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Program Title (English) : Investigating the alloying behavior of platinum-tin alloy on the alkaline-earth metal doped Al_2O_3 supports under the oxidative propane dehydrogenation in the presence of CO_2.

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Key words : Oxidative propane dehydrogenation, CO_2, alkaline–earth metal, PtSn, alloy

1. Summary

In this study, we systematically investigated the influence of alkaline-earth metals (Mg, Ca, Sr, and Ba) as promoters for $PtSn/Al_2O_3$ catalysts. Among the tested metals, Sr provided the most significant improvement in catalyst performance. XAS analysis showed that Sr effectively prevented the dealloying of the Pt–Sn alloy, thereby demonstrating high stability during reaction conditions. These findings highlight the unique stabilizing role of Sr in promoting catalyst stability under ODPC condition.

2. Experimental

In–situ XAS experiments were conducted on $PtSn/Al_2O_3$ and Sr-modified $PtSn/Al_2O_3$ catalysts. The experimental conditions employed for in–situ XAS measurements under H_2 reduction and ODPC reaction conditions (C_3H_8+CO_2) are illustrated in Figure 1.

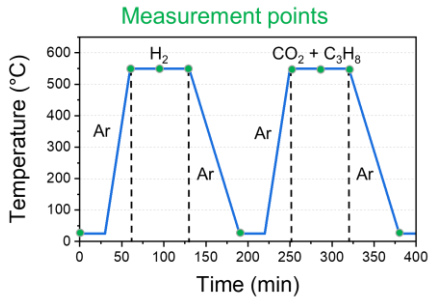

Figure 1. Temperature and gas conditions for in-situ XAS measurements on alkaline-earth modified $PtSn/Al_2O_3$ catalysts.

3. Results and Discussion

In–situ XAS measurements were performed on the Sr-modified $PtSn/Al_2O_3$ catalysts at Pt L_3 and Sn K edge under H_2 and ODPC reaction condition at reaction temperature. Under H_2 reduction conditions, both catalysts exhibited the formation of the Pt–Sn alloy, which is a highly active species for the ODPC reaction. Under the reaction condition, Sr-modified catalysts retained PtSn alloy which formed during reduction. In contrast, the alloy in the unmodified catalyst decomposed into metallic Pt upon CO_2 introduction. This suggests that Sr promotes CO_2 activation, thereby stabilizing the alloy phase, enhancing catalytic activity and stability during ODPC conditions. Therefore, Sr emerges as a highly promising promoter for improving both catalyst activity and stability.

4. Others

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