Concluding Remarks

Light-metal matrix nanocomposites are promising materials to replace conventional metal alloys and their metal matrix composites (with micron-size reinforcements) particularly for applications wherein specific strength, high temperature microstructural and mechanical stability, wear resistance and retention of ductility are critical. While Al- and Mg- based nanocomposites can be produced by both via liquid-state and solid-state processes, in this book a detailed report on those produced using liquid-state processing have been presented. Liquid-state processing methods are simple, cost-effective and have high degree of process flexibility when compared to solid-state processes. This book highlights the fact that most of the liquid-state processes used for composites with micron-size reinforcements can also be adopted for making nanocomposites. Considering that uniform dispersion of nano reinforcements devoid of agglomeration/clustering is the major requirement to achieve high quality nanocomposites, various intermediary processes have been utilised to bring forth efficient incorporation of the reinforcements. Ultrasonic cavitation, effective stirring followed by disintegration of the melt using bottom pouring or pre-mixing of reinforcement elements have proved to be effective as to obtain uniform dispersion. Alternative methods such as friction stir process and various semi-solid processing methods have also been investigated, although the studies are in the infant stage.

The Al- and Mg- based nanocomposites reported in this book have been discussed in terms of their microstructural and mechanical properties (hardness, tensile and compressive). Microstructural studies reveal that in most cases, the processes employed have successfully resulted in uniform dispersion of nano reinforcements with minimum porosity. The nanoscale reinforcements have also been successful in obtaining fine, equi-axed matrix grains. Mechanical properties evaluation highlights that in most cases, the nano reinforcements exactly perform the role that they were selected for in the first instance, i.e. production of composites with significantly high yield point with retention/enhancement of ductility, which gives rise to higher toughness. The absence of these critical properties had been the major drawback in conventional micron-sized reinforced metal matrix composites. The microstructural characteristics and the occurrence of prominent yield/ductility are strongly dependent on the volume/weight fraction and the process parameters. The improvement

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in mechanical properties, viz, hardness, yield and ultimate strength and ductility are usually governed by strengthening mechanisms such as the Hall-Petch effect, Orowan strengthening, load-bearing capacity and increased dislocation density due to matrix/reinforcement CTE mismatch, brought forth by the addition of nano reinforcements. While this is true for cast Al- and Mg- nanocomposites, in wrought Mg-nanocomposites, texture modification effects also play a dominant and additive role in defining the strengthening/deformation characteristics.

In this book, several topics that can provide impetus for future research have also been addressed. It was stressed the need to investigate other properties such as fatigue, wear, corrosion and oxidation behaviour, as the studies pertaining to these critical, industrial application-oriented properties are meagre. Likewise, the requirement to study products other than castings/extrusions of nanocomposites such as rolling, sheet metal, forgings is mentioned. While most of the discussed processes are very suitable and robust in producing nanocomposites at the laboratory scale, the need to translate these processes towards industrial-scale and component-level production are emphasized by examining the various requirements that should be met during such translation. A brief remark has also been made on the importance of nanocomposite recycling.

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