



US 20050160678A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0160678 A1**
Bourlier (43) **Pub. Date: Jul. 28, 2005**

(54) **ABRASIVE PARTICLES BASED ON
ALUMINIUM OXYNITRIDE**

Publication Classification

(51) **Int. Cl.⁷** **B24D 3/02**

(52) **U.S. Cl.** **51/307; 501/98.4; 501/153;
501/127**

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(57) **ABSTRACT**

A plasma processing apparatus includes an evacuable processing vessel; a workpiece mount base for mounting thereon an object to be processed; a microwave transmitting plate provided in an opening of a ceiling of the processing vessel; a planar antenna member for supplying a microwave into the processing vessel via the microwave transmitting plate; a shield lid grounded to cover a top of the planar antenna member; a waveguide for guiding the microwave to the planar antenna member; a member elevating mechanism for relatively varying a vertical distance between the planar antenna member and the shield lid; a tuning rod insertable into the waveguide; a tuning rod driving mechanism for moving the tuning rod to adjust an insert amount thereof; and a matching control section for controlling an elevation amount of the planar antenna member and the insert amount of the tuning rod to obtain a matching adjustment.

(21) **Appl. No.: 10/504,154**

(22) **PCT Filed: Feb. 24, 2003**

(86) **PCT No.: PCT/FR03/00594**

(30) **Foreign Application Priority Data**

Feb. 28, 2002 (FR)..... 0202554

ABRASIVE PARTICLES BASED ON ALUMINIUM OXYNITRIDE

TECHNICAL DOMAIN OF THE INVENTION

[0001] The invention relates to the domain of abrasive grains, particularly agglomerated grains designed for use on grinding wheels, grains applied to cloth and paper type supports, and grains used for projection or in polishing paste.

STATE OF THE ART

[0002] In the domain of abrasives, alumina based products occupy an important place and have been done for many years, since the use of emery was already known in the Greek world. The most commonly used product nowadays is electrically melted corundum, which is white corundum composed of almost pure alumina, or brown and less pure corundum obtained by melting-reduction of bauxite.

[0003] Patent GB 786815 (National Lead) filed in 1954 describes hard abrasive grains in which fine crystals of titanium carbide are dispersed in a corundum matrix.

[0004] Major progress has been made with the appearance of abrasive grains obtained by sintering of sol-gel aluminas. Thus, patent EP 0273569 (3M) describes abrasive particles composed of alumina, γ aluminium oxynitride (AlON) and possibly a nitride of a metal in group IVb in the periodic classification table, prepared by sol-gel method and reactive sintering. The high cost of these products has caused a search for abrasive grains capable of giving a better quality-price ratio.

[0005] Patent EP 0494129 filed by the applicant describes a direct process using nitrogen for the nitridation of metals with a low melting point, and particularly aluminium.

[0006] Patent EP 0509940 filed by the applicant describes a wide range of abrasive or refractory products based on oxynitrides obtained by melting in an electric furnace, including AlON type aluminium oxynitride-based products.

[0007] Patent FR 2720391 filed by the applicant describes abrasives based on AlON oxynitride, obtained by melting in an electric furnace, for which the hardness has been improved by dispersing fine crystals of titanium carbide in the basic material.

SCOPE OF THE INVENTION

[0008] The purpose of the invention is to provide abrasive grains based on aluminium oxynitride, that will be used as grains applied to cloth and paper type supports, or agglomerated grains in metal and metallic alloy grinding wheels, or in projection or in a polishing paste, and capable of high performances.

PURPOSE OF THE INVENTION

[0009] The purpose of the invention is abrasive grains based on aluminium oxynitride, with an equivalent content of AlN as measured on an Al_2O_3 -AlN pseudo-binary diagram equal to between 2.5% and 7.5%, and preferably between 3 and 6% by weight, and a structure composed mainly of ϕ' AlON and γ AlON.

[0010] These grains usually have a metal aluminium content of less than 0.3% by weight and preferably 0.1%, and a free aluminium nitride content AlN of less than 0.3% and preferably less than 0.1%.

[0011] Another purpose of the invention is a process for preparation of such abrasive grains including the preparation of a charge of alumina, aluminium nitride AlN and/or oxynitride $\text{Al}_x\text{O}_y\text{N}_z$, and possibly titanium oxide and/or chromium oxide, this charge being melted and cooled at less than 1°C . per minute. Another purpose is a process for preparation of such abrasive grains including the preparation of a mix of alumina, aluminium nitride AlN and/or oxynitride $\text{Al}_x\text{O}_y\text{N}_z$ and possibly titanium oxide and/or chromium oxide powders, reactive sintering of this mix at a temperature of between 1950 and 2000°C ., and cooling of the sintered grains at less than 1°C . per minute.

DESCRIPTION OF THE INVENTION

[0012] The following defines the composition of products made of aluminium oxynitride by their equivalent content in AlN, considering an AlN- Al_2O_3 pseudo-binary diagram rather than an Al-O-N ternary diagram, which in no way means that these AlN and Al_2O_3 phases are actually present in the product described. Therefore, a distinction is made between equivalent contents of AlN that are only intended to position the corresponding product in the pseudo-binary diagram, and the real contents of AlN denoted as free AlN contents.

[0013] Three defined aluminium oxynitride type compounds are known, that can be described in the AlN- Al_2O_3 pseudo-binary diagram:

[0014] compound 2 Al_2O_3 , AlN that forms a solid phase called the " γ phase", for which the equivalent content in AlN is 16.7%, but for which the existence range that depends on the temperature extends from 6.6% to 18.6% of AlN. This phase is only stable between 1640°C . and 2085°C ., and is slowly decomposed in the solid state below 1640°C . This material is often called γ AlON.

[0015] compound 4 Al_2O_3 , AlN that forms a solid phase called the " ϕ' phase", for which the equivalent content of AlN is 9.1%, but for which the existence range that depends on the temperature, extends from 4.7% and 9.3% of AlN. This phase is only stable between 1925°C . and 2064°C ., and slowly decomposes in the solid state below 1925°C . This material is often called ϕ' AlON.

[0016] compound 8 Al_2O_3 , AlN that forms a solid phase called " δ phase", for which the equivalent content of AlN is 4.8%. This phase is only stable between 1985°C . and 2041°C . Below 1985°C ., this phase decomposes into the ϕ' phase and α alumina.

[0017] Many studies have been carried out on the Al_2O_3 -AlN phases diagram, including a thesis by Patrick Tabary in the *Université de Paris-Sud* (Paris South University) in 1997.

[0018] It is found that the value of the Vickers hardness for the three phases described is 18.4 GPa compared with 20 GPa for corundum and 22 GPa for aluminas obtained using the sol-gel method.

[0019] These three phases have a remarkable chemical inertia and cannot be attacked by water over a wide pH range. On the other hand, the AlN nitride quickly decomposes on contact with water, producing ammonia gas.

[0020] The applicant has attempted to develop abrasive grains based on aluminium oxynitride of the γ AlON type, with an equivalent content of AlN between 11 and 12.5%, prepared by direct nitridation and melting according to patents EP 0 494 129 and EP 0 509 940, and obtained by fast cooling from the molten material.

[0021] Experience has shown that despite a strong quenching, it was impossible to avoid some decomposition of γ AlON into aluminium nitride and alumina, which has the consequence of leaving a product which releases ammonia when in contact with moisture.

[0022] Moreover, despite a hardness that is significantly less than the hardness of α alumina, the abrasive properties of this material are admittedly better than the properties of α alumina, but are not as good as the properties of abrasive grains prepared using the sol-gel method.

[0023] While manufacturing a γ AlON type electrically melted material designed to be cast and quenched, an incident on the furnace caused a prolonged shutdown; the content finally solidified in the furnace without being cast and the absence of liquid content made it impossible to resume melting. Finally, the furnace was disassembled and it was particularly difficult to demolish it. The zones that were the most difficult to demolish were analysed to identify the materials that had particularly attractive properties, despite the low equivalent contents of AlN and a particularly slow cooling rate.

[0024] The applicant thus isolated the materials that were composed of a mix of ϕ' AlON and γ AlON, and which had unusual and unexpected hardness after very slow cooling.

[0025] This type of material prepared in grains demonstrated exceptional abrasive qualities, very much better than those according to prior art, with AlN contents of between 11 and 12.5%.

[0026] This material was then produced using a Higgins type furnace instead of the melting furnace; in this technique, the furnace is filled gradually and the contents are not poured from it. The furnace is abandoned when it is full and is allowed to cool naturally. Note that the cooling rate of the material thus produced depends directly of the size of the furnace.

[0027] After several tests intended to optimise the material composition, an optimum composition range was finally identified with equivalent contents of AlN between 2.5% and 7.5%, and preferably between 3% and 6%.

[0028] Despite cooling rates very much less than 1° C. per minute that are observed with a furnace capable of preparing 16 tonne masses, very low real contents of AlN were observed, less than 0.3% or even less than 0.1%.

[0029] Moreover, the product obtained is mechanically stable in contact with water. Thus, washing of the grain product with water can eliminate traces of residual AlN without corrupting the mechanical quality of the grains; thus, the real content of AlN in grains can be lowered to less than 0.01%. The advantage of washing with water in this way is essentially to provide grains that will not release any smell when it comes into contact with moisture later on.

[0030] It was also observed that processes described in EP 0494129 and EP 0509940 can be used to obtain materials with low contents of aluminium metal.

[0031] Thus, materials according to the invention used in these processes may be prepared with Al contents of less than 0.3%, or less than 0.1%. If care is taken to perform washing with water to destroy AlN traces with acid water with a pH of between 5 and 7, for example with sulphuric acid, the content of residual aluminium can be lowered at the same time to less than 0.01%.

[0032] In the process described in patents EP 0494129 and EP 0509940, the manufacture of molten and cast oxynitrides requires the preparation of a large volume liquid bath heated sufficiently to enable pouring. This step appears inevitable in order to obtain a stabilised product by quenching. However, it unexpectedly appeared that with extremely slow cooling rates, much less than 1° C. per minute such as can be obtained with an industrial Higgins furnace weighing several tonnes, it is possible to obtain products that firstly contain very little free aluminium nitride, and secondly maintain a structure with a majority composition of ϕ' AlON and γ AlON. These products have remarkable abrasive properties, and particularly a hardness equal to or more than 16 GPa and a toughness equal to or more than 1.5 MPaVm.

[0033] The applicant has also observed that a tougher material could be obtained by adding titanium and/or chromium oxide with a global content of between 0.2 and 3.5%, and preferably between 2.5 and 3.5% by weight of the total content.

[0034] Thus, for example, some or all of the alumina in the contents of the Higgins furnace can be replaced by brown corundum containing titanium oxide. The result obtained for a content of brown corundum containing 3% of TiO₂ and aluminium oxynitride prepared by the process according to patent EP 0494129 is materials with toughness more than 2 MPaVm.

[0035] The advantage of melting in a Higgins type industrial furnace is that it becomes possible to work with a much simpler process than that described in patents EP 0494129 and EP 0509940.

[0036] Products according to the invention can also be made by sintering under an inert atmosphere of nitrogen or argon, starting from basic materials at temperatures of between 1950° C. and 2000° C. The abrasive properties of the abrasive grains thus obtained are similar to the properties of the product obtained by passing through the liquid phase, provided that this material is restored to ambient temperature at comparable cooling rates.

EXAMPLES

[0037] Analysis and Check Methods

[0038] The equivalent AlN content was measured on 5 mg samples weighed to within 0.1 mg, by combustion in a LECO CT 436 gas analyzer, and analysis by thermal conductivity for nitrogen, and infrared absorption spectrometer for oxygen.

[0039] The result given for each sample is the average of five measurements.

[0040] The content of free AlN is measured by acid attack in a sulphuric medium and analyses of the NH₄⁺ ions obtained.

Example 1

[0041] 2500 kg of powder Bayer alumina smaller than 100 μm was mixed with 1000 kg of powder alumina with a size grading smaller than 1.2 mm. This mix was placed in a leaktight furnace, vacuum degassed, then heated at a nitrogen pressure of 1 at.

[0042] Nitridation started at about 700° C., and the nitrogen pressure was maintained to facilitate the temperature increase of the content. The exothermal reaction made it possible to reach about 1750° C. at the end of the operation.

[0043] The mass recovered after cooling at the end of the operation was 4010 kg, and it is porous, homogenous, and not very strong mechanically.

[0044] The operation was repeated three times, and the end result was a 16100 kg batch that was ground to a size grading of less than 10 mm, and was then sampled and analysed. The analysis results were:

[0045] Content of equivalent AlN: 35.6%

[0046] Real content of AlN in the form AlN: 5.3%

[0047] Content of Al metal: 0.05%.

Example 2

[0048] 16000 kg of a mix composed of 3200 kg of the product obtained in example No. 1 and 12800 kg of Bayer alumina was prepared.

[0049] This mix was melted in a 1.8 MW Higgins furnace.

[0050] The furnace was shutdown at the end of the operation, and allowed to cool naturally. After five days, the mass obtained was sufficiently cool so that it could be broken.

[0051] A structural examination was carried out on the product obtained, and two main phases were observed, namely ϕ' AlON and γ AlON, with a minority phase, namely α alumina.

[0052] The product obtained was ground and packaged in grains.

[0053] The analysis results for this product were:

[0054] Content of equivalent AlN: 5.9%

[0055] Real content of AlN in the form AlN: 0.05%

[0056] Content of Al metal: 0.02%.

[0057] The product was ground, washed with water, dried and then packaged and sorted into different size gradings, including F30 grains and F80 grains according to the FEPA standard.

[0058] These grains were tested in a moist atmosphere: no release of ammonia gas was detected.

[0059] The mechanical properties of F30 grains obtained in the operation were measured by indentation with a force of 2N applied for 10 seconds and compared with the results given by other products.

[0060] Table 1 contains the results:

TABLE 1

	Knoop hardness	Vickers hardness	Toughness
Product of example 2	18.1 GPa	17.7 GPa	1.65 MPa · m ^{1/2}
White corundum	20.3 GPa	20 GPa	2.0 MPa · m ^{1/2}
Al oxynitride according to prior art	18.0 GPa	17.3 GPa	1.6 MPa · m ^{1/2}
Sol-gel type abrasive	21.5 GPa	21.2 GPa	3.7 MPa · m ^{1/2}

[0061] Two batches of F80 abrasive grains were prepared for comparative tests of wheels with a vitrified binder:

[0062] one batch of sol-gel alumina grains like those usually used in this application,

[0063] one batch of abrasive grains derived from the previous example.

[0064] Six batches of grinding wheels were made, using a mix of 70% of F80 grains of electrically melted white corundum and 30% of grains to be tested, in each case.

[0065] The dimensions of these grinding wheels were as follows:

[0066] Outside diameter=160 mm; inside diameter=20 mm; thickness=20 mm.

[0067] Three batches of grinding wheels were made with these samples, with binder contents corresponding to grades I, K and M.

[0068] Grinding tests were carried out with these six batches of grinding wheels on 100C6 steel rods with section 12×12 mm at a pressure of 2 bars and a tangential wheel velocity at the periphery of 50 m/s. The duration of each test was 6 minutes, namely 3 operations of 2 minutes each, with a stop lasting for 3 minutes between 2 successive operations.

[0069] Table 2 contains the results obtained in terms of the three frequently used parameters: material removal, G ratio (material removal/grinding wheel wear) and absorbed power:

TABLE 2

	Sol - gel alumina			Product of example 2		
	Grade I	Grade K	Grade M	Grade I	Grade K	Grade M
Material removal (g/min)	15.6	8.9	5.3	19.0	15.0	13.0
G ratio	50.6	38.3	27.7	48.7	42.8	43.3
Absorbed power (W)	955	1068	1113	912	1350	1560
Energy / removal of material (kwh/kg)	1.02	2.0	3.5	0.8	1.5	2.0

[0070] Therefore, it can be seen that material can be removed more quickly, the G ratio is better and energy

consumption is lower, than for the best product according to prior art, resulting in less temperature rise of the machined part.

[0071] The same grinding test was carried out using three M grade batches of grinding wheels made under the same conditions as in the above examples, either using the batch of grains prepared in this example, or using a batch of Al oxynitride type grains according to prior art, or a batch of sol-gel alumina grains like those usually used in this application.

[0072] This test was followed by a grinding wheel test made exclusively with white corundum F80 grains.

[0073] Table 3 contains the results expressed in terms of the three frequently used parameters: material removal, G ratio (material removal/grinding wheel wear) and absorbed power:

TABLE 3

	Material removal	G ratio	Absorbed power (W)	Energy/Material removal (kwh/kg)
Product of example 2	13.0	43.3	1560	2.0
Al oxynitride according to prior art	5.4	20.6	1231	3.8
Sol-gel type abrasive	5.3	27.7	1113	3.5
White corundum	4.9	15.0	1558	5.3

Example 3

[0074] A mix was prepared composed of 20% of the product obtained in Example No. 1 and 80% of Bayer alumina. This mix was ground to a size grading of less than 2 μm . A paste was prepared by mixing with the addition of 1% of carboxymethylcellulose, and was then pressed to 500 bars and extruded into 1 mm diameter cylindrical rods.

[0075] This unbaked material was then treated at 1950° C. and then cooled to ambient temperature at a rate of 1° C. per minute.

[0076] The material was then ground, washed, dried and then sorted: the following operations were carried out on F30 and F80 grains:

[0077] on F30 grains, the mechanical properties of the material were measured,

[0078] F80 grains were used to make a batch of Grade M grinding wheels under exactly the same conditions as in Example 2; these grinding wheels were tested under the same conditions as in the previous example.

[0079] Table 4 contains the results of these tests:

TABLE 4

	Knoop hardness	Vickers hardness	Toughness
Product of example 3	17.9 GPa	17.5 GPa	1.6 MPa $\sqrt{\text{m}}$

TABLE 4-continued

Sol-gel type abrasive	21.5 GPa	21.2 GPa	3.7 MPa $\sqrt{\text{m}}$	
	Material removal (g)	G ratio	Absorbed power (W)	Energy/Material removal (kwh/kg)
Product of example 3	7.9	43	1232	2.6
Sol-gel type abrasive	5.3	27.7	1113	3.5

Example 4

[0080] Example 2 was repeated, replacing the Bayer alumina in the content of the Higgins furnace by brown corundum with a TiO₂ content of 3.6%.

[0081] The analysis results for this product were:

[0082] Content of equivalent AlN: 6/0%

[0083] Real content of AlN in the form AlN: 0.05%

[0084] Content of Al metal: 0.02%

[0085] Titanium content “expressed in TiO₂”: 2.8%

[0086] According to the jargon used by a chemist skilled in the art, the expression “expressed in TiO₂” means that the determined content of elementary titanium has been multiplied by 80/48, by making the simpler and partially incorrect assumption that all titanium is present in the form of oxide.

[0087] The product obtained was then ground, washed with water, dried, then packaged and sorted into different size gradings, including F30 grains and F80 grains according to the FEPA standard.

[0088] These grains were tested in a moist atmosphere: no release of ammonia gas was detected.

[0089] The mechanical properties of F30 grains obtained in the operation were then measured by indentation using a force of 2N applied for 10 seconds and compared with the results given by other products.

[0090] Table 5 contains the results:

TABLE 5

	Knoop hardness	Vickers hardness	Toughness
Product of example 2	18.1 GPa	17.7 GPa	1.65 MPa $\cdot$ m ^{1/2}
White corundum	20.3 GPa	20 GPa	2.0 MPa $\cdot$ m ^{1/2}
Al oxynitride according to prior art	18.0 GPa	17.3 GPa	1.6 MPa $\cdot$ m ^{1/2}
Sol-gel type abrasive	21.5 GPa	21.2 GPa	3.7 MPa $\cdot$ m ^{1/2}
Product of example 4	18.9 GPa	18.0 GPa	2.4 MPa $\cdot$ m ^{1/2}

[0091] Table 6 contains the results obtained in the grinding test:

TABLE 6

	Grade I	Grade K	Grade M
Material removal (g/min.)	16.6	12.0	8.0
G ratio	47.4	41.4	32.0
Absorbed power (W)	896	1224	1200
Energy/removal of material (kWg/kg)	0.9	1.7	2.5

Example 5

[0092] A mix composed of 20% of the product obtained in Example No. 1 and 80% of brown semi-friable corundum with a TiO₂ content of 1.4%, was prepared.

[0093] This mix was ground to a size grading of less than 2 μ m.

[0094] A paste was prepared by mixing with the addition of 1% of carboxymethylcellulose, and then pressed at 500 bars and extruded in 1 mm diameter cylindrical rods.

[0095] This unbaked material was then treated at 1980° C. and then cooled to an ambient temperature at a rate of 1° C. per minute.

[0096] This material was then ground, washed, dried, then sorted; the mechanical properties of the material were measured on the F30 grains thus obtained.

[0097] Table 7 contains the results of these tests:

TABLE 7

	Knoop hardness	Vickers hardness	Toughness
Product of example 5	19.0 GPa	18.6 GPa	2.2 MPa · m ^{1/2}
Sol-gel type abrasive	21.5 GPa	21.2 GPa	3.7 MPa · m ^{1/2}

Example 6

[0098] A melting test was carried out in a Higgins furnace with the following content:

[0099] 1500 kg of product obtained in Example 1

[0100] 1500 kg of Bayer alumina

[0101] 13000 kg of brown corundum with 3.6% of TiO₂.

[0102] This mix was melted in 1.8 MW Higgins furnace.

[0103] At the end of the operation, the furnace was shut-down and allowed to cool naturally. After five days, the mass obtained was sufficiently cooled so that it could be broken.

[0104] A structural examination was carried out on the product obtained, and two main phases were observed, namely ϕ' AlON and γ AlON, with a minority phase of α alumina. The product obtained was ground and packaged in grains.

[0105] The analysis results for this product were:

[0106] Content of equivalent AlN: 3.0%

[0107] Content of titanium expressed as TiO₂: 2.9%

[0108] The product was then ground, washed with water, dried and then packaged and sorted into different size gradings including F30 grains and F80 grains according to the FEPA standard.

[0109] These grains were tested in a moist atmosphere: no release of ammonia gas was detected.

[0110] The mechanical properties of F30 grains obtained in the operation were measured by indentation with a force of 2 N applied for 10 seconds and compared with the results given by other products.

[0111] Table 8 contains the results:

TABLE 8

	Knoop hardness	Vickers hardness	Toughness
Product of example 2	18.1 GPa	17.7 GPa	1.65 MPa · m ^{1/2}
White corundum	20.3 GPa	20 GPa	2.0 MPa · m ^{1/2}
Al oxynitride according to prior art	18.0 GPa	17.3 GPa	1.6 MPa · m ^{1/2}
Product of example 4	18.5 GPa	18.0 GPa	2.0 MPa · m ^{1/2}
Product of example 6	18.9 GPa	18.4 GPa	2.4 MPa · m ^{1/2}

1. Abrasive grains based on aluminium oxynitride, characterised by an equivalent content of AlN as measured on an Al₂O₃AlN pseudo-binary diagram equal to between 2.5% and 7.5% by weight, and a structure composed mainly of ϕ' AlON and γ AlON.

2. Abrasive grains according to claim 1, characterised by an equivalent content of AlN equal to between 3% and 6% by weight.

3. Abrasive grains according to claim 1, characterised by a metal aluminium content of less than 0.3% by weight, and a free aluminium nitride content AlN of less than 0.3%.

4. Abrasive grains according to claim 3, characterised by a metal aluminium content of less than 0.1% by weight, and a free aluminium nitride content AlN of less than 0.1%.

5. Abrasive grains according to claim 1, further comprising titanium and/or chromium oxides at a total content of between 0.2% and 3.5% by weight.

6. Abrasive grains according to claim 5, further comprising titanium and/or chromium oxides at a total content of between 2.5% and 3.5% by weight.

7. Process for preparation of abrasive grains according to claim 1, including the preparation of an alumina content, or an aluminium nitride AlN and/or oxynitride Al_xO_yN_z, this content being melted and cooled at less than 1° C. per minute.

8. Process according to claim 7, characterised in that the content also includes titanium and/or chromium oxide.

9. Process according to claim 8, characterised in that the titanium oxide is added to the content in the form of brown corundum containing from 1% to 4% TiO₂.

10. Process according to claim 7, characterised in that melting is done in a Higgins furnace without pouring.

11. Process for preparation of abrasive grains according to claim 1, including the preparation of a mix of alumina, aluminium nitride AlN and/or oxynitride $\text{Al}_x\text{O}_y\text{N}_z$ and possibly titanium oxide and/or chromium oxide powders, reactive sintering of this mix at a temperature of between 1950 and 2000°C ., and cooling of the sintered grains at less than 1°C . per minute.

12. Process according to claim 11, characterised in that the mix also contains chromium oxide and/or titanium oxide.

13. Process according to claim 12, characterised in that the titanium oxide is added in the form of brown corundum containing from 1% to 4% of TiO_2 .

14. Process according to claim 7, characterised in that it includes final washing of the grains with acid water with a pH of between 5 and 7.

15. Abrasive grains prepared according to the process claimed in claim 14, characterised by an aluminium metal content less than 0.01% and a real content of aluminium nitride Al less than 0.01%.

16. Abrasive grains according to claim 1, characterised by a hardness equal to or more than 16 GPa, and by a toughness equal to or more than 1.5 MPa $\sqrt{\text{m}}$.

17. An abrasive grinding wheel for grinding metals and metallic alloys, comprising abrasive grains according to claim 1.

18. Abrasive cloth or paper support for polishing comprising abrasive grains according to claim 1.

19. A polishing paste or spraying abrasive comprising abrasive grains according to claim 1.

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