~~BRIEF DESCRIPTION~~SUMMARY OF THE INVENTION

These problems are solved by the present ~~invention~~ disclosure which offers *inter alia* new cerium based particles having a rough surface thanks to a specific core-shell morphology and a making process thereof.

One object of the ~~invention~~ disclosure thus relates to a process for producing a dispersion of cerium based core-shell particles in a liquid, comprising the following steps:

(a) providing an aqueous dispersion comprising particles of cerium oxide optionally doped with at least one metal (M); providing an aqueous solution comprising a cerium (III) salt; and optionally providing an aqueous solution comprising at least one metal (M') salt;

(b) contacting, under oxidizing atmosphere, the aqueous dispersion with the aqueous solution(s) provided in step (a), while maintaining the temperature comprised between 0°C and 80°C and the pH lower or equal to 11, to produce the dispersion of cerium based core-shell particles;

at least one of the steps (a) and (b) being carried out in the presence of nitrate ions.

The ~~invention~~ disclosure also relates to the cerium based core-shell particles and dispersions thereof obtainable or obtained by this process.

A cerium based core-shell particle of the ~~invention~~ present disclosure can be described as a core particle of cerium oxide optionally doped with at least one metal (M) and a shell consisting of a plurality of nanoparticles of cerium oxide optionally doped with at least one metal (M'), said nanoparticles being formed on the surface of the core particle, wherein the ratio of the average size of the core-shell particles measured by TEM to the average size of the core-shell particles measured by BET is of at least 1.5.

In one aspect, there is provided a dispersion of cerium based core-shell particles in a liquid obtainable by the process described herein, wherein each cerium based core-shell particle has a core particle made of cerium oxide optionally doped with at least one metal (M) and a shell consisting of a plurality of nanoparticles of cerium oxide optionally doped with at least one metal (M'), said nanoparticles being formed on the surface of the core particle, wherein the ratio of the average size of the core-shell

particles measured by TEM to the average size of the core-shell particles measured by BET is of at least 1.5.

In another aspect, there is provided a cerium based core-shell particles powder obtainable by the process described herein, wherein each cerium based core-shell particle has a core particle made of cerium oxide optionally doped with at least one metal (M) and a shell consisting of a plurality of nanoparticles of cerium oxide optionally doped with at least one metal (M'), said nanoparticles being formed on the surface of the core particle, wherein the ratio of the average size of the core-shell particles measured by TEM to the average size of the core-shell particles measured by BET is of at least 1.5.

Advantageously, the specific core-shell morphology of the particles of the ~~invention~~ present disclosure increases their surface roughness and thus their surface specific area by comparison with smooth cerium oxide particles not having a shell in accordance with the present ~~invention~~disclosure. Accordingly, by increasing the contact surface between the particles and the substrate to be polished, the abrasive properties of the core-shell particles of the ~~invention~~ present disclosure are improved, allowing to advantageously use them in a chemical mechanical polishing process. The core-shell particles dispersions of the ~~invention~~ present disclosure especially allow

a higher removal rate due to their rough surface while maintaining the same defectivity thanks to equivalent size distributions compared to dispersions of smooth surface cerium oxide particles having no shell in accordance with the present ~~invention~~disclosure.

The dispersions of cerium based core-shell particles of the ~~invention~~ present disclosure can be used to prepare powders of cerium based core-shell particles, as well as polishing compositions, as it will be detailed hereafter in the specification.

In one aspect, there is provided a polishing composition comprising a dispersion of cerium based core-shell particles described herein or a cerium based core-shell particles powder described herein.

In another aspect, there is provided a use of the dispersion of cerium based core-shell particles described herein or of the cerium based core-shell particles powder described herein for the preparation of a polishing composition, more particularly a chemical mechanical polishing composition.

In yet another aspect, there is provided a method of removing a portion of a substrate, the method comprising polishing the substrate with a polishing composition prepared from a dispersion described herein or from a dispersion prepared from a core-shell cerium oxide particles powder described herein.

In a further aspect, there is provided a aemiconductor comprising a substrate polished by the method described herein.

Additionally, one advantage of the core-shell particles of the ~~invention~~ present disclosure is that the nanoparticles from the shell are well attached to the core particle. It has notably been observed that they remain attached to the core during the whole chemical mechanical polishing process in which they are implemented. It is all the more important since the particles shells withstand the mechanical stress during the chemical mechanical polishing process. If the nanoparticles of the shell came off during the polishing, these small cerium oxide particles could remain attached to the substrate even after a washing step, which is not acceptable by the end users. It would result in

unacceptable costs due to the substrate loss and the recurrent polishing composition replacement.

Another advantage of the core-shell particles of the ~~invention~~ present disclosure lies in the fact they have the adapted size range for the CMP application and are monodisperse.

FIGURES

Figures 1 is a TEM pictures of a dispersion of the core-shell particles of the invention obtained by the process illustrated in example 1, having a cerium oxide core and a cerium oxide shell.

Figure 2 is a TEM picture of a dispersion of particles of cerium oxide obtained by the process illustrated in counter example 1.

Figures 3 is a SEM picture of a dispersion of the cerium oxide particles intended to be used as core particles in the process illustrated in examples 1, 2 and 4.

Figure 4 is a SEM picture of a dispersion of the core-shell particles of the invention obtained by the process illustrated in example 1, having a cerium oxide core and a cerium oxide shell.