Characterization of Mechanical and Wear Properties of AA6061 / MgO and BN Hybrid Nano Composites

U. Srikanth

M. Tech (AMS), Roll No.:21011D3310, Department of Mechanical Engineering, JNTUH College of Engineering, Science & Technology, Hyderabad

Under the Guidance of Dr. A. Chennakesava Reddy, Senior Professor, JNT University Hyderabad

ABSTRACT

In recent times, metal matrix composites have gathered significant attention due to their excellent characteristics, including notable wear resistance, lightweight design, high stiffness, and good strength-to-weight ratio. These composites, enhanced with robust ceramic particles, find applications across diverse sectors such as aerospace, automotive, energy, defence, engineering, and biotechnology. The exercising of stir casting, a nanoparticle synthesis method, plays a major role in refining the properties of the base material. This includes improvements in wear resistance, mechanical strength, damping, and the prevention of grouping. Incorporating of these advanced materials and fusion techniques underscores the versatility and widespread applicability of metal matrix composites in various industries.

This study focuses on investigating AA6061/BN/MgO composites, where aluminium alloy is reinforced with Boron Nitride (BN) and Magnesium oxide (MgO), using the stir casting process. The goal is to identify optimal parameter values for enhanced mechanical and tribological properties. AA6061 is the chosen matrix material, and weight percentages of BN and MgO are added by varying proportions.

In the fabrication process, stirring parameters are taken as speed of 500 RPM for 10 minutes of time, then after the molten metal is poured into the preheated die at 700°C. This technique will lead to the elimination of oxides and material separation within the composites.

For evaluating mechanical and tribological properties of reinforced composites. tensile test, wear test, Rockwell hardness and impact test were conducted. The results will indicate an improvement in the tribological and mechanical properties with the variation in wt. percentage of reinforcement materials. GRA (Grey Relation Analysis), an optimization technique is used to optimize the process parameters.

CONCLUSION

1. Incorporating the BN + MgO with AA606l of (0+2)%, (1+3)%, (2+4)%. (3+l)% eight resulted in high hardness. The observed enhancement in the material's properties can be assigned to the uniform separation and increased hardness of the reinforcing particles, specifically Boron Nitride (BN) and Magnesium Oxide (MgO). Among the composites the AA606I with 1%BN and 3%MgO exhibited the highest hardness measuring at 7l .33 RHN at

stirring speed of 500 RPM.

2. The findings indicate that introducing BN + MgO of (1+3)%, (2+4)%. (4+2)% wt. to e matrix metal led to improve in the tensile test comparing to the base metal. Furthermore, the other composition of BN + MgO percentage resulted in a corresponding decrease in the ultimate tensile strength of the metal matrix composites. Notably, BN + MgO of (4+2)% wt. exhibited a noteworthy tensile strength value of 145.812 MPa during stirring at l0 RPM for l0 minutes.

3. Investigation revealed that the composites containing (l+3)%, - (2+4)%, (3+1)% wt of reinforcements to the base metal have high energy absorption capacity. Notably the AA606l with 1% BN wt and 3% MgO wt exhibited substantial impact strength of 82J at stirring conditions of 500 RPM for l0 minutes.

4. Among the samples in this study. those reinforced with (l+3)%, (2+4)%, (3+l)% wt. of BN + MgO with matrix metal exhibited enhanced wear resistance in comparison to the base alloy and other samples.

REFERENCES

1. A. C. Reddy, Effect of Porosity Formation during Synthesis of Cast AA4015/Titanium Nitride Particle-Metal Matrix Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, pp. 139-143, 2006.

2. A. C. Reddy, Stir Casting Process on Porosity Development and Micromechanical Properties of AA5050/Titanium Oxide Metal Matrix Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, pp. 144-148, 2006.

3. A. C. Reddy, Investigation of the Clustering Behavior of Titanium Diboride Particles in TiB2/AA2024 Alloy Metal Matrix Composites, 4th International Conference on Composite Materials and Characterization, Hyderabad, pp. 216-220, 2003.

4. A. C. Reddy, Effect of Clustering Induced Porosity on Micromechanical Properties of AA6061/Titanium Oxide Particulate Metal matrix Composites, 6th International Conference on Composite Materials and Characterization, Hyderabad, pp. 149-154, 2007.

5. A. C. Reddy, Finite Element Analysis Study of Micromechanical Clustering Characteristics of Graphite/AA7020 Alloy Particle Reinforced Composites, 4th International Conference on Composite Materials and Characterization, Hyderabad, pp. 206-210, 2003.

6. A. C. Reddy, Wear and Mechanical Behavior of Bottom-Up Poured AA4015/Graphite Particle-Reinforced Metal Matrix Composites, 6th National Conference on Materials and Manufacturing Processes, Hyderabad, pp. 120-126, 2008.

7. K. Shiva Kumar, A. C. Reddy, Mechanical and Tribological Behavior of Particulate Filled Silicon Nitride Reinforced Nylon-6 Polymer Composites, International Journal of Rngineering and Advanced Technology, vol.8, No. 6, 2019.