

## A New Catalyst System V-Cs-Cu-Tl for Selective Oxidation of *p*-tert Butyl Toluene to *p*-tert Benzaldehyde

Min CHEN\*, Ren Xian ZHOU, Xiao Ming ZHENG

Institute of Catalysis, Zhejiang University, Xixi Campus, Hangzhou 310028

**Abstract:** In this paper, a new catalyst system V-Cs-Cu-Tl was studied in the gas phase selective oxidation for *p*-tert butyl toluene to *p*-tert benzaldehyde. The catalyst system was prepared by impregnation method. The results obtained are optimum value and have good advantages in environmental protection.

**Keywords:** Catalyst, selective oxidation, *p*-tert benzaldehyde.

*p*-tert benzaldehyde is an important raw material of chemical industry. It is widely used in foodstuff, medicine and also used as intermediates of perfume. The conventional method of production of *p*-tert benzaldehyde resulted in waste water, which is easy to cause environmental pollution<sup>1-3</sup>. We tried to produce *p*-tert benzaldehyde from catalytic gas phase selective oxidation method. The study of the gas phase selective oxidation of *p*-tert butyl toluene to *p*-tert benzaldehyde is sparsely reported, because it is quite difficult to get good coordination between the conversion of *p*-tert butyl toluene and the selectivity of *p*-tert benzaldehyde<sup>4-6</sup>.

In our study, TiO<sub>2</sub> and SiC were used as the supports. Using impregnation method, V, Cs, Cu, Tl were loaded on the supports with an aqueous solution of nitrate. The sample were dried at 250°C for 2 h and then calcined in air at 600°C for 4 h. The analysis of the reactor effluent was performed by gas chromatography. The effects of various factors such as reaction temperature, space velocity, and concentration of *p*-tert butyl toluene and oxygen density to reaction behaviors are investigated. On V-Cs-Cu-Tl catalyst system the conversion of *p*-tert butyl toluene and the selectivity of *p*-tert benzaldehyde were above 10 mol% and 80 mol%, respectively. The reaction activities of catalysts are shown in **Table 1**.

It is found that the selectivity of *p*-tert benzaldehyde increased with the addition of Cs, however the conversion of *p*-tert butyl toluene is low. Furthermore, the catalyst of addition of Cu is advantageous to both the conversion of *p*-tert butyl toluene and the selectivity of *p*-tert benzaldehyde. After adding Thallium into the V-Cs-Cu system, *i.e.* V-Cs-Cu-Tl catalyst system showed much higher activity and selectivity in the catalytic gas phase selective oxidation of *p*-tert butyl toluene.

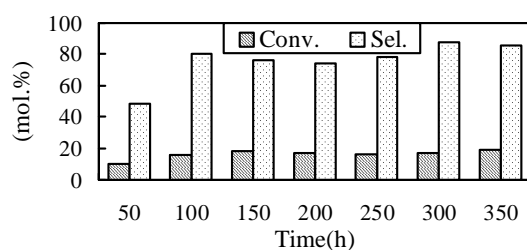
The V-Cs-Cu-Tl catalyst system remained its excellent reaction properties even after 365 hours running (showed in **Figure 1**). The catalyst system shows potential

application in gas phase selective oxidation of *p*-tert butyl toluene to *p*-tert benzaldehyde in industry.

**Table 1** Reaction activity of catalysts

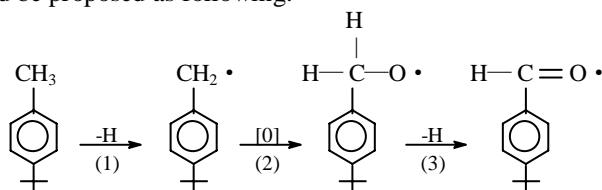
Catalyst	Temp. (°C)	Conv. (mol%)	Sel. (mol%)
V <sub>2</sub> O <sub>5</sub> /TiO <sub>2</sub> • SiC	480	2.4	50.2
VCs <sub>0.2</sub> /TiO <sub>2</sub> • SiC	480	4.8	84.8
VCs <sub>0.2</sub> Cu <sub>0.15</sub> /TiO <sub>2</sub> • SiC	480	20.5	75.2
VCs <sub>0.2</sub> Cu <sub>0.15</sub> /TiO <sub>2</sub> • SiC	440	8.0	40.8
VCs <sub>0.2</sub> Cu <sub>0.15</sub> Tl <sub>0.01</sub> /TiO <sub>2</sub> • SiC	440	10.8	86.0
VCs <sub>0.2</sub> Cu <sub>0.15</sub> Tl <sub>0.02</sub> /TiO <sub>2</sub> • SiC	440	8.6	92.1
VCs <sub>0.2</sub> Cu <sub>0.15</sub> Tl <sub>0.03</sub> /TiO <sub>2</sub> • SiC	440	12.0	85.0

**Figure 1** The stability of the catalytic behavior of V-Cs-Cu-Tl catalyst system



Spectroscopic measurements XRD, IR, XPS have been used to study the relationship between the structure of the catalyst and its reaction property. The TPR, O<sub>2</sub>-TPD techniques are also applied to investigate the property of oxygen on the surface of the catalyst.

Based on our experimental data, it was found that probable mechanism of the gas phase selective oxidation from *p*-tert butyl toluene to *p*-tert benzaldehyde on the catalyst of V-Cs-Cu-Tl could be proposed as following:



## References

1. U.S. Pat. 5,136,104, **1992**.
2. M. Ai, *J. Catal.*, **1975**, *40*, 318.
3. T. Ono, *et al.*, *Bull. Chem. Soc. Japan.*, **1981**, *54*, 343.
4. H. K. Matralis, *et al.*, *Appl. Catal. A*, **1995**, *126*, 365.
5. J. Miki, Y. Osada, T. Konoshi, *et al.*, *Appl. Catal. A*, **1996**, *137*, 93.
6. A. J. Van Hengsturn, J. G. Van Ommen, H. Bosch, *et al.*, *Appl. Catal. A*, **1983**, *8*, 369.

Received 17 July, 2000