

Chapter 11

Conclusions

From the observations made in this research work, the following important conclusions can be drawn:

1. CuMnOx catalysts have been synthesized using various combination of salts solutions $\{\text{Mn}(\text{Ac})_2 + \text{Cu}(\text{NO}_3)_2\}$, $\{\text{Mn}(\text{Ac})_2 + \text{Cu}(\text{Ac})_2\}$, $\{\text{Mn}(\text{NO}_3)_2 + \text{Cu}(\text{NO}_3)_2\}$, $\{\text{Mn}(\text{NO}_3)_2 + \text{Cu}(\text{AC})_2\}$ and Co-precipitated by KMnO_4 solution. The Co-precipitated precursors are calcined by various routes (stagnant air, flowing air and reactive calcination) to form CuMnOx catalysts. The activity of the catalysts for air oxidation of CO has been evaluated. The catalyst prepared using $\{\text{Mn}(\text{Ac})_2 + \text{Cu}(\text{NO}_3)_2\}$ exhibits the best activity for CO oxidation due to the high oxygen mobility. The RC route is the most appropriated calcination strategy for the production of highly active CuMnOx catalyst for CO oxidation. The calcination order with respect to the performance of catalyst for CO oxidation is as follows: reactive calcination > flowing air > stagnant air.
2. CuMnOx catalysts have been synthesized using $\{\text{Mn}(\text{Ac})_2 + \text{Cu}(\text{NO}_3)_2\}$ and different precipitants (KMnO_4 , Na_2CO_3 or KOH) by co-precipitation method and their catalytic activity for CO oxidation has been evaluated. The catalyst prepared by KMnO_4 as a precipitant exhibited the best catalytic activity for CO oxidation. The order of precipitant with respect to the performance of catalyst for CO oxidation is as follows: $\text{KMnO}_4 > \text{Na}_2\text{CO}_3 > \text{KOH}$. Maintaining the same salts solutions while changing the precipitants, a change in the density of active sites occurs which influence the CO oxidation activity.

3. The preparation conditions of CuMnOx catalyst for getting excellent catalytic activity are 1/8 (Cu:Mn) molar ratio, 110°C drying temperature for 24h and calcination at 300°C for 2h. In particular, the catalyst drying and calcination conditions have found to be the most importance and control of these parameters should be integrated into the design of experimental program.
4. Progress in the activity of Cu₁Mn₈ catalysts for CO oxidation has been attempted by doping promoters like Ag, Co, Ce, and Fe. The purpose of this study is to understand the effect of different dopants on the textural properties of the Cu₁Mn₈ catalyst. The order of activity for different types of doped and un-doped Cu₁Mn₈ catalysts for CO oxidation is as follows: 3%AgCuMn₈Ox > 3%CeCuMn₈Ox > 3%FeCuMn₈Ox > 3%CoCuMn₈Ox > Cu₁Mn₈.
5. Addition of small amount of promoters (Ce, Ag or Au) into the Cu₁Mn₈ catalyst has proven beneficial in their catalytic activity. A small amount of (1.5wt.%) CeOx added into the Cu₁Mn₈ catalyst improves its activity for CO oxidation. Further addition of (1wt.%) AgO₂ or (0.5wt.%) AuOx into the 1.5%CeCuMn₈Ox catalyst, additional increase of their activity for CO oxidation is observed. The new surface sites created upon doping result in enhanced activity for CO oxidation over AuOx or AgOx promoted 1.5%CeCuMn₈Ox catalyst. The order of activity for different types of doped and un-doped Cu₁Mn₈ catalysts for CO oxidation is as follows: 1.5%Ce0.5%AuCuMn₈Ox > 1.5%Ce1.0%AgCuMn₈Ox > 1.5%CeCuMn₈Ox > Cu₁Mn₈.
6. The γ -Al₂O₃ supported 3%AgCuMn₈Ox catalyst is evaluated for practical application in CO oxidation. Among the various percentages of a γ -Al₂O₃ support into the 3%AgCuMn₈Ox catalysts, the 3%AgCuMn₈Ox/60% γ -Al₂O₃ catalyst has

shown the greatest catalytic activity towards CO oxidation. Application of γ -Al₂O₃ support makes the catalyst cheaper without sacrificing their performance for CO oxidation.

7. The kinetics study provides with a phenomenological summarize to understand the reaction of 3%AgCuMn₈Ox/60% γ -Al₂O₃ catalyst for CO oxidation. Intrinsic rate of CO oxidation over 3%AgCuMn₈Ox/60% γ -Al₂O₃ catalyst is determined in the temperature range of (25-30°C). The rate of CO oxidation is given by Rate (-r_p) = $7.165 \times 10^5 \exp(-50261/RT)(C_{CO})^{0.97}$ g.mol/gcat.h and the value of activation energy is found to be 50.26kJ/mol. The order of reaction for CO oxidation by this 3%AgCuMn₈Ox/60% γ -Al₂O₃ catalyst is found to be first-order.