

Research Article

Thermal Analysis of Ni-Cu Alloy Nanocomposites Processed by Sand Mold Casting

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Ni-Cu based alloy metal matrix nanocomposites are in great demand for advanced technological applications due to their high temperature, strength, and better thermal properties. The aim is to investigate the thermal conductivity and coefficient of thermal expansion of the nickel based alloy nanocomposites reinforced with titanium dioxide (TiO₂) which varies from 3 to 12 weight % nanoparticles (45 to 60 nm). The thermal conductivity was measured using a comparative cut bar method (ASTM E1225), and thermal expansion was analyzed using a push-rod dilatometer method (ASTM E228). From experimentation, it was observed that thermal conductivity of the nanocomposites activity increases with inclusion of the nanoparticles up to 9 weight % after descent due to the temperature effects in nanocomposites, and thermal expansion of the nanocomposites decreases with addition of the nanoparticles up to 9 weight % and further rises marginally due to ductility of composites. Due to the incorporation of hard ceramic particles into the matrix, the composites' thermal conductivity increases to 57.42 W/m °C, and their thermal expansion decreases to 12 × 10⁻⁶. Nickel alloys are widely used in marine, automotive, valve, pump, and aircraft applications.

1. Introduction

Nickel (Ni) has made significant contributions in its elementary form with other materials and promises to provide materials for a much more demanding future. Nickel is a multifaceted metal with a variety of other metals. Nickel alloys are employed in different applications due to their ability to withstand harsh working conditions such as high

temperatures, corrosion, wear, strength, intense friction, metallurgical durability, solderability, and strength. The high corrosion and heat resistance are required in most applications, such as aircraft applications, nuclear power systems, and automotive and petrochemical exhaust valves [1–5]. As composite prices come down and design suppleness improves, particle reinforced composites like hard ceramic particulates and fiber reinforced composites like fiberglass

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