In this context, we believe that there is a need for cerium based particles having improved abrasive properties without the above mentioned disadvantages.

There is also a need for a making process of improved cerium based particles which is simple and easy to implement at an industrial scale.

BRIEF DESCRIPTION OF THE INVENTION

These problems are solved by the present invention which offers *inter alia* new cerium based particles exhibiting a rough surface, as well as a process for making the same.

One object of the invention thus relates to cerium based particles having substantially the shape of polyhedrons which have one or more faces with protrusions thereon, said protrusions being integrally formed with said cerium based particles.

In one aspect, the present invention provides cerium based particles having substantially the shape of polyhedrons which have one or more faces with protrusions thereon, said protrusions being integrally formed with said cerium based particles, wherein said polyhedrons are cubes, truncated octahedrons or combinations thereof, and wherein the cerium based particles are characterized by a specific surface are (BET) comprised between 16 and 55 m^2/g.

The invention also relates to dispersions of the above-disclosed particles in a liquid medium.

Another object of the invention relates to a process for producing such cerium based particles, comprising the following steps:

(a) contacting, under an inert atmosphere, an aqueous solution of a base and an aqueous solution comprising NO_3^-, Ce^{III}, optionally Ce^{IV}, optionally M^{n+} with M a metal of valence n, wherein the difference between the base/total(Ce+optional M) molar ratio and the NO_3^-/Ce^{III} molar ratio is lower than 2;

(b) subjecting the mixture obtained in step (a) to a thermal treatment, wherein the temperature is comprised between 55°C and 75°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.

The invention also relates to the cerium based particles and dispersions thereof susceptible to be obtained by this process.

CLAIMS

1. Cerium based particles having substantially the shape of polyhedrons which have one or more faces with protrusions thereon, said protrusions being integrally formed with said cerium based particles,
   wherein said polyhedrons are cubes, truncated octahedrons or combinations thereof, and
   wherein the cerium based particles are characterized by a specific surface area (BET) comprised between 16 and 55 m^2/g.

2. Cerium based particles according to claim 1, wherein the protrusions extend over at least 60%, in particular at least 70%, in particular at least 80%, in particular at least 90 %, of the surface of said face.

3. Cerium based particles according to claim 1 or 2, wherein the protrusions are blunt.

4. Cerium based particles according to any of claims 1 to 3, having at least one edge portion and/or corner being substantially free from protrusions.

5. Cerium based particles according to any of claims 1 to 4, wherein said particles are made of cerium oxide or of a mixed oxide of cerium and at least one metal (M), preferably chosen among lanthanum, praseodymium and neodymium, being more preferably lanthanum.

6. Cerium based particles according to claim 5, wherein the particles made of a mixed oxide of cerium and at least one metal (M) have a molar ratio M/(M+Ce) comprised between 0.01 and 0.15, more particularly between 0.01 and 0.12, even more particularly between 0.01 and 0.04, especially between 0.02 and 0.03.

7. Cerium based particles according to any of claims 1 to 6, characterized by an hydrodynamic mean diameter Dh determined by dynamic light scattering comprised between 75 nm and 1000 nm, more particularly between 80 nm and 500 nm, even more particularly between 85 nm and 300 nm, especially between 90 nm and 240 nm.

8. Cerium based particle according to any of claims 1 to 7, characterized by a median diameter D50 determined by laser diffraction comprised between 70 nm and 200 nm, more particularly between 75 nm and 170 nm, even more particularly between 79 nm and 150 nm.

9. Cerium based particle according to any of claims 1 to 8, characterized by a diameter D10 determined by laser diffraction comprised between 55 nm and 200 nm, more particularly between 60 nm and 150 nm, even more particularly between 65 nm and 110 nm.

10. Cerium based particle according to any of claims 1 to 9, characterized by a diameter D90 determined by laser diffraction comprised between 80 nm and 300 nm, more particularly between 90 nm and 260 nm, even more particularly between 94 nm and 230 nm.

11. Cerium based particle according to any of claims 1 to 10, characterized by a diameter D99 determined by laser diffraction comprised between 90 nm and 400 nm, more particularly between 100 nm and 385 nm, even more particularly between 107 nm and 370 nm.

12. Cerium based particle according to any of claims 1 to 11, characterized by a dispersion index σ/m lower than 0.60, particularly lower than 0.42, wherein σ/m = (D90-D10)/2D50, D10, D50 and D90 being determined by laser diffraction.

13. Cerium based particle according to any of claims 1 to 12, characterized by a ratio D90/D50 comprised between 1.10 and 1.60, D50 and D90 being determined by laser diffraction.

14. Dispersion of cerium based particles according to any one of claims 1 to 13 in a liquid medium.

15. Dispersion according to claim 14 exhibiting a conductivity lower than 300 µS/cm, more particularly lower than 150 µS/cm, even more particularly lower than 100 µS/cm, especially lower than 50 µS/cm.

16. Use of the cerium based particles according to any of claims 1 to 13 or the dispersion according to claim 14 or 15 for the preparation of a polishing composition, more particularly a chemical mechanical polishing composition.

17. Polishing composition comprising the cerium based particles according to any of claims 1 to 13 or the dispersion according to claim 14 or 15.

18. Polishing composition according to claim 17, further comprising one or more of the following ingredients: abrasive particles other than the cerium based particles according to any of claims 1 to 13; and/or a pH regulator; and/or a surfactant; and/or a rheological control agent, including viscosity enhancing agents and coagulants; and/or an additive selected from an additive selected from an anionic copolymer of a carboxylic acid monomer, a sulfonated monomer, or a phosphonated monomer, and an acrylate, a polyvinylpyrrolidone, or a polyvinylalcohol (e.g., a copolymer of 2-hydroxyethylmethacrylic acid and methacrylic acid); a nonionic polymer, wherein the nonionic polymer is polyvinylpyrrolidone or polyethylene glycol; a silane, wherein the silane is an amino silane, an ureido silane, or a glycidyl silane; an N-oxide of a functionalized pyridine (e.g., picolinic acid N-oxide); a starch; a cyclodextrin (e.g., alpha-cyclodextrin or beta-cyclodextrin), and combinations thereof.

19. Method of removing a portion of a substrate, the method comprising polishing the substrate with a polishing composition according to claim 17 or 18.

20. Use of a substrate polished by the method according to claim 19 to produce a semiconductor.

21. Process for producing the cerium based particles according to any of claims 1 to 13, comprising the following steps:

(a) contacting, under an inert atmosphere, an aqueous solution of a base and an aqueous solution comprising NO_3^-, Ce^{III}, optionally Ce^{IV}, optionally M^{n+} with M a metal of valence n, wherein the difference between the base/total(Ce+optional M) molar ratio and the NO_3^-/Ce^{III} molar ratio is lower than 2;

(b) subjecting the mixture obtained in step (a) to a thermal treatment, wherein the temperature is comprised between 55 and 75°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.