Claims

1. An in vitro method for forming a tissue construct having a composite structure, comprising:
   (a) providing a biodegradable substrate in vitro, wherein the substrate is adapted to allow deposition or growth of a plurality of cells;
   (b) providing a vascularized layer in vitro, the vascularized layer comprising a plurality of blood vessels therein; and
   (c) adhering the vascularized layer to the biodegradable substrate in vitro.

2. The in vitro method of claim 1, wherein the plurality of blood vessels are formed by:
   (i) providing a plurality of biodegradable fibres;
   (ii) encapsulating the plurality of biodegradable fibres with cells selected from the group consisting of endothelial cells, smooth muscle cells, microvascular endothelial cells, stem cells, and combination thereof; and
   (iii) allowing the biodegradable fibres to degrade.

3. The in vitro method of claim 2, further comprising embedding the plurality of biodegradable fibers encapsulated with cells in a gel.

4. The in vitro method of claim 2, wherein encapsulating comprises culturing the biodegradable fibres with the cells in the presence of growth factors such as vascular endothelial growth factor (VEGF) medium.

5. The in vitro method of claim 2, wherein each of the substrate and the biodegradable fibres is independently selected from the group consisting of a polyglycolide, a polylactide, a polycaprolactone, a polyamide, an aliphatic polyester, a poly(ester amide), a poly(amino acid), a pseudo-poly(amino acid), a poly(lactide glycolide), poly(lactic acid ethylene glycol), poly(ethylene glycol), poly(ethylene glycol) diacrylate, a polyalkylene succinate, polybutylene diglycolate, polyhydroxybutyrate, polyhydroxyvalerate, a polyhydroxy-butyrate/polyhydroxyvalerate copolymer, poly(hydroxybutyrate-co-valerate), a polyhydroxyalkaoates, a poly(caprolactone-polyethylene glycol) copolymer, poly(valerolactone), a polyanhydride, a poly(orthoester), a polyanhydride, a polyanhydride ester, poly(anhydride-co-imide), an aliphatic polycarbonate, a poly(hydroxyl-ester), a polydioxanone, a polycyanoacrylate, a poly(alkyl cyanoacrylate), a poly(amino acid), a poly(phosphazene), a poly(propylene fumarate), poly(propylene fumarate-co-ethylene glycol), a poly(fumarate anhydride), a poly(propylene carbonate), fibrinogen, fibrin, gelatin, cellulose, a cellulose derivative, chitosan, alginate, a polysaccharide, starch, amylase, collagen, a polycarboxylic acid, a poly(ethyl ester-co-carboxylate carbonate), poly-(iminocarbonate), poly(bisphenol A-iminocarbonate), poly(trimethylene carbonate), poly(ethylene oxide), poly(epsilon-caprolactone-dimethyl-trimethylene carbonate), a poly(alkylene oxalate), a poly(alkylcarbonate), poly(adipic anhydride), a nylon copolyamide, carboxymethyl cellulose, a copoly(ether-ester), a polyether, a polyester, a polydihydropyran, a polyketal, a polydepsipeptide, a polyarylate, a poly(propylene fumarate-co-ethylene glycol), a hyaluronates, poly-p-dioxanone, a polyphosphoester, a

polyphosphoester urethane, rayon, rayon triacetate, latex, and a composite thereof.

6. The in vitro method of claim 5, wherein the biodegradable fibres are poly(lactic-co-glycolic acid) (PLGA).

7. The in vitro method of claim 1, wherein the surface of the substrate is patterned to form a plurality of regions for the deposition or growth of the plurality of cells thereon.

8. The in vitro method of claim 7, wherein the substrate is further patterned to form a plurality of channels in the direction transverse to the substrate surface.

9. The in vitro method of claim 7, wherein the patterning of the substrate surface is formed by micro-contact printing, laser cutting, lithography or fibre spinning.

10. The in vitro method of claim 1, wherein the adhering comprises adhering the vascularized layer to the substrate via an intermediate layer.

11. The in vitro method of claim 10, wherein the intermediate layer is formed of gelatin, collagen or fibrin glue.

12. The in vitro method of claim 1, wherein the adhering comprises suturing the vascularized layer to the substrate.