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

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.

To the best of the inventors' knowledge, the roughness index achieved by the particles of this subject matter of the present invention is higher than the one of the cerium oxide particles of the state or the art. It is believed that it contributes to achieve a greater efficiency of polishing when such particles are used as abrasive particles in a CMP composition or process.

The invention also relates to a process for producing the cerium oxide particles of the invention, comprising at least 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 -aryl or -heteroaryl carboxylic acid;

(b) subjecting the mixture obtained in step (a) to a thermal treatment;

(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.

Advantageously, this process enables to prepare in a simple manner the cerium oxide particles of the invention.

The invention also relates to the cerium oxide particles obtainable or obtained by the above mentioned process, to a dispersion of the cerium oxide particles of the invention in a liquid medium, to the use of said dispersion or of the particles of the invention to prepare a CMP composition, to the CMP composition comprising said dispersion or said particles, to a polishing process wherein said CMP composition is used to remove a portion of the substrate and to the semiconductor comprising the substrate polished thereby.

In one aspect, the present disclosure provides Cerium oxide particles characterized in that said particles are substantially cubical, exhibit a roughness index RI of at least 2.4, 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%.

In another aspect, there is provided a dispersion of cerium oxide particles as described herein in a liquid medium.

In yet another aspect, there is provided a use of the cerium oxide particles as described herein or of the dispersion as described herein for the preparation of a polishing composition, more particularly a CMP composition.

In a further aspect, there is provided a polishing composition comprising the cerium oxide particles as described herein or the dispersion as described herein.

In yet another aspect, there is provided a method for removing a portion of a substrate, comprising polishing the substrate with a polishing composition as described herein.