Chapter - 7

CONCLUSIONS

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7.1 Conclusions

On the basis of important and interesting observations obtained from the synthesis of TiC powder from ilmenite concentrate, preparation and characterization of TiC reinforced Aluminium and polymer matrix composites following major conclusions have been drawn.

It has been possible to synthesize TiC powders directly from ilmenite concentrate by the carbothermal reduction process by using a DC extended arc thermal plasma reactor. Ilmenite is considered as a low cost, natural raw material which is abundantly available in India. Thermal plasma processing provides very high processing temperature within a short period of time which reduces the reaction time considerably. The carbothermal reduction of ilmenite and activated carbon results in the formation of Fe–TiC composites in which globular TiC particles are embedded in the iron matrix. 20 minutes thermal plasma treated time is considered as the optimized period for synthesis of TiC from ilmenite concentrate. For preparation of TiC powder, grinding followed by acid leaching is adopted to remove iron from the Fe-TiC composite. The particle size distribution shows that the synthesized TiC powders have an average particle size in the order of 10 μm. The TiC powders obtained from this experimental technique are very much comparable to the commercial TiC powder.

Al-TiC composite has been developed by using TiC powder prepared by plasma processing route as reinforcement. The Al-based MMCs have been produced by powder metallurgy method. Microstructural examination shows a uniform distribution of TiC particulates in the Al matrix with small amount of micro porosity. The composite sample shows encouraging room temperature mechanical properties with improved young's modulus over that of the pure Al matrix. Vickers hardness values have been increased from the matrix to the composites. The compressive strength increases from 85 MPa for pure Al to about 320 and 360 MPa with 5 and 20 Vol.% of reinforcement, respectively. Similarly, the Young's modulus also increases with addition of the TiC reinforcement of about 70 GPa for pure Al to 78 and 89 GPa for the composites with 5 and 20 Vol.% of reinforcement, respectively. Hence, Al–TiC composites prepared by this method are suitable for structural and industrial applications, like other Al based MMCs.

Successful fabrication of multi-component hybrid Glass-Epoxy composites with reinforcement of TiC prepared by plasma processing route has been possible. The polymer matrix composite is prepared by hand lay-up method which is a simple and less expensive method for composite production. With the incorporation of filler particulates into the composites, the mean hardness has been improved from 29 Hv for composite with 0 % TiC to 53 Hv for composite with 20% TiC. These composites have adequate potential for applications in highly erosive environments. The erosion wear performance of the composites shows significant improvement with the addition of TiC filler. Among all the factors, impact velocity is the most significant factor followed by TiC percentage and impingement angle, while the erodent size has the least significance on erosion rate. The presence of particulate fillers (Titanium carbide) in these composites improves their erosion wear resistance and this improvement depends on the weight content of the filler.

7.2 Future scope of work

The present research work leaves a wide scope for future investigators to explore many other aspects of Titanium carbide reinforced composites. Some recommendations for future research include:

- *Study of metal matrix composites by reinforcing TiC in other metal matrices and their properties can be compared with Al – TiC composites.*
- *Study of polymer matrix composites by reinforcing TiC in other polymer matrices and their properties can be compared with Glass-Epoxy – TiC composites.*
- *The possible use of TiC as reinforcement in ceramic matrix like Al_2O_3 to form ceramic matrix composites that can be used for cutting tools.*
- *Study of TiC as reinforcement for wear resistant coatings on various substrates.*