Chapter 3

Aims and Objectives of the Present Work

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The aims and objectives of present investigations are focused on the preparation and characterization of Fe-Al_2O_3, CoO and CeO_2 doped Fe-Al_2O_3 and Fe-Al_2O_3-ZrO_2 hybrid metal matrix nanocomposite specimens. On the basis of the results of the initial work [Gupta (2011)] a detailed work plan was prepared to explore the optimum composition and processing parameters for development of Fe – Al_2O_3 Metal Matrix Nanocomposites with good mechanical, erosive and corrosive properties. The characteristics of materials also depend on doping them with suitable dopants and additives as secondary phases. Therefore, in order to investigate the effect of doping we have selected one transition metal oxide CoO and one rare earth oxide CeO_2 to selected compositions of Fe-Al_2O_3 nanocomposite. These compositions were processed with optimum sintering schedule to study the effect of doping on mechanical and electrochemical behavior. Similarly, to investigate the effect of addition of secondary ceramic reinforcement, we investigated Fe-Al_2O_3-ZrO_2 hybrid metal matrix nanocomposite to study the effect of composition and processing parameter on structural and mechanical behavior.

The aims and objectives of the present work are as follows:

Preparation

- To synthesize Fe-Al_2O_3 metal matrix nanocomposite system using varying amounts (5-30 wt %) of aluminium oxide and sintering in an argon atmosphere in the temperature range 900°C-1100°C for 1-3h.
- To synthesize CoO and CeO_2 doped Fe-Al_2O_3 (10 wt% Al_2O_3) metal matrix nanocomposite system by sintering in an argon atmosphere at 1100°C for 1h.
- To synthesize Fe-Al_2O_3-ZrO_2 hybrid metal matrix nanocomposites with (i) 2.5% ZrO_2+2.5% Al_2O_3 and (ii) 3.5% ZrO_2 + 1.5% Al_2O_3 and sintering these in argon atmosphere in the temperature range 900°C-1100°C for 1-3h.

Physical Characterization

- To determine the density of the specimens sintered under different conditions and study their densification behavior.
- To determine the density of deformed specimens and study its variation under different deformation conditions.

Structural Characterization

- To determine the phases in different specimens using X-Ray Diffraction and study the effect of composition and processing parameters on the development of phases during sintering in Fe-Al_2O_3 composites.
- To determine the phases in different corroded specimens using X-Ray Diffraction and understand the effect of corrosion on the phase formation.
- To determine the microstructure using Scanning Electron Microscope and study the effect of composition and processing parameters on development of microstructure of the composites.
- To determine the composition of the specimens as a whole or different regions of the microstructure using energy dispersive spectroscopy studies of the synthesized nanocomposite specimens.
- To study the microstructure of the worn surface of the nanocomposite specimen in order to determine its wear mechanism.
- To study the microstructure of the corroded specimens in order to determine morphology of the particles after corrosion.

Mechanical Characterization

- To study the effect of composition and processing parameters on the mechanical characteristics of the composites.
- To measure the hardness of the nanocomposite specimens using Rockwell Hardness tester.
- To measure the wear rate at different loads to study the wear mechanism taking place in these nanocomposite specimens.

- To study the effect of height/diameter ratio and interfacial frictional conditions on the deformation characteristics of the Fe-5%Al_2O_3 nanocomposite specimens.

Electrochemical Characterization

- To study the corrosion behavior of the synthesized Fe-Al_2O_3, CoO and CeO_2 doped Fe-Al_2O_3 nanocomposite specimens and to study the effect of doping and processing parameters on the corrosion behavior.

The next chapter 4 will discuss about the various synthesis and characterization methods undertaken in the present thesis.