CERAMIC FOR RESTORATION DENTISTRY

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Instroduction

A ceramic based on Yttrium-Tetragonal Zirconia Polycrystal (Y-TZP) has bio-compatibility and matters as advanced material for restoration dentistry [1] However, the implant of Y-TZP ceramics demonstrates a significant failure. This is explained by the instability caused by low– temperature aging degradation (LTAD), taking place in the aqueous solutions of Y-TZP zirconia ceramics.

There is the reduction of impact of Y-TZP ceramic low-temperature "aging," showing itself in instability of mechanical parameters. Several ways of improving Y-TZP ceramic characteristics were proposed.

It is well known that "stability" of such materials increases when grains smaller than 800 nm are in the microstructure and in the presences other stabilizer except for Y^{+3}.

An alternative to Y-TZP ceramics is a Ce-TZP ceramics, which resists to LTAD and has high parameters of durability. Unfortunately, the bending strength of the Ce-TZP ceramics could not reach the values of Y-TZP ceramics.

The object of this work: changing stabilizer Y^{+3} for obtaining ceramic materials with high parameters of purity and possess a thin microstructure and adequate sanitary-chemical requirements for materials used for medical purposes.

Experimental procedure

Source powders for ceramic materials were obtained on the basis of compositions where ZrO_2 is stabilized by CeO_2 and Yb_2O_3 in tetragonal modification.

The powder precursors were obtained by hydrosol version of the sol-gel process in presence of polyvinyl alcohol and isobutanol as the complex surface-active substances under simultaneous component precipitation. A concentrated solution of aqueous ammonia was used as a precipitant. Gel-like precipitates were dried, then obtained xerogel was heat treated and sintered [2].

Research and control methods

The ultimate composition of the precursor was determined on the basis of the technique of atomic emission spectrometry with inductively coupled plasma using an ULTIMA-2 spectrometer of the JOBIN YVON HORIBA Company (France-Japan). The relative standard deviation (S_r) for different elements did not exceed 0.025.

To measure the powder surface area, a low-temperature adsorption technique was used (TriStar-3000 adsorptive-structural analyzer, Micromeritics, USA).

Qualitative analysis of samples was carried out means of an XRD-6000 diffractometer (Shimadzu) on radiation $CuK_a\lambda$ =1.54 A in the interval of angles 2θ=26°–65° with scanning step of 0.02° and identification according to international standard bank (JCPDS).

Ceramic relative density and void structure was determined by means of hydrostatic weighing.

Ultimate bending strength and crack strength were determined by the three -point bending technique on a Instron 5581universal testing machine.

Scanning electron microscope "LEO1420" and atomic force microscope "NEXT" were used to study the microstructure of the ceramics.

The instability caused by low– temperature aging degradation (LTAD), was tested in the hot aqueous solutions within 7 hours that is equivalent to 20 years of stay implant in an alive body.

Results

The content of these powders is represented by the only main crystal phase, which corresponds to a solid solution based on T-ZrO_2

We obtained ceramic materials based on synthesized powders with a specific density 99% than the theoretical one.

According to electron microscopy of the obtained ceramic materials, average grain sizes vary from 400 to 200 nm. It benefits the increasing the stability at low temperature aging. The results of AFM study reveal the structure is traced on all volume of a sample and is submitted of fine grains separate from each other is without the large connections of borders, which could create of a crack in microstructure. The microstructure of ceramic stabilized by Yb_2O_3 is shown at FIG.1.

A longitudinal and cross speeds of a sound were measured at samples ceramics, accordingly, 6800-6700 м/с and 3600- 3700 м/с.

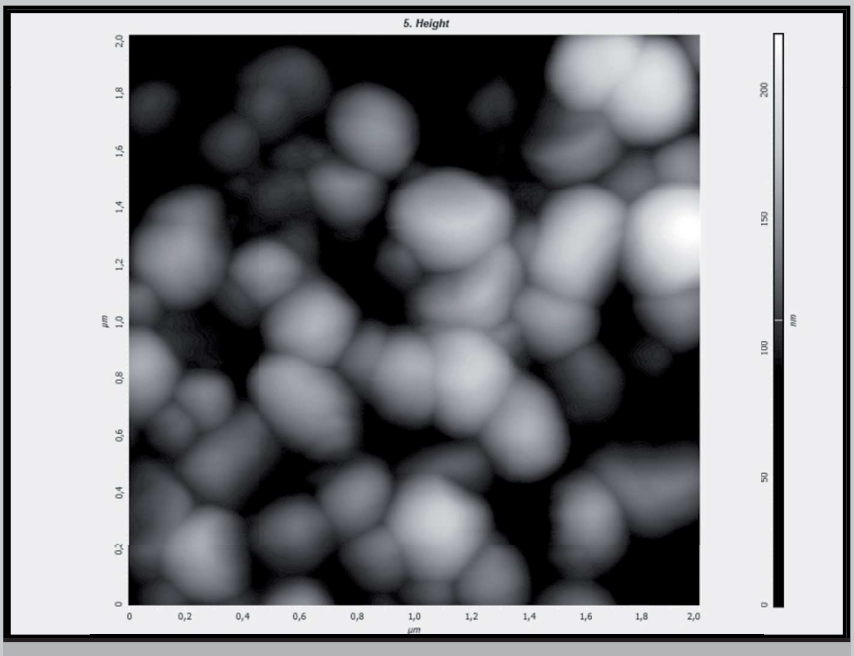

FIG. 1. The images of ceramic with Yb_2O_3 obtained by AFM.

TABLE 1. Residual element content in precursors by YB_2O_3

Element	Content [wt %]
Hf	1,2
Al	O,25
Ca	~0,01
Fe	< 0,01
Na	< 0,01
Ba	< 0,001

The ultimate bending strength of ceramics stabilized by CeO_2 and Yb_2O_3 remained without changes after aging in hot water environment.

The quantity of residual elements in the synthesized powders is insignificant; its qualitative composition is not dangerous to health. As TABLE 1 shows, among residual elements, the content of Hf is the maximal one, which is an inseparable residual element of Zr.

Investigation of subacute toxicity was carried out in conditions where white mice intragastrically repeatedly received ceramic extracts. During the whole observation period, there were no cases of test animal death or changes in appearance, behavior, eating, and physical activity compared to control group. The toxicity index was 98% with the standard value from 70 to 120%. Sample extracts did not show any hemolytic action in experiments in vitro with isolated erythrocytes of rabbits: hemolysis was 0% with the permissible value less than 2%.

Ceramics based on T-ZrO_2 stabilized by CeO_2 and Yb_2O_3 are nontoxic, meets the requirements of standardized documentation, and can be applied as a material for medical purposes.

Acknowledgements

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References

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COMPARATIVE ASSESSMENT OF THE PREPARATIONS "BIOSITAL" AND "KAFAM" INFLUENCE COMBINED WITH ELECTROACUPUNCTURE ON THE HEALING OF ALVEOLAR PROCESSES OF THE MAXILLA BONES IN EXPERIMENT

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Introduction

It's well known that special care rendering by stomatological health authorities is in great demand. Bone defects left in the maxilla bones after the healing of chronic odontogenic infection focuses, treatment of non-cancerous growth after the implants extraction considerably reduce the maxilla bone strength and worsen conditions of the tooth system functioning, provoke disturbance of the chewing function what has negative influence on the human body state [1,5]. Thus, development and introduction into the clinical practice of the new complex methods of patients rehabilitation with bone defects of alveolar processes allowing effective recovery and reconstruction of the injured tissues and remain the main direction in maxillofacial surgery and stomatology.

Toxico-hygienic examinations of «Biosital» and «Kafam» preparations made before, demonstrated that they have bioactive characteristics due to the calcium and phosphorus migration from the surfaces of these materials when contacting with the blood plasma which cause there high osteogenic indices. There are scientific medical works confirming the positive effects of electroacupuncture on the processes of bone modeling [4]. But the range of morphological aspects of the complex interaction of mentioned above osteotrop medicines with biological tissues during the acupuncture treatment is not yet studied and examined actually.

Aim of the work was to make comparative evaluation of the preparations «Biosital», «Kafam» influence and electroacupuncture treatment with electronic device «Vityaz AET-01» in skin projection of acupoints on the process of the alveolar sockets healing after the teeth extraction on the lower jaw in experiment according to the clinic macroscopic visual evaluation data.

Objects and methods

Examination was performed according to the Regulations for experiments on animals [2]. Experiment was done on 45 sexually mature males of Shinshila rabbits of the same age and weight. All animals were divided into 5 series, 9 animals in every one. The first series was the control one. Animals of this series had operation for the central incisor extrac-