CHAPTER 10

SUMMARY AND FUTURE SCOPE

Based on the present research following conclusions can be drawn:

- The literature has been scanned and a review paper entitled “Preparation and application of perovskite catalysts for diesel soot emissions control: An overview” has been published.
- Perovskite catalysts are active and cost effective for diesel soot oxidation emerging as alternative to the PGM catalysts.
- All the catalysts prepared by various methods possessed the perovskite structure as confirmed by XRD and FTIR except $LaZnO_y$.
- 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 order of the preparation method according to the activity of the catalyst for soot oxidation is as follows: co-ppt > sol-gel > SCS.

- The order of the preparation method according to the stability of the catalyst for soot oxidation is as follows: sol-gel > co-ppt > SCS.
- Irrespective of the preparation methods, $750^{o}C$ is the optimum calcination temperature, producing the active catalyst for soot oxidation.
- Gas Hourly space Velocity of 22556 h^{-1} is found to be optimum under the present experimental conditions.
- Pure perovskite $LaCoO_3$ catalyst shows the best result (T_f = $420^{o}C$) in comparison to $LaFeO_3$ and $LaNiO_3$ for soot oxidation.
- Substitution of Sr in $LaCoO_3$ hardly improves the activity but imparts the stability to the catalysts.
- The best formulation of the double-substituted catalyst resulted by calcination in air is $La_{0.9}Sr_{0.1}Co_{0.5}Fe_{0.5}O_{3-\delta}$ for soot oxidation (T_f = $355^{o}C$).
- High activity of the perovskite is due to adsorbed surface oxygen and presence of mixed valence state of Co-ions (Co^{2+}/Co^{3+})
- A novel route of reactive calcination (RC) of the precursor in a chemically reactive CO-air mixture produces $La_{0.9}Sr_{0.1}Co_{0.5}Fe_{0.5}O_{3-\delta}$ perovskite catalyst with improved performance for diesel soot oxidation (T_f = $325^{o}C$).
- The reactive grinding (RG) method produces $La_{0.9}Sr_{0.1}Co_{0.5}Fe_{0.5}O_{3-\delta}$ catalysts possessing very high surface area and higher activity for soot oxidation as compare to sol gel prepared catalyst sample.
- The kinetics of air oxidation of soot over $La_{0.9}Sr_{0.1}Co_{0.5}Fe_{0.5}O_{3-\delta}$ catalyst in the temperature range 325-$355^{o}C$ represents the following rate expression:

$$Rate = 6.46 * 10^{10} \exp(-101.08\ kJ/RT)(m)\ g\ gcat^{-1}s^{-1}$$

- The activation energy found to be 101.08 kJ mol^{-1} is the least compared with the reported values for different catalysts in the literature.
- The perovskite catalyst, $La_{0.9}Sr_{0.1}Co_{0.5}Fe_{0.5}O_{3-\delta}$ is inexpensive, thermally stable and shows the highest activity within the temperature range of diesel engine exhaust, therefore could be applied in the self-regenerative DPF.

FUTURE SCOPE

Diesel soot oxidation experiments were performed on laboratory scale reactor; therefore it should also be conducted in a real situation of diesel engine exhaust.

The catalysts prepared should also be evaluated for its appropriateness in context of its deactivation and poisoning properties with feed containing moisture and SO_x for its application for the treatment of diesel exhaust.

The catalytic converter should be designed by depositing the developed perovskite catalysts on a cordierite monolith honeycomb structure and should be tested for diesel soot oxidation.