

Project Number : 2024A-E04
Program Title (English) : Investigating the active species of M-doped Al₂O₃ supported Pt-Sn catalysts under oxidative propane dehydrogenation condition
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Key words : Oxidative propane dehydrogenation, CO₂, PtSn alloy, XAS

1. Summary

Based on our preliminary results, an incorporation of Ca onto PtSn/Al₂O₃ catalyst enhanced catalytic activity and stability in CO₂-assisted oxidative dehydrogenation of propane (ODPC). It was expected that Pt-Sn alloy was active species for ODPC, exhibiting a highly active nature for propane activation. However, introduction of CO₂ as oxidant could segregate the Pt-Sn alloy by oxidizing Sn to Sn oxides. Therefore, XAS measurements under H₂, CO₂, and reaction condition were required to reveal the behavior of Pt-Sn alloy by comparing the oxidation state and local coordination nature of Pt and Sn under various gas condition at reaction temperature.

2. Experimental

The experimental conditions of *in-situ* XAS experiment for the Ca-PtSn/Al₂O₃ and PtSn/Al₂O₃ catalysts are described in Figure 1. The main focus of the *in-situ* XAS experiments was investigation of Pt-Sn alloy behavior under H₂, CO₂, and reaction condition at reaction temperature.

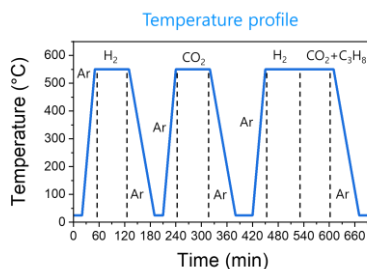


Figure 1. Temperature and gas conditions for *in-situ* XAS measurement for Ca-PtSn/Al₂O₃ catalysts

3. Results and Discussion

The *in-situ* XAS measurements for Ca-PtSn/Al₂O₃ and PtSn/Al₂O₃ catalysts at Pt L₃ and Sn K edges under H₂ reduction, CO₂ oxidation, and reaction condition (C₃H₈+CO₂) at reaction temperature (550 °C). The Pt and Sn formed Pt-Sn alloy under H₂ reduction, whereas the formed Pt-Sn alloy was dealloyed under CO₂ oxidation for both catalysts. Under the reaction condition, Ca-PtSn/Al₂O₃ exhibited similar Pt-Sn alloy behavior with H₂ reduction, while PtSn/Al₂O₃ catalyst showed Pt-Sn alloy behavior similar with metallic Pt, not with that with H₂ reduction. These results revealed that the incorporation of Ca onto PtSn/Al₂O₃ catalyst promoted an inhibition of dealloying of the Pt-Sn alloy under the reaction condition, which led to more active and stable catalytic activity.

4. Others

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) No. 2021R1A5A1084921.