Accordingly, there is a need in the art for boron-free hollow spherical glass particles featured by improved mechanical properties.

Therefore, it is an object of the present disclosure to provide boron-free hollow spherical glass particles having a small particle diameter and a homogenous wall thickness as well as a process for the preparation of said hollow spherical glass particles.

The foregoing and other objects are solved by the subject-matter of the present disclosure.

According to a first aspect of the present disclosure, a hollow spherical glass particle comprising a spherical glass shell defining a hollow interior is provided, said hollow spherical glass particle comprising

i) at least 30 wt.-% of Al_2O_3,
ii) at least 35 wt.-% of SiO_2, and
iii) at least 18 wt.-% of at least one alkali metal oxide,

based on the overall weight of the hollow spherical glass particle,
wherein the hollow spherical glass particle has a particle diameter in the range of more than 20 to 75 µm,
and wherein the hollow spherical glass particle is free of boron.

In another aspect, there is provided a plurality of hollow spherical glass particles as defined above.

In another aspect, there is provided a process for the preparation of hollow spherical glass particles, comprising the steps of

a) providing a composition comprising
   i) at least 30 wt.-% of Al_2O_3,
   ii) at least 35 wt.-% of SiO_2, and
   iii) at least 18 wt.-% of at least one alkali metal oxide,
   based on the overall weight of the composition,
b) optionally subjecting the composition obtained in step a) to a grinding process such that finely ground particles having a particle size of 10.0 µm or below are obtained,
c) mixing the finely ground particles obtained in step b) with water and optionally an organic binder, thereby obtaining a slurry,
d) spray-drying the slurry obtained in step c), and
e1) feeding the particles obtained in step d) into a heating device such that the particles are blown upwards while the temperature is maintained above 1000 °C, thereby obtaining the hollow spherical glass particles.

In another aspect, there is provided a hollow spherical glass particle, obtained according to the process as defined above.

In another aspect, there is provided an article, comprising the plurality of hollow spherical glass particles as defined above.

In another aspect, there is provided the use of the plurality of hollow spherical glass particles as defined above as a filler for high temperature products, molten metal, injection moulded synthetic materials, flame-retardant insulating foams, cement slurries, mortars, concretes and oil field applications.

It was surprisingly found by the inventors that hollow spherical glass particles having a diameter in the range of more than 20 to 75 µm can be obtained from a starting material composition comprising Al_2O_3, SiO_2 and at least one alkali metal oxide. Particles of this size can be applied for articles having a more refined surface structure.

It is especially preferred that the hollow spherical glass particle has a particle diameter in the range of more than 20 to 70 µm.

According to one embodiment of the present invention, the at least one alkali metal is selected from Na_2O, K_2O or mixtures thereof. In particular, it is preferred that the at least one alkali metal oxide is a mixture of Na_2O and K_2O.

According to another embodiment of the present invention, the weight ratio between Na_2O and K_2O is in the range of 10:1 to 30:1.

According to a further embodiment the ratio between the particle diameter [in µm] and the wall thickness [in µm] is in the range of 10 to 30, more preferably in the range of 15 to 25, still more preferably in the range of 17 to 23, like in the range of 20 to 22. Without being bound to theory, a ratio between the particle diameter and the wall thickness within said range improves the mechanical stability of the hollow spherical glass particle.

Accordingly, it is preferred that the hollow spherical glass particle according to the present invention has a wall thickness in the range of 0.1 to 15 µm, more preferably in the range of 0.2

Claims

1. A hollow spherical glass particle comprising a spherical glass shell defining a hollow interior, said hollow spherical glass particle comprising
   i) at least 30 wt.-% of Al_2O_3,
   ii) at least 35 wt.-% of SiO_2, and
   iii) at least 18 wt.-% of at least one alkali metal oxide,
   based on the overall weight of the hollow spherical glass particle,
   wherein the hollow spherical glass particle has a particle diameter in the range of more than 20 to 75 µm,
   and wherein the hollow spherical glass particle is free of boron.

2. The hollow spherical glass particle according to claim 1, having a particle diameter in the range of more than 20 to 70 µm.

3. The hollow spherical glass particle according to any one of the preceding claims, wherein the ratio between the particle diameter [in µm] and the wall thickness [in µm] is in the range of 10 to 30.

4. The hollow spherical glass particle according to claim 1 or 2, having a wall thickness in the range of 0.1 to 15 µm.

5. The hollow spherical glass particle according to any one of the preceding claims, comprising
   i) 30 to 45 wt.-% of Al_2O_3,
   ii) 35 to 42 wt.-% of SiO_2, and
   iii) 18 to 30 wt.-% of a mixture of Na_2O and K_2O,
   based on the overall weight of the hollow spherical glass particle.

6. The hollow spherical glass particle according to any one of the preceding claims, having a pressure collapse strength value in the range of 120 to 150 MPa.

7. A plurality of hollow spherical glass particles according to any one of claims 1 to 6.

8. The plurality of hollow spherical glass particles according to claim 7, having an average particle diameter (D50) in the range of more than 20 to 75 µm.

9. Process for the preparation of hollow spherical glass particles, comprising the steps of
   a) providing a composition comprising
      i) at least 30 wt.-% of Al_2O_3,
      ii) at least 35 wt.-% of SiO_2, and
      iii) at least 18 wt.-% of at least one alkali metal oxide,
      based on the overall weight of the composition,

b) optionally subjecting the composition obtained in step a) to a grinding process such that finely ground particles having a particle size of 10.0 µm or below are obtained,

c) mixing the finely ground particles obtained in step b) with water and optionally an organic binder, thereby obtaining a slurry,

d) spray-drying the slurry obtained in step c), and

e1) feeding the particles obtained in step d) into a heating device such that the particles are blown upwards while the temperature is maintained above 1000 °C, thereby obtaining the hollow spherical glass particles.

10. Process according to claim 9, wherein the finely ground particles, optionally obtained in step b) containing a first fraction of particles having a particle size in the range of 1.0 to 10 µm, preferably in the range of 1.0 to 7.0 µm and a second fraction of particles having a particle size of 1.0 µm or below.

11. Process according to claim 9 or 10, wherein in step c) the finely ground particles, optionally obtained in step b) are further mixed with an organic binder, which is preferably a higher hydric alcohol.

12. Hollow spherical glass particle, obtained according to the process according to any one of claims 9 to 11.

13. Article, comprising the plurality of hollow spherical glass particles according to claims 7 or 8.

14. Article according to claim 13 wherein said article is a high temperature product, an injection moulded synthetic material, a flame-retardant insulating foam, a cement slurry, a mortar or concrete.

15. Use of the plurality of hollow spherical glass particles according to claims 7 or 8 as a filler for high temperature products, molten metal, injection moulded synthetic materials, flame-retardant insulating foams, cement slurries, mortars, concretes and oil field applications.