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# A COMPREHENSIVE INVESTIGATION AND MECHANICAL CHARACTERIZATION OF ALUMINUM-BASED METAL MATRIX COMPOSITES REINFORCED WITH BORON NITRATE AND COPPER SULPHATE FOR ENHANCED AEROSPACE APPLICATIONS

**Abstract**

Aluminum and its composites have evolved as one of the most highly regarded materials in the space industry due to their unique mechanical characteristics, such as high strength-to-weight ratio, low density, and exceptional corrosion resistance. The mechanical behavior of three metal matrix composites made using the stir-casting method has been thoroughly examined in this work. These composites are made of 95 percent aluminium and 5 percent boron nitrate, 5 percent copper sulphate, and with a combination of 2.5 percent boron nitrate and 2.5 percent copper sulphate. To achieve genuine and accurate findings, the mechanical characteristics of the composites were assessed using strict ASTM standards of testing.

Under different loading circumstances, the study concentrated on significant metrics like tensile strength, impact resistance, hardness,elongation, etc... In order to recreate the extreme conditions that aerospace constructions must withstand, the impact resistance of the composites was also investigated at temperatures both below and above absolute zero. The study's objective was to enhance the mechanical performance of the developed composites, particularly for use in significant aeronautical structures.

The composite containing 5 percent copper sulphate displayed the best overall mechanical performance, according to the data. This behaviour was strongly linked to the inclusion of copper sulphate particles, which increased the composite's performance by increasing its resistance to varied loading situations. The composite incorporating the combination of boron nitrate and copper sulphate demonstrated an optimum improvement in overall mechanical behavior, as the presence of copper sulphate nanoparticles improved the resistance to external loading while the presence of boron nitrate generated additional mechanical, chemical, and thermal stability to the composite matrix.

The research's findings show that the fabricated aerospace-grade aluminium composites' mechanical characteristics have significantly improved. The results offer insightful information on the development and mechanical behaviour of these composite materials, which may help to improve their performance for certain aerospace applications in the future. The study's highly technical and complex methodology guarantees that the conclusions are precise and can potentially be utilized as a framework for additional research to significantly contribute to this ever-growing field of space science.