

Claims

What is claimed is:

Claim 1. An article of manufacture comprising a trabecular bone-inspired lattice, the trabecular bone-inspired lattice comprising

a plurality of plates, wherein each plate comprises a ribbon structure comprising a length, width and thickness and having a predominant axis; and

a plurality of rods, wherein each rod comprises an elongated structure and wherein the plurality of rods interconnects the plates with one another.

Claim 2. The trabecular bone-inspired lattice of Claim 1, wherein

the width of the plate is between 2 and 50 times its thickness; and

the length of the plate is between 2 and 100 times the width of the plate.

Claim 3. The trabecular bone-inspired lattice of Claim 1, wherein

the plate comprises an elongated rectangle.

Claim 4. The trabecular bone-inspired lattice of Claim 1, wherein

the plate comprises an elongated, irregular structure.

Claim 5. The trabecular bone-inspired lattice of Claim 1, wherein

the plates comprise a ribbed, concave, or convex surface.

Claim 6. The trabecular bone-inspired lattice of Claim 1, wherein
the plate is twisted or helical.

Claim 7. The trabecular bone-inspired lattice of Claim 1, wherein
the rods are flat, square, circular, or irregular.

Claim 8. The trabecular bone-inspired lattice of Claim 1, wherein
40%, to 90% of the plates align along a predominant axis.

Claim 9. The trabecular bone-inspired lattice of Claim 1, wherein
different subsets of the plates align along two or more predominant axes.

Claim 10. The trabecular bone-inspired lattice of Claim 1, wherein
the trabecular bone-inspired lattice is surrounded by a cage comprising a shell or
lattice.

Claim 11. The trabecular bone-inspired lattice of Claim 1, wherein
the volume of the lattice comprises one or more localized volumes of an increased
measure of mechanical strength, relative to the average mechanical strength measured
over the volume of the trabecular bone-inspired lattice.

Claim 12. The trabecular bone-inspired lattice of Claim 11, wherein

one or more localized volumes of an increased measure of mechanical strength comprises one or more features selected from an increased width and/or thickness of plates, increased density of rods, increased width, thickness, and/or diameter of rods, and increased alignment of plates.

Claim 13. The trabecular bone-inspired lattice of Claim 1, wherein

the structural model index of the lattice is between 0.5 and 3.5.

Claim 14. The trabecular bone-inspired lattice of Claim 1, wherein

wherein the ellipsoid factor is between -0.5 and 0.5

Claim 15. The trabecular bone-inspired lattice of Claim 1, wherein

the degree of anisotropy is between 0.5 and 3.0.

Claim 16. The trabecular bone-inspired lattice of Claim 1, wherein

the lattice comprises a replica of a trabecular bone structure.

Claim 17. The trabecular bone-inspired lattice of Claim 16, wherein

the source bone on which the replica is based comprises bone having a predominant axis of mechanical stress.

Claim 18. The trabecular bone-inspired lattice of Claim 1, wherein

the lattice is made by additive manufacturing.

Claim 19. The trabecular bone-inspired lattice of Claim 1, wherein

the lattice comprises a material selected from stainless steel, titanium, aluminum, copper, cobalt chrome, PEEK, ultrahigh molecular weight polyethelene, polyphenylsulfones, polyetheramide materials, polylactic acid, nylons, polymeric material coated with metal, and woven carbon fiber reinforced plastics.

Claim 20. An implant for facilitating fusion of two bony structures, comprising

a trabecular bone-inspired lattice of any of Claims 1-19.

Claim 21. The implant of Claim 20, wherein

the implant is a posterior lumbar interbody fusion implant.

Claim 22. The implant of Claim 21, wherein

the implant is an implant sized and shaped for a fusion selected from the group consisting of a transforaminal lumbar interbody fusion, anterior lumbar interbody fusion, and lateral lumbar interbody fusion.

Claim 23. The implant of Claim 20, wherein

the trabecular bone-inspired lattice is surrounded by a ring of solid material.

Claim 24. The implant of Claim 20, wherein

the intra-lattice space is packed with bone graft material.

Claim 25. The implant of Claim 19, wherein the trabecular bone-inspired lattice comprises a trabecular bone replica.

Claim 26. The implant of Claim 25, wherein the trabecular bone replica comprises a predominant axis of mechanical strength.

Claim 27. The implant of Claim 26, wherein the trabecular bone replica is configured to be deployed such that the predominant axis of mechanical strength is aligned with the predominant axis of stress to which the implant will be subjected.

Claim 28. A method of fusing two bony structures, comprising

placement an implant comprising a trabecular bone-inspired lattice of any of Claims 1-18 between and in contact with the two bony structures.

Claim 29. The posterior lumbar interbody fusion implant of Claim 21, comprising

a groove, wherein the groove bisects the implant along a longitudinal equatorial plane and wherein one or more bridging regions of material connect the halves of the implant body bisected by the groove.

Claim 30. A posterior lumbar interbody fusion implant, comprising

a posterior slope, wherein the slope begins in the posterior portion of the interbody device, at least 25% from the posterior edge and at least a 30-degree slope and less than a 90-degree slope relative to the inferior surface.

Claim 31. An implant comprising,

a graft window comprising a trabecular bone inspired lattice; and
one or more windows, the window comprising a hollow channel that spans an axis of the implant.

Claim 32. An object, comprising

an object selected from the group consisting of personal protective gear, an automobile bumper, a vehicle body, an automobile radiator, and armor; and

wherein the object comprise a trabecular-bone inspired lattice of any of Claims 1-19.

Claim 33. The object of Claim 32, wherein

the trabecular bone-inspired lattice is an anisotropic lattice having one or more predominant axes of mechanical strength.