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Gyroid structures with topology-optimised mechanical properties designed by simulations

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Triple periodic minimal surfaces can be approximated to three-dimensional cell structures, which are found in many forms in nature, such as on butterfly wings or on the skeletal plate of a sea urchin. The structures are representable by a mathematical periodic function. For sheet-based structures, the result is two disjoint, intertwined channels with a uniformly curved surface. The three most common sheet-based structures are D-gyroids, Schwartz diamonds, and Schwartz primitive structures.
The three-dimensional regular periodic structure makes them attractive for various research areas, such as in the medical field for tissue engineering or as a possible heat exchanger, due to their high surface to volume ratio, bionic and mechanical properties.
In this work, the sheet-based gyroid structures with different porosity-levels are topology optimized with respect to their mechanical stability at constant volume using the inhouse micro structure simulation framework "Pace3D". The optimized structures and the original structures are simulated and compared with respect to their mechanics in the linear-elastic range, and other properties such as the surface-to-volume ratio are also investigated.
Simulations of mechanical load in the linear elastic regime are carried out on both the optimized as well as the original structures and the mechanical properties are compared. Furthermore, micro structure characteristics such as the surface-to-volume ratios are evaluated.

Participation

In-Person

References

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