Claims

What is claimed is:

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

the predominant axis of each plate is aligned with a predominant axis of stress which the article of manufacture will be subjected, and wherein

the TBI lattice is surrounded by a cage or shell, or the TBI lattice is self-supporting whereby terminal ends of the plurality of plates are not connected to shared structures.

Claim 2. The article of manufacture of Claim 1, wherein

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

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

Claim 3. The article of manufacture of Claim 1, wherein

each plate comprises an elongated rectangle.

Claim 4. The article of manufacture of Claim 1, wherein

each plate comprises an elongated, irregular structure.

Claim 5. The article of manufacture of Claim 1, wherein

each plate comprises a ribbed, concave, or convex surface.

Claim 6. The article of manufacture of Claim 1, wherein

each plate is twisted or helical.

Claim 7. The article of manufacture of Claim 1, wherein

each rod is flat, square, circular, or irregular.

Claim 8. The article of manufacture of Claim 1, wherein

40% to 90% of the plurality of plates align along one predominant axis of stress which the article of manufacture will be subjected.

Claim 9. The article of manufacture of Claim 1, wherein

different subsets of the plurality of plates align along two or more predominant axes of stress which the article of manufacture will be subjected.

Claim 10. The article of manufacture of Claim 1, wherein

the terminal ends of the plurality of plates in the TBI lattice are attached to the cage or shell that encircles the TBI lattice.

Claim 11. The article of manufacture of Claim 1, wherein

the TBI lattice comprises one or more localized regions of an increased measure of mechanical strength, relative to the average mechanical strength measured over the whole TBI lattice.

Claim 12. The article of manufacture of Claim 11, wherein

the one or more localized regions 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 the plurality of plates.

Claim 13. The article of manufacture of Claim 1, wherein

the TBI lattice has a structural model index between 0.5 and 3.5.

Claim 14. The article of manufacture of Claim 1, wherein

the TBI lattice has an ellipsoid factor between -0.5 and 0.5.

Claim 15. The article of manufacture of Claim 1, wherein

the TBI lattice has a degree of anisotropy between 0.5 and 3.0.

Claim 16. The article of manufacture of Claim 1, wherein

the TBI lattice comprises a replica of a trabecular bone structure.

Claim 17. The article of manufacture 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 article of manufacture of Claim 1, wherein

the TBI lattice is made by additive manufacturing.

Claim 19. The article of manufacture of Claim 1, wherein

the TBI 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. The article of manufacture of any of Claims 1 to 19 selected from a group consisting of a personal protective gear, an automobile bumper, a vehicle body, an automobile radiator, and armor.

Claim 21. An implant for facilitating fusion of two bony structures, comprising a trabecular bone-inspired (TBI) lattice, the TBI 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 plurality of plates with one another, wherein

the predominant axis of each plate is aligned with a predominant axis of stress which the implant will be subjected, and wherein

the TBI lattice is surrounded by a cage or shell, or the TBI lattice is self-supporting whereby terminal ends of the plurality of plates are not connected to shared structures; and wherein an intra-lattice space is packed with bone graft material.

Claim 22. The implant of Claim 21, wherein

the implant is a posterior lumbar interbody fusion implant.

Claim 23. The implant of Claim 22, wherein

the implant is 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 24. The implant of Claim 21, wherein

the TBI lattice is surrounded by a ring of solid material.

Claim 25. The implant of Claim 21, wherein

the TBI 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. The implant of any of Claims 21-27, wherein

the implant is configured to be placed between and in contact with the two bony structures.

Claim 29. The implant of Claim 22, further comprising

a groove, wherein the groove comprises a hollow portion that 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. The implant of Claim 22, further comprising

a posterior slope, wherein the slope begins in the posterior portion of the implant, 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. The implant of any one of Claims 21-30, further comprising,

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

Claim 32. The implant of Claim 21, wherein

the implant is an osteotomy implant.