CHAPTER IX
SUMMARY AND FUTURE PLANS

9.1 Summary

In the present work Ag NPs were prepared by an efficient and simpler way, using low temperature, cost effective, large scale production and rapid solution combustion method. Ag NPs were synthesized with improved structural and optical properties by changing organic fuels (citric acid and glycine) in the stoichiometry (fuel-to-oxider) molar ratio. The optical, structural, and surface morphological properties of the prepared nanoparticles were studied through XRD, TEM, SEM and UV-vis spectra. The interaction between the organic molecule-(CNPSA, CFSA, BMANQ, DBrN, DMNMAD and DMBMAD) on Ag NPs and the resulting intensity enhancement was investigated using Raman spectroscopy. The Ag NPs were synthesized by adding the fuel in stoichiometric equibalance (φ=1) based on the theromochemical concepts of propellant chemistry calculation of fuel-oxident mixtures. The effects of various organic fuels on particle size and its structure have been investigated.

Surface morphology of prepared silver nanoparticles were systematically characterized with FESEM and HR-TEM to confirm the nanostructure of the metal nanoparticles obtained by solution combustion method. The Ag NPs exhibited spherical shape and multi twinned structure with five fold symmetry and average size ranging from 15 to 55nm respectively. The prepared nanoparticles had perfect stoichiometry without any contaminations. The optical characterization of Ag NPs was analyzed by taking UV-vis absorption spectra.

Sample	Organic molecules	Orientation
Benzene derivatives		
Ag	CNPSA	Tilted
	CFSA	Stand-on
Naphthalene derivatives		
Ag	BMANQ	Stand-on
	1,4-DBrN	Stand-on
Anthracene derivatives		
Ag	DMNMAD	Stand-on
	DMBMAD	Stand-on

- Surface Enhanced Raman Scattering (SERS) studies of Ag nanoparticles when added to organic molecules.

Table 9.1 comparative study of the organic molecules adsorbed on the Ag NPs.

Raman intensity of different organic molecules has been studied by taking SERS spectrum. The organic molecules were adsorbed on the surface of the Ag NPs which leads to improvement of Raman intensity. The anthracene molecule exhibited excellent enhancement than other molecules. The benzene derivatives adsorbed on the Ag NPs also showed high enhancement of SERS studies. The naphthalene derivative molecules adsorbed on the Ag NPs revealed good enhancement. Ag NPs prepared by CNPSA molecule showed 'tilted' orientation where as Ag NPs prepared with other organic molecules exhibited 'stand-on' orientation. The high enhancement of Raman intensity obtained is mainly due to the use of donor with high molecular weight as acceptor or may depend on size of the Ag NPs. On comparison it could be suggested that the enhancement of all the organic molecules adsorbed on Ag NPs completely depends on size, shape, uniformity, crystallinity and quality. The HOMO-LUMO analysis confirms that the energy gap value has significant influence on the intermolecular charge transfer and that the organic molecules has quite established configuration.

9.2 Proposals for future research

The author has synthesized Ag NPs by solution combustion method using citric acid and glycine as fuels. Raman intensity of different organic molecule has been studied by taking SERS spectra. The organic molecules were adsorbed on silver NPs which lead to enhancement of Raman intensity.

- ✓ New and more exotic samples have to be prepared and characterized from different metal nitrates and fuels by solution combustion method. Other new combustion techniques like microwave and furnace combustion should also be tried.
- ✓ The detailed study of additional experimental parameters have to be done which have significant effect on the nanomaterial properties such as different temperature treatment and in various other atmospheres and important characterizations like TERS and FTIR should be carried out for future research.
- ✓ Since the prepared Ag NPs are showing good enhancement property, further researches have to be done with different organic molecules with varying concentrations and these properties should be taken to several applications like dye synthesize, solar cells, biosensors and in bio medical field. Its antimicrobial activity should also be tried.