CLAIMS

1. Process for producing cerium oxide particles, comprising the following steps:

(a) contacting, under an inert atmosphere, (i) an aqueous solution of a base, (ii) an aqueous solution comprising NO_3^-, Ce^{III}, optionally Ce^{IV}, and (iii) an organic acid or a salt thereof to obtain a mixture, wherein the organic acid is a substituted or unsubstituted, C1-C20 -alkyl, -alkenyl or -alkynyl carboxylic acid;

(b) subjecting the mixture obtained in step (a) to a thermal treatment carried out at a temperature ranging from 75°C to 95°C;

(c) optionally acidifying the mixture obtained in step (b);

(d) optionally washing with water the solid material obtained at the end of step (b) or (c);

(e) optionally subjecting the solid material obtained at the end of step (d) to a mechanical treatment to deagglomerate the particles.

2. Process according to claim 1, wherein the organic acid is a substituted or unsubstituted C1-C12 alkyl carboxylic acid, preferably an unsubstituted C1-C6 alkyl carboxylic acid or a C1-C6 alkyl carboxylic acid which is substituted by at least one C1-C3 alkyl group, more preferably a C1-C3 alkyl carboxylic acid which is substituted by at least one C1-C2 alkyl group, even more preferably pivalic or a dicarboxylic acid.

~~3. Process according to any one of claims 1 or 2, wherein the thermal treatment of step (b) is carried out at a temperature ranging from 75°C to 95°C.~~

~~4. Cerium oxide particles obtainable by the process according to any one of claims 1 to 3.~~

~~5. Cerium oxide particles characterized in that said particles exhibit a roughness index RI of at least 5, in particular ranging from 5 to 20, in particular ranging from 6 to 17, more particularly ranging from 7 to 14, wherein RI is defined by the formula:~~

$$RI = \frac{TEM\ size}{SSA\ size}$$

wherein "TEM size" denotes the average size of the particles measured on transmission electron microscopy images and " SSA size" denotes the theoretical average size of the particles determined from their BET specific surface area.

6. Cerium oxide particles according to claim 5, wherein the " SSA size" is calculated according to the following formula:

$$SSA\ size = \frac{6}{SSA \times \rho}$$

wherein SSA denotes the BET specific surface area of the particles and ρ denotes the density of cerium(IV) oxide and is equal to 7.22 g/cm^3.

7. Cerium oxide particles according to claim 5 or 6, wherein the BET specific surface area of the particles is determined by nitrogen adsorption.

8. Cerium oxide particles according to any of claims 5 to 7, characterized in that said particles are spheroidal in shape.

9. Cerium oxide particles according to claim 8, characterized in that said particles exhibit a sphericity ratio SR between 0.8 and 1.0, more particularly between 0.85 and 1.0, even more particularly between 0.90 and 1.0.

10. Cerium oxide particles according to claim 9, wherein SR is calculated from the measured perimeter P and area A of the particles projection using the following equation:

$$SR = 4\pi \frac{A}{P^2}$$

11. Cerium oxide particles according to claims 9 or 10, wherein SR is determined by a Dynamic Image Analysis (DIA), notably pursuant to ISO 13322-2 (2006).

12. Cerium oxide particles according to any one of claims 5 to 11, characterized in that said particles exhibit a carbon weight ratio ranging from 0.001 wt% to 5 wt%, in particular from 0.1 wt% to 2.5 wt%.

~~13. Cerium oxide particles according to any one of claims 5 to 12, characterized in that said particles exhibit a specific surface area comprised between 15 and 100 m2/g, more particularly between 32 and 80 m2/g, more particularly between 35 and 70 m2/g, even more particularly between 36 and 60 m2/g.~~

~~14. Cerium oxide particles according to claim 13, characterized in that said particles exhibit a specific surface area comprised between 20 and 40 m2/g.~~

~~15. Cerium oxide particles according to any one of claims 5 to 14, characterized in that said particles exhibit an average size from 30 to 500 nm, in particular from 70 to 300 nm, said average size being measured from TEM images.~~

~~16. Cerium oxide particles according to claim 15 characterized in that said particles exhibit an average size which is comprised between 140 and 300 nm, in particular between 145 and 270 nm, more particularly between 150 and 250 nm, even more particularly between 155 and 240 nm. said average size being measured from TEM images.~~

~~17. Cerium oxide particles according to any one of claims 5 to 16, which are obtainable by the process according to any one of claims 1 to 3.~~

~~18.~~3. Cerium oxide particles characterized in that said particles are spheroidal in shape and exhibit a roughness index RI of at least 2, ~~particularly of at least 3.5~~ wherein RI is defined by the formula:

$$RI = \frac{TEM\ size}{SSA\ size}$$

wherein "TEM size" denotes the average size of the particles measured on transmission electron microscopy images from at least 80 particles and " SSA size" denotes the theoretical average size of the particles according to the following formula:

$$SSA\ size = \frac{6}{SSA \times \rho}$$

wherein SSA denotes the BET specific surface area of the particles determined by nitrogen adsorption and ρ denotes the density of cerium(IV) oxide and is equal to

7.22 g/cm^3 and in that said particles exhibit a carbon weight ratio ranging from 0.001 wt% to 5 wt%~~, in particular from 0.1 wt% to 2.5 wt%~~.

4. Cerium oxide particles according to claim 3, characterized in that said roughness index RI is of at least 3.5.

5. Cerium oxide particles according to claim 3 or 4, characterized in that said particles exhibit a carbon weight ratio ranging from 0.1 wt% to 2.5 wt%.

~~19.~~ Cerium oxide particles according to claim ~~18~~any of claims 3 to 5, characterized in that said particles exhibit a sphericity ratio SR between 0.8 and 1.0, more particularly between 0.85 and 1.0, even more particularly between 0.90 and 1.0~~.~~

~~20.~~6. ~~Cerium oxide particles according to claim 19~~, wherein SR is calculated from the measured perimeter P and area A of the particles projection using the following equation:

$$SR = 4\pi\frac{A}{P^2}$$

~~21. Cerium oxide particles according to claims 19 or 20,~~ wherein SR is determined by a Dynamic Image Analysis (DIA), notably pursuant to ISO 13322-2 (2006).

~~22.~~7. Cerium oxide particles according to any one of claims ~~18~~ 3 to ~~21~~6, characterized in that said particles exhibit a specific surface area comprised between 15 and 100 m^2/g, more particularly between 32 and 80 m^2/g, more particularly between 35 and 70 m^2/g, even more particularly between 36 and 60 m^2/g.

~~23.~~8. Cerium oxide particles according to claim ~~22~~ 7 characterized in that said particles exhibit a specific surface area comprised between 20 and 40 m^2/g.

~~24.~~9. Cerium oxide particles according to any one of claims ~~18~~ 3 to ~~23~~8, characterized in that said particles exhibit an average size from 30 to 500 nm, in particular from 70 to 300 nm, said average size being measured from TEM images.

~~25.~~10. Cerium oxide particles according to claim ~~24~~ 9 characterized in that said particles exhibit an average size which is comprised between 140 and 300 nm, in particular between 145 and 270 nm, more particularly between 150 and 250 nm, even more particularly between 155 and 240 nm. said average size being measured from TEM images.

~~26.~~11. Cerium oxide particles according to any one of claims ~~18~~ 3 to ~~25~~10, which are obtainable by the process according to ~~any one of~~ claim 1 ~~to~~ or ~~3~~2.

~~27.~~12. Dispersion of cerium oxide particles according to any one of claims ~~4~~ 3 to ~~26~~10 in a liquid medium.

~~28.~~13. Use of the cerium oxide particles of any one of claims ~~4~~ 3 to ~~26~~10 or of the dispersion of claim ~~27~~12 for the preparation of a polishing composition, more particularly a CMP composition.

~~29.~~14. Polishing composition comprising the cerium oxide particles of any one of claims ~~4~~ 3 to ~~26~~10 or the dispersion of claim ~~27~~12.

~~30.~~15. Method for removing a portion of a substrate, comprising polishing the substrate with a polishing composition according to claim ~~29~~14.