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GYROID STRUCTURE: IMPACT OF FILL VARIATION ON MECHANICAL PROPERTIES

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Abstract - Nature has always been a primary source of inspiration for humans. Among the elements that have aroused the interest of the scientific community, triple periodic minimal surfaces (TPMS) stand out, observed, for example, in the shape of balsa wood cells [1]. Among these geometries, the gyroid stands out for combining lightness, high porosity, and remarkable mechanical properties, characteristics that have favored its widespread application in additive manufacturing. In this context, the present work, based on a literature review of the applications of cellular structures such as the gyroid, aimed to evaluate the impact of filling on the mechanical properties of the materials studied, gathering and analyzing information from the most recent studies available.

As a result of the research analyzed, the gyroid demonstrated high versatility, being applied in porous carbon structures, in the formation of ceramic-based composites, and in the production of scaffolds for cell and tissue growth. This geometry enabled the auxetic behavior of the materials, characterized by their ability to withstand large compressive deformations without fracturing [2, 3]. Additionally, it proved effective in forming bone substitutes, demonstrating excellent load-bearing capacity and deformability, while also promoting compatibility between different materials due to its high interconnectivity and porosity [4]. This cellular structure also demonstrated superior performance in flexural tests for high filling levels (approximately 80%), distinguishing itself for its near isotropy and high energy dissipation capacity, which makes it suitable for applications that require multidirectional resistance [5]. In polymeric materials, the use of gyroids has contributed to the production of parts that are more resistant to shear and bending, with an emphasis on their adaptation according to the direction of the applied load, thereby improving the relationship between strength and lightness in industrial and biomedical applications [6].

References

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