ABSTRACT

Great attention is required to produce materials with lightweight, high-specific strength, corrosion-resistance, high-temperature strength, wear-resistance, etc. Materials research can be done effectively through the material paradigm, which helps to identify the new materials pertaining to achieving the demands of new challenges in technologies. In recent days, many researchers are working to improve the properties of light weight metals like aluminium, magnesium, titanium, etc. The magnesium is the lightest metal in the metal family. Magnesium provides an excellent affinity to bond with reinforcing ceramic materials (either continuous or discontinuous) in metal matrix composites. The present world needs the use of magnesium for manufacturing engineering components to meet out the reduction of weight. Magnesium matrix composites have many applications, especially in the automotive and aerospace industries, due to their superior specific properties.

There is a growing interest in magnesium and its alloys, which are rising as promising structural materials for lightweight constructions. Consequently, the need to optimize their processing conditions, this work could be very useful to the community. The ceramic particle reinforced composite have offered excellent mechanical properties like specific stiffness, abrasive wear resistance and strength.

The main objective of this work is to study the dry sliding wear behavior and hot workability of a magnesium matrix composite reinforced with Zinc-Oxide nano-particles. A magnesium matrix composite with 0.5 vol. % ZnO nano-reinforcement was prepared using powder metallurgy and was hot-extruded to eliminate pores. Wear behavior of the Mg/ZnO nano-composite was investigated by conducting dry sliding wear test as a function
of wear with an oil-hardened non-shrinking steel (OHNS) disc as the counterpart on a pin-on-disc apparatus. Wear tests were conducted for normal loads of 5, 7.5 and 10 N at sliding velocities of 0.6, 0.9 and 1.2 m/s at room temperature. The variations of the friction coefficients and wear rates with the sliding distances (500, 1000 and 1600 m) for different normal loads and sliding velocities were plotted and analyzed. To study the dominant sliding wear mechanism for various test conditions, the worn surfaces were analyzed using scanning electron microscopy. The wear rate increased the increase in load and sliding velocity.

The processing map for Zinc-Oxide (ZnO) reinforced magnesium (Mg) nano-composite has been investigated by the hot deformation process. The extruded nano-composite preforms of Mg-0.5 vol. %ZnO were deformed by applying a compressive force at the constant temperatures of 250, 300, 350 and 400°C. The hot deformation behavior of composite was studied for four strain rates, namely 0.01, 0.1, 1 and 1.5 s⁻¹. The flow stress, true strain, strain rate sensitivity, instability strains, efficiency of power dissipation and activation energy were calculated based on the engineering stress and strain data. Deformed composites structures were analysed using images of transmission electron microscopy (TEM) and scanning electron microscopy (SEM). The nano-composite processing map was used to identify the deformation mechanism of dynamic recrystallization (DRX), instability regions and dynamic recovery (DRY). The region was having a strain rate of 0.01s⁻¹ at the temperature of 400°C for the best hot working of composites. The instability domains were noted at a higher strain rate and lower temperatures. The magnesium reinforced with nano-zinc oxide particle metal matrix composite properties such as wear and hot deformation were studied. It was observed that the composite can be effectively used for structural applications.