

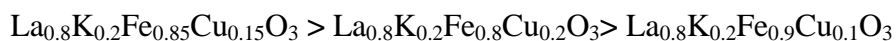
CHAPTER - 6

CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSIONS

Several effective perovskite-type lanthanum ferrites (LaFeO_3) based catalysts have been prepared, characterized by various techniques and studied for the activity measurements for simultaneous removal of NO_x and soot in a laboratory scale reactor. Based on the experimental results and discussion following conclusions can be drawn:

- ✚ Sol-gel (SG) method of catalyst preparation is found to be the best method in comparison to solution combustion synthesis (SCS) and reactive grinding (RG) method.
- ✚ Optimum calcination temperature of the precursor is found to be 700°C .
- ✚ Calcination strategies reveal order of calcinations environment as per activity of the catalysts formed, reactive calcinations > flowing air > stagnant air.
- ✚ Substituted perovskite structured catalysts are more active than un-substituted type of catalysts for the simultaneous soot- NO_x control.
- ✚ Potassium (K) substitution at A-site and Cu substitution at B-site of LaFeO_3 catalyst improves the catalytic activity for simultaneous soot- NO_x reduction.
- ✚ The stability test revealed that $\text{LKFeCu}_s\text{-E}$ catalyst is stable at 350°C for 50hrs on run under experimental conditions.
- ✚ The best formulated perovskite catalyst $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ synthesised by sol-gel method is attributed high activity, selectivity and stability for simultaneous soot- NO_x reduction.
- ✚ The performance order of K and Cu substitution of LaFeO_3 catalysts is as follows:



- ✚ The order of calcination strategies of the precursor according to the activity of $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ catalyst is as follows:
 $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ (RC) > $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ (FA) > $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ (SA)
- ✚ The activity of the catalyst for soot conversion is higher for tight contact than loose contact but reverse is true for NO reduction.
- ✚ Morphological microscopy (SEM) of the explored samples demonstrated agglomerates involved mostly thin, smooth flakes and layers perforated by a large number of pores.
- ✚ The particle size of the perovskite oxides is small and uniformly distributed. The average particle size of the catalyst is about 100-120 nm, close to that for diesel soot particulates (70-100 nm), favourable to achieving the highest specific number of contact points between the two counterparts.
- ✚ The best formulation of the double-substituted catalyst resulted by calcination in air is $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ for soot oxidation ($T_f = 363^\circ\text{C}$, 100%).
- ✚ The best formulation of the double-substituted catalyst resulted by calcination in air (stagnant air) is $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ for NO reduction ($T_{\text{m-NO}} = 369^\circ\text{C}$, 71.41%).
- ✚ The calcinations strategy of $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ (stagnant air) comparing with flowing air and reactive calcinations, the reactive calcinations is best. The complete combustion of soot is found at 319°C and NO reduction improved to 75.62% at 378°C .
- ✚ The catalyst, LKFeCus700-E is highly selective towards CO_2 and N_2 . The CO_2 selectivity of the catalyst is 100% at all temperatures. The N_2 selectivity is >

94%, beyond 300°C SN_2 is more than 100% due to additional decomposition of NO to N_2 . Whereas, maximum N_2O selectivity is 8% at 300°C, further the selectivity decreases to a minimum value of 4% above 400°C. Hence the catalyst maintained the good selectivity.

6.2. FUTURE SCOPE

Particulate matter (PM) and Nitrogen oxides (NO_x) are two major pollutants emitted from diesel engines exhaust. Our research has focused on the simultaneous catalytic control of diesel soot and NO_x . The catalyst formulation, $\text{La}_{0.8}\text{K}_{0.2}\text{Fe}_{0.85}\text{Cu}_{0.15}\text{O}_3$ showed 100% soot conversion and 75.62% NO conversion simultaneously in lab scale reactor in simulated gas mixture within the diesel exhaust temperature range ($\cong 400^\circ\text{C}$).

Further, for 100 % conversion of NO_x , experiment should be conducted by feeding with some extra reductant. The additional reductants that can be used are ammonia, urea, HC, LPG, etc. In future, for the commercial exploitation the catalyst developed should be tested in actual diesel exhaust conditions after impregnation over wash-coated monolithic converter. Simultaneous removal NO_x and soot experiments were performed on laboratory scale reactor; therefore it should also be conducted in a real situation of diesel engine exhaust.