

Claims

- [Claim 1] A method of producing an osteoinductive bone regeneration material formed of a plurality of electrospun biodegradable fibers, comprising: preparing a fibrous scaffold material formed of the plurality of electrospun biodegradable fibers, wherein the plurality of electrospun biodegradable fibers are 40-320 μm in diameter and 5-20mm in length, wherein the plurality of electrospun biodegradable fibers entangle with each other to form a cotton-wool like structure having inter-fiber spaces forming a microenvironment for cell growth therein, the electrospun biodegradable fibers comprise 43-60 vol% β -TCP particles distributed in the electrospun biodegradable fibers such that a portion of the β -TCP particles is partially exposed on a surface of the electrospun biodegradable fibers without being coated by a polymer layer, and immersing the fibrous scaffold in a solution containing BMP-2 so that the BMP-2 is bound to the β -TCP particles exposed on the surface of the fibers forming the microenvironment throughout the cotton-wool like structure to produce the osteoinductive bone graft, wherein an area of binding site for BMP-2 on β -TCP particles exposed on a surface of the electrospun biodegradable fibers is adjusted by an amount of the β -TCP particles contained in the electrospun biodegradable fibers.
- [Claim 2] The method of claim 1, wherein diameters of the plurality of electrospun biodegradable fibers are 70-250 μm .
- [Claim 3] The method of claim 1, wherein lengths of the plurality of electrospun biodegradable fibers are 4-10 mm.
- [Claim 4] The method of claim 1, wherein the plurality of electrospun biodegradable fibers comprise PLGA.
- [Claim 5] The method of claim 1, wherein diameters of the β -TCP particles are 2-5 μm .
- [Claim 6] The method of claim 1, wherein the BMP-2 is targetable BMP-2.
- [Claim 7] An osteoinductive bone regeneration material produced by the method of claims 1-6.
- [Claim 8] A fibrous scaffold material for osteoinductive bone regeneration material comprising a plurality of electrospun biodegradable fibers, wherein the plurality of electrospun biodegradable fibers is 40-320 μm

in diameter and 5-20mm in length,
 wherein the plurality of electrospun biodegradable fibers are entangled with each other to form a cotton-wool like structure having inter-fiber spaces forming a microenvironment for cell growth therein,
 wherein the electrospun biodegradable fibers comprise 45-60 vol% β -TCP particles distributed in the electrospun biodegradable fibers such that a portion of the β -TCP particles is partially exposed on a surface of the electrospun biodegradable fibers without being coated by a polymer layer,
 wherein an area of binding site for BMP-2 on β -TCP particles exposed on a surface of the electrospun biodegradable fibers is adjusted by an amount of the β -TCP particles contained in the electrospun biodegradable fibers.

- [Claim 9] The fibrous scaffold material of claim 8, wherein diameters of the plurality of electrospun biodegradable fiber are 70-250 μ m.
- [Claim 10] The fibrous scaffold material of claim 8, wherein lengths of the plurality of electrospun biodegradable fibers are 4-10 mm.
- [Claim 11] The fibrous scaffold material of claim 8, wherein the electrospun biodegradable fibers comprise PLGA.
- [Claim 12] The fibrous scaffold material of claim 8, wherein diameters of the β -TCP particles are 2-5 μ m.
- [Claim 13] The fibrous scaffold material of claim 8, wherein the β -TCP particles are bound to BMP-2.
- [Claim 14] The fibrous scaffold material of claim 13, wherein the BMP-2 is targetable BMP-2.
- [Claim 15] The fibrous scaffold material of any one of the previous claims, wherein the BMP-2 comprises any one of SEQ ID NOS: 1-38, or a combination or two more sequences from SEQ ID NOS: 1-38.
- [Claim 16] A composition comprising:
 a scaffold comprising about 60 wt% to about 80 wt% calcium containing compound, and
 a targetable BMP-2 comprising (i) VIGESTHHRPWS (SEQ ID NO: 23), (ii) IIGESSHHKPFT (SEQ ID NO: 24), (iii) GLGDTTHHRPWG (SEQ ID NO: 25), (iv) ILAESTHHKPWT (SEQ ID NO: 26), or (v) a combination of two more of (i)-(iv).
- [Claim 17] The composition of claim 16, wherein the targetable BMP-2 comprises VIGESTHHRPWS (SEQ ID NO: 23).
- [Claim 18] The composition of claim 16 or claim 17, wherein the targetable BMP-

- 2 comprises IIGESSHHKPFT (SEQ ID NO: 24).
- [Claim 19] The composition of any one of claims 16-18, wherein the targetable BMP-2 comprises GLGDTTHHRPWG (SEQ ID NO: 25).
- [Claim 20] The composition of any one of claims 16-19, wherein the targetable BMP-2 comprises ILAESTHHKPWT (SEQ ID NO: 26).
- [Claim 21] The composition of any one of claims 16-20, wherein the targetable BMP-2 further comprises LLADTTHHRPWT (SEQ ID NO: 1).
- [Claim 22] The composition of any one of claims 16-21, wherein the targetable BMP-2 comprises QAKHKQRKRLKSSCKRHPLYVDFSDVGWND-WIVAPPGYHAFYCHGECPFPLADHLNSTNHAIVQTLVNSVNSKI PKACCVPTELSAISMLYLDENEKVVLKKNYQDMVVEGCGCR (SEQ ID NO: 32).
- [Claim 23] The composition of any one of claims 16-22, wherein the targetable BMP-2 comprises any one of SEQ ID NOS: 33-38.
- [Claim 24] The composition of any one of claims 16-22, wherein the targetable BMP-2 comprises SEQ ID NO: 33.
- [Claim 25] The composition of any one of claims 16-24, wherein the calcium containing compound comprises calcium phosphate, vaterite, or calcium phosphate and vaterite.
- [Claim 26] The composition of any one of claims 16-24, wherein the calcium containing compound comprises beta-tricalcium phosphate (β -TCP).
- [Claim 27] The composition of claim 26, wherein the β -TCP is present in the scaffold at about 60 wt% to about 80 wt% of the scaffold.
- [Claim 28] The composition of claim 27, wherein the β -TCP is present in the scaffold at about 70 wt%.
- [Claim 29] The composition of claim 26, wherein the β -TCP is present in the scaffold at about 30 wt% to about 50 wt% of the scaffold.
- [Claim 30] The composition of claim 29, wherein the β -TCP is present in the scaffold at about 40 wt%.
- [Claim 31] The composition of any one of claims 16-26 or claims 29-30, wherein the calcium containing compound comprises vaterite.
- [Claim 32] The composition of claim 31, wherein the vaterite is present in the scaffold at about 20 wt% to 40 wt% of the scaffold.
- [Claim 33] The composition of claim 32, wherein the vaterite is present in the scaffold at about 30 wt%.
- [Claim 34] The composition of any one of claims 25 or 31-33, wherein the vaterite comprises silicon-doped vaterite (SiV).
- [Claim 35] The composition of any one of claims 16-34, wherein the scaffold

- comprises a biodegradable polymer.
- [Claim 36] The composition of any one of claims 16-34, wherein the scaffold comprises poly(lactic-co-glycolic acid) (PLGA).
- [Claim 37] The composition of claim 36, wherein the scaffold comprises about 20 wt% to about 40 wt% PLGA.
- [Claim 38] The composition of claim 37, wherein the scaffold comprises about 30 wt% PLGA.
- [Claim 39] A method of treating a subject in need thereof, comprising administering to the subject a composition of any previous claim.
- [Claim 40] The method of claim 38, wherein the subject has a bone defect.