CHAPTER-7

SUMMARY AND FUTURE SCOPE

7.1 SUMMARY

A surface deposition treatment like electroless Ni–P deposition, which is known for its use in a wide range of engineering applications owing to many advantages, including low cost and good wear resistance, may improve the antibacterial activity and physical properties of stainless steel biomedical devices. However, it is still anticipated that new opportunities for the use of electroless nickel coatings will become evident to those not already familiar with their wide range of properties, thereby promoting growth within the industry. In the present study we have developed Ni-P-ZnO composite coatings and the results of the study have been summarized here:

1. ZnO powder was synthesized by different methods including autocombustion method, sol-gel method, and by mechanical milling route. The advantages of autocombustion method over others including the good yield of the powder ease of the method, less contamination and cheap chemical used. Therefore, we used autocombustion method for the present study. The synthesized powder was well characterized by XRD, FESEM-EDAX, AAS, AFM, TEM etc.

2. Ni-P-ZnO coatings were developed successfully by incorporation of ZnO powder (i. commercially available ZnO powder (~ 20 µm) and, ii. synthesized ZnO by autocombustion method (30-100 nm). Uniform and grayish bright Ni-P-ZnO composite coatings on mild steel substrates were observed. The coatings were heat treated to attain crystalline nature of coatings which improves the mechanical properties of the coatings. The electroless Ni-P-ZnO coatings exhibit good adherence on the mild steel and glass substrate. For the as-coated Ni-P-ZnO coatings the results of chemical composition obtained by FESEM-EDAX suggest that the particles of ZnO are codeposited in the Ni–P matrix uniformly on the surface with some agglomeration. Zn in the localized region is found to be about 4.5 wt %. The optimum concentration evaluated for the second phase particles for the study is 5 g/l.

3. AFM study reveals that the nodule size had increased with increase in incorporation of second phase particle in the deposit compared to plain Ni–P deposit.
4. XRD studies revealed that composite coatings are having Ni(200) and (220) peaks apart from high intensity Ni(111) peak. However, the intensity of ZnO peaks is slightly less due to the smaller concentration of ZnO particles into the matrix. This also suggests the incorporation of ZnO into the matrix.

5. Improvement in microhardness values was observed for Ni-P-ZnO nanocomposite coatings.

6. In NaCl solution, the corrosion resistance property of electroless Ni–P coating is improved by the incorporation of ZnO particles, which is evidenced by the higher OCP value occur for Ni-P-ZnO coating. On increasing the concentration of ZnO powder in the coatings corrosion resistance property of further improved because of the increased thickness of composite coating with the incorporation of ZnO nanoparticles into the Ni-P matrix, which is evidenced from the SEM micrographs. In other words, it decreases the electrochemically active area on the surface of the substrate and thus decreases the corrosion rate.

7. Antibacterial activity of ZnO powder, Ni-P and Ni-P-ZnO coated substrate has been carried out. The results obtained for Ni-P coated ZnO powder are clearly shown zone of inhibition. However, for Ni-P-ZnO coated mild steel substrate no growth of bacteria was observed on the plate but zone of inhibition was not clearly seen.
7.2 SCOPE FOR FUTURE WORK

1. In the present study the Ni-P-ZnO coatings are developed and optimized and incorporation of doped ZnO and other doped particles can be added to the bath to developed coatings with improved and novel properties as very less number of reports are available on dopped second phase particles.

2. The coatings in the present study are developed by conventional method, i.e., introducing the second phase particles to the bath. These coatings show improved properties and microstructures when second phase particles developed inside the bath. So in-situ coatings can be done and can be studied for their properties.

3. From the present study it has been concluded that the developed coating when used for commercial application can provide better adhesion with good hardness on the substrate surface and provide corrosion resistance properties. These coatings also resist the adhesion of microbes on the coated surface. Therefore, these coatings have better future but more experiment in the field need to be done for their commercial applications.