst)=0.0009 mol. TBHP in decane was used as oxidizing agent.

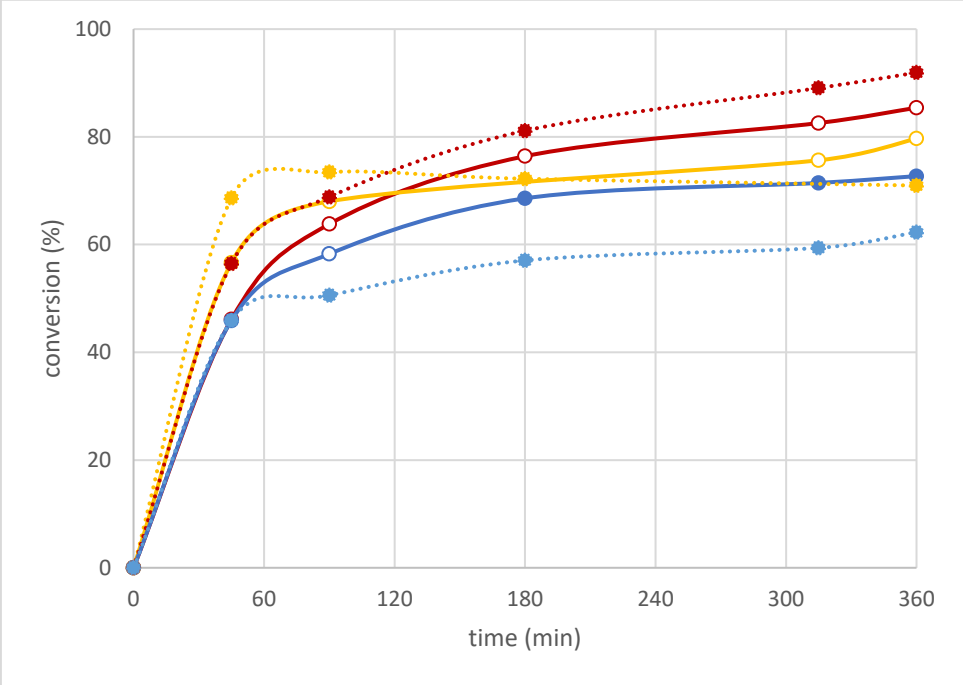

Fig 3. The influence of oxidizing agent. Converted cyclooctene vs. time with tested catalysts, from up to down: $70V_2O_5$-$10P_2O_5$-$20Nb_2O_5$ yellow curve, $70V_2O_5$-$10P_2O_5$-$20Na_2O$ red curve, $35Na_2O$-$55V_2O_5$-$10P_2O_5$ blue curve. Coloured dots present the reactions in which oxidizing agent was TBHP in water, while empty dots present the reactions in which oxidizing agent was TBHP in decane. *n*(catalyst)=0.0009 mol. At the reaction temperature 50 °C, activity of all samples was low and the results are not presented in this report.

Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

Contributions to the specific objectives of the Action CA20216 are the following:

1: New application and opportunities of porous and non-porous materials containing transition metal oxides in catalytic oxidation reactions. This kind of catalytic applications have not been reported so far, to the best of our knowledge, being pioneer work. Comparison and correlation of electrical and catalytic performances provides a new platform for the application of the obtained materials.

2: Preliminary tests of several new materials glasses/glass ceramics containing transition metal oxides gave insight into their potential catalytic performance that is assumed to be dependable on their structural properties. As presumed, the materials with higher vanadium loading showed better catalytic performances.

3: Environmentally friendly process following the principles of green chemistry: low catalyst loading, no addition of the organic solvents, use of the oxidant in the greenest solvent available–water, showed great potential.

4: Interdisciplinary of different academic groups and maximization of the potential in different research fields: preparation (synthesis, electrical investigation, and catalytic performances), continuing to work together.

5: Promotion and involvement of the European researcher at any age and career stage (J. Pisk is Assistant Professor) providing future collaboration pathways with other scientists across this Action and networking.

6: Based on the preliminary results, it is expected to publish **a joint communication paper to spread the ideas and results to a wider audience within the period of 4 months**.

Future plans:

- continuation of the catalytic research with the planned compositions of transition metal oxides (Fe, Mo and W)
- continuation of the catalytic research with the best tested catalyst containing different ratios of V^{4+} and V^{5+} ions, depending on the crystallization temperature, that will influence electrical and consequently catalytic properties