Investigation on microstructure and hardness of nickel-alumina functionally graded material

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ABSTRACT

In this research study, six-layered nickel-alumina (Ni-Al2O3) functionally graded material (FGM) was prepared using powder metallurgy (PM) method. The objectives of this study were to investigate the microstructure and hardness of the graded composite layer by layer. Using a cylindrical steel die, the six-layered nickel-alumina graded structure was fabricated considering 0%, 20%, 40%, 60%, 80% and 100% weight percentage of ceramic concentration for different layers. A hydraulic press was used for fabrication of the FGM layered structure and 30 ton compaction load was applied. Considering two-step sintering cycle, sintering was carried out at sintering temperature 1200 °C and sintering time 4 h. The sintered specimens were characterized using optical microscopy (OM), scanning electron microscopy (SEM) and hardness testing. It was observed that uniform particle distribution within the graded layers and smooth microstructural transition occurred between adjacent layers. It was also observed that the interface lines are obvious, less wavy, straight and parallel which confirms proper layer stacking process. On the other hand, from the SEM micrographs, the existence of microcracks and voids are identified in the alumina-rich layer and mostly around alumina particles.

KEYWORDS

Functionally graded material; Hardness; Microstructure; Nickel-alumina; Powder Metallurgy

ACKNOWLEDGEMENTS

This research work was performed under the IRGS/012017/009 grant and the authors are grateful to DRB-HICOM University of Automotive Malaysia for the financial support. The authors also acknowledge the assistance by the technical staffs of the faculty of manufacturing engineering, University Malaysia Pahang (UMP).