Claims

1. A pharmaceutical formulation that is useful in the treatment of metabolic disorders or conditions, comprising a plurality of particles suspended in a carrier system, which particles:
(a) have a weight-, number-, or volume-based mean diameter that is between amount 10 nm and about 700 μm; and
(b) comprise solid cores comprising at least one glucagon-like peptide-1 receptor agonist, or a pharmaceutically-acceptable salt thereof, coated, at least in part, by a coating of inorganic material comprising mixture of:
(i) zinc oxide; and
(ii) one or more other metal and/or metalloid oxides,
wherein the atomic ratio ((i):(ii)) is at least about 1:10 and up to and including about 10:1.

2. A formulation as claimed in Claim 1, wherein:
(a) the atomic ratio ((i):(ii)) is at least about 1:1 and up to and including about 6:1, and/or
(b) the coated particles comprise one or more discrete layers surrounding said cores, in which at least one of said discrete layers comprises a mixture of zinc oxide and one or more other metal and/or metalloid oxides.

3. A formulation as claimed in Claim 1 or Claim 2, wherein:
(a) coated particles comprise more than one discrete layers surrounding said cores;
(b) at least one of said discrete layers consists essentially of a single metal and/or metalloid oxide; and/or
(c) at least one of said discrete layers of single metal and/or metalloid oxide is applied directly to the core prior to and/or after application of said one or more layers comprising said mixture of zinc oxide and one or more other metal and/or metalloid oxides.

4. A formulation as claimed in Claim 3, wherein:
(a) the number of discrete layers is up to four layers of single metal and/or metalloid oxide; and/or
(b) said single metal and/or metalloid oxide is aluminium oxide.

5. A formulation as claimed in any one of the preceding claims, wherein:
(a) the cores consist essentially of at least one glucagon-like peptide-1 receptor agonist, or a pharmaceutically-acceptable salt thereof;
(b) the weight-, number-, or volume-based mean diameter of the particles is between amount 1 μm and about 50 μm;

(c) more than one discrete layer of the mixture of oxides is applied to the core sequentially,
(d) between 3 and 10 discrete layers of the mixture of oxides are applied;
(e) the total thickness of the mixed oxide coating is between about 0.5 nm and about 2 μm; and/or.
(f) the one or more other metal and/or metalloid oxides are selected from aluminium oxide and/or silicon dioxide.

6. A formulation as claimed in any one of Claims 2 to 5, wherein the maximum thickness of an individual discrete layer of oxide coating is about 1 hundredth of the weight-, number-, or volume-based mean diameter of the core, including any other discrete layers that have previously been applied to the core.

7. A formulation as claimed in any one of the preceding claims in the form of a sterile injectable dosage form that is administrable *via* a surgical administration apparatus that forms a depot formulation.

8. A formulation as claimed in any one of the preceding claims, wherein the at least one glucagon-like peptide-1 receptor agonist is liraglutide or semaglutide.

9. A process for the preparation of a formulation as defined in any one of the preceding claims, wherein the coated particles are made by applying the layer(s) of mixed oxide coating material to the cores, and/or previously-coated cores, by atomic layer deposition.

10. A process as claimed in Claim 9, wherein:
(i) solid cores are coated with a first discrete layer of mixed oxide coating material;
(ii) the coated cores from step (i) are then subjected to a deagglomeration process step;
(iii) the deagglomerated coated cores from step (ii) are then coated with a second discrete layer of mixed oxide coating material;
(iv) repeating steps (ii) and (iii) to obtain the required number of discrete layers.

11. A process as claimed in Claim 10, wherein the deagglomeration step that takes place between applications of coatings comprises sieving, wherein said sieving comprises sonic sifting or vibrational sieving, which vibrational sieving comprises controlling a vibration probe coupled to the sieve.

12. A process for the preparation of a formulation as defined in any one of Claims 1 to 9, wherein the coated particles are mixed with the carrier system after coating.

13. An injectable dosage form comprising a formulation as defined in any one of Claims 1 to 9 contained within a reservoir that is connected to, and/or is in association with, an injection means that is a surgical administration apparatus and/or is an autoinjector.

14. The use of a formulation as defined in any one of Claims 1 to 8, or a dosage form as defined in Claim 13, for the manufacture of a medicament for the treatment of a metabolic disorder or condition.

15. A use as claimed in Claim 14, wherein the metabolic disorder or condition is selected from type 2 diabetes, obesity and comorbidities or either.

16. A use as claimed in Claim 15, wherein, following injection:
(a) the formulation provides a depot formulation from which the at least one glucagon-like peptide-1 receptor agonist is released over a period of time that is between 3 months and about 1 year; and/or
(b) the total exposure for the at least one glucagon-like peptide-1 receptor agonist is at least about 80% to about 125% of the total exposure obtained from a dosing regimen comprising administering daily or weekly injections of said at least one glucagon-like peptide-1 receptor agonist over the same time period.