Claims

1. A microneedle particle comprising a substantially spherical substrate and a plurality of microneedles projecting from the substrate, wherein the microneedle particle is capable of moving in three dimensions on skin or tissue and the plurality of microneedles are configured to penetrate skin or tissue when the microneedle particle is rolled on the skin or tissue in any directions, wherein an average diameter of the substrate is 0.05 mm to 100 mm, and an average height of the plurality of microneedles is (i) 50 μm to 500 μm, or (ii) 500 μm to 950 μm.

2. The microneedle particle according to claim 1, wherein the microneedle particle comprises gelatin, gelatin methacrylate hydrogel, hyaluronic acid, silicone, polymer, sugar, glass, ceramic, metal, or any combination thereof.

3. The microneedle particle according to claim 1, wherein the microneedle particle further comprises calcium phosphate, calcium carbonate, silica, graphene, carbon nanotubes or a combination thereof.

4. The microneedle particle according to claim 1, wherein the microneedle particle further comprises a therapeutic or cosmetic agent.

5. The microneedle particle according to claim 4, wherein the therapeutic or cosmetic agent is comprised in the form of a coating on the microneedle particle.

6. The microneedle particle according to claim 4, wherein the therapeutic or cosmetic agent is encapsulated into the microneedle particle.

7. The microneedle particle according to claim 4, wherein the therapeutic or cosmetic agent is co-formulated with the microneedle particle.

8. The microneedle particle according to claim 1, where in use the microneedle particle is configured to be pressed down and rolled on any directions on skin or tissue to achieve 3-dimensional movement.

9. The microneedle particle according to claim 1, wherein the average diameter of the substrate is 0.05-10 mm.

10. The microneedle particle according to claim 1, wherein the substrate has an aspect ratio ≤ 2.

11. The microneedle particle according to claim 1, wherein each of the plurality of microneedles has the same or different height.

12. The microneedle particle according to claim 1, wherein the average height of the plurality of microneedles is 50-500 μm.

13. The microneedle particle according to any one of claims 1-10, wherein each of the plurality of microneedles has the same or different shape.

14. The microneedle particle according to claim 4, wherein the microneedle particle is configured for transdermal delivery of the therapeutic or cosmetic agent.

15. The microneedle particle according to claim 4, wherein the microneedle particle is configured for oral delivery of the therapeutic or cosmetic agent.

16. A method of forming a microneedle particle comprising a substantially spherical substrate and a plurality of microneedles projecting from the substrate, wherein the microneedle particle is capable of moving in three dimensions on skin or tissue and the plurality of microneedles are configured to penetrate skin or tissue when the microneedle particle is rolled on the skin or tissue in any directions, wherein an average diameter of the substrate is 0.05 mm to 100 mm, and an average height of the plurality of microneedles is (i) 50 μm to 500 μm, or (ii) 500 μm to 950 μm, the method comprising 3D printing the microneedle particle.

17. A method of forming a microneedle particle comprising a substantially spherical substrate and a plurality of microneedles projecting from the substrate, wherein the microneedle particle is capable of moving in three dimensions on skin or tissue and the plurality of microneedles are configured to penetrate skin or tissue when the

microneedle particle is rolled on the skin or tissue in any directions, wherein an average diameter of the substrate is 0.05 mm to 100 mm, and an average height of the plurality of microneedles is (i) 50 μm to 500 μm, or (ii) 500 μm to 950 μm, the method comprising:

- providing a mould of the microneedle particle, the mould having the shape of the microneedle particle;
- casting the mould with a precursor solution;
- curing the precursor solution to form the microneedle particle;
- shrinking and/or hardening the microneedle particle within the mould; and
- removing the microneedle particle from the mould.

18. The method according to claim 17, wherein the precursor solution comprises gelatin, a gelatin methacrylate hydrogel, hyaluronic acid, silicone, a polymer, sugar, a glass, a ceramic, a metal precursor solution, or a photoinitiator.

19. The method according to claim 17, wherein the precursor solution further comprises calcium phosphate, calcium carbonate, silica, graphene, carbon nanotubes, or a combination thereof.

20. The method according to claim 17, wherein the shrinking and/or hardening is via evaporation.

21. The method according to claim 17, further comprising vacuuming the mould after the casting.

22. A capsule comprising one or more microneedle particles, wherein the one or more microneedle particles comprises a substantially spherical substrate and a plurality of microneedles projecting from the substrate, wherein an average diameter of the substrate is 0.05 mm to 100 mm, and an average height of the plurality of microneedles is (i) 50 μm to 500 μm, or (ii) 500 μm to 950 μm; wherein in use the capsule is configured to break down and release the one or more microneedle particles, and the plurality of microneedles are configured to penetrate tissue.