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Datasheet for the decision of 14 July 2009

Case Number: T 1874/06 - 3.2.07

Application Number: 97937764.5

Publication Number: 1021584

IPC: C23C 14/06

Language of the proceedings: EN

Title of invention:
Tool with protective layer system

Patentee:
Unaxis Balzers Aktiengesellschaft

Opponent:
Hauzer Techno-Coating B.V.

Headword:
-

Relevant legal provisions:
EPC Art. 83, 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Sufficiency of disclosure (yes)"
"Inventive step (all requests - no)"

Decisions cited:
T 0198/84

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1874/06 **-** 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 14 July 2009

Appellant: (Patent Proprietor)
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Representative:
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 13 October 2006 revoking European patent No. 1021584 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: P. O'Reilly
Members: H. Hahn
I. Beckedorf

Summary of Facts and Submissions

I. The patent proprietor (appellant) lodged an appeal against the decision of the Opposition Division to revoke European patent No. 1 021 584.

II. In this decision the following documents are cited:

E1 = Thin Solid Films 195 (1991), pages 99-110, Metallurgical and Protective Layers, T. Ikeda and H. Satoh: "Phase formation and characterization of hard coatings in the Ti-Al-N System, prepared by the cathodic arc plating method"

E2A = English translation of Japanese patent Pub. No. 08-209335 [Appl. No. 07-034632] Hitachi Tool Eng. Ltd., published 13/08/96

D4 = Thin Solid Films, 193/194 (1990), pages 547-556, J.R. Roos et al.: "Interrelationship between processing, coating properties and functional properties of steered arc physically vapour deposited (Ti,Al)N and (Ti,Nb)N coatings", XP000168996

D5 = Thin Solid Films, 293 (1997), pages 212-219, B.-Y. Shew et al.: "Effects of r.f. bias and nitrogen flow rates on the reactive sputtering of TiAlN films", XP004080859

Sketches A and B as filed by the appellant with letter of 13 February 2007

Annex B = XRD diffractogram of a TiAlN2 layer on HSS

III. An opposition had been filed against the patent in its entirety under Article 100(a) EPC, for lack of novelty and inventive step, and under Article 100(b) EPC, that the patent does not disclose the invention in a manner

sufficiently clear and complete for it to be carried out by a person skilled in the art.

IV. The Opposition Division held that claims 1 to 16 of the single request as filed at the oral proceedings of 14 September 2006 met the requirements of Articles 83, 123(2) and (3) and of Article 54 EPC. The Opposition Division considered that the subject-matter of claims 1 and 12 did not meet the requirements for a selection invention with respect to E2A since the selected range of $Q_I \geq 5$ is not narrow compared to the range of $Q_I \geq 1.5$ of E2A and is also not far removed from its example 7 showing $Q_I = 2.3$ and the Patentee was unable to show a special technical effect for said selection of a Q_I value of ≥ 5.

V. With a communication annexed to the summons dated 28 January 2009 the Board arranged for oral proceedings and presented its preliminary opinion based on claims 1-15 of a single request as filed together with the grounds of appeal dated 13 February 2007.

It stated amongst others that independent claims 1 (e.g. the intermediate generalization of the upper value of the new Q_I range of from $5 \leq Q_I \leq$ **22.5** appeared not to be allowable) and 12 seemed to contravene Article 123(2) EPC so that the single request did not seem to be admissible.

With respect to the issue of Article 83 EPC the Board indicated that it seemed that the determination of the "average noise intensity" of a diffractometer most presumably will be done automatically by software of the diffractometer. It seemed that the Siemens

diffractometer D500 carried out such a noise correction. The arguments of the respondent concerning repeating measurements with the Siemens diffractometer D500 for infringement appeared not to be convincing since diffractometers of different manufacturers should produce identical XRDs when using the same radiation source and parameters. With respect to the fluorescence according to annex B the Board indicated that it seemed that the XRD conditions for measuring the sample were such that they did not seem to fall under the definition of the diffractometer settings of claims 1 and 12, that fluorescence was not covered by "noise", and that this would be discussed at the oral proceedings.

With respect to the discussion of inventive step the Board remarked that this issue would be dealt with taking into consideration the problem-solution approach. Starting from the closest prior art and taking account of the problem to be solved - which would be based on the effect of the distinguishing features - it would be discussed whether or not the available prior art, particularly E2A or E1, rendered obvious the subject-matter claimed when either combined with another teaching in the prior art or with the common general knowledge of the person skilled in the art.

In this context the Board noted with respect to "sketch A" of the appellant that it would be discussed whether or not it is suitable to demonstrate an effect of the Q_I value in the range of from 5 to 22.5, and whether or not it is in agreement with the established case law of the Boards of Appeal, i.e. that this effect has its origin (only) in the distinguishing feature. The Board

annexed a diagram to the communication and stated in this context that it would be discussed with respect to the points of "sketch B" whether or not the person skilled in the art can reach a Q_I value of 5 or more taking account of extrapolations based on the data for the six coating materials of Table 1 according to E2A and when considering that the applied middle bias voltage is stated to be 50-100 V. It further remarked that it appeared that the patent in suit does not reveal any examples which prove that the limitation of the x-range and y-range according to the subject-matter of claim 1 is actually critical.

Finally the Board remarked that any further written submission should be filed as soon as possible and at least one month before the date of the oral proceedings and that the admittance of facts and evidence was still subject to the provisions of Article 114(2) EPC and Articles 12 and 13 of the Rules of Procedure of the Boards of Appeal (RPBA).

VI. With letter dated 20 May 2009 the appellant submitted two sets of claims as an amended main request and first auxiliary request together with arguments concerning the allowability of the amendments made therein and concerning the patentability of the subject-matter of these claims, taking account of the Board's communication.

VII. The respondent submitted with a first undated letter received on 12 June 2009 and with a second letter dated 15 June 2009 further arguments with respect to the patentability of the subject-matter of the claims of the two new requests.

VIII. Oral proceedings before the Board were held on 14 July 2009.

(a) The appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the set of claims filed as the main request during the oral proceedings, or alternatively, on the basis of one of the sets of claims filed as auxiliary requests I, II and III during the oral proceedings.

(b) The respondent requested that the appeal be dismissed.

At the end of the oral proceedings the Board announced its decision.

IX. Claims 1 and 12 of the main request dated 14 July 2009 read as follows:

"1. A tool with a tool body and a wear resistant layer system, said layer system comprising at least one layer of MeX, wherein
- Me comprises titanium and aluminum;
- X is at least one of nitrogen and of carbon
and wherein said layer has a Q_I value which is at least equal to a predetermined value,
wherein $Q_I=I(200)/I(111)$
and said tool body is of one of the materials
- high speed steel (HSS);
- cemented carbide,
characterized by the facts that said layer comprises said titanium with a content x in the Me component of the MeX material for which there is valid:

$$70 \text{ at.\%} \geq x \geq 40 \text{ at.\%}$$

and an aluminum content y in the Me component of the MeX material for which there is valid:

$$30 \text{ at.\%} \leq y \leq 60 \text{ at.\%},$$

and wherein said Q_I value is:

$$5 \leq Q_I$$

and said tool is not a solid carbide end mill and not a solid carbide ball nose mill and whereby the value of I(200) is at least 20 times the intensity average noise value and wherein I(200)- and I(111)-values as well as the intensity average noise value are measured with following equipment and settings:

Siemens Diffractometer D500	
Power	Operating voltage: 30 kV Operating current: 25 mA
Aperture Diaphragms	Diaphragm position I: 1° Diaphragm position II: 0.1°
Detector Diaphragm	Soller slit
Time constant	4 s
2 angular speed	0.05°/mm
Radiation	Cu-Kα(0.15406 nm)

."

"12. A method of producing a tool which is not a solid carbide end mill and not a solid carbide ball nose mill comprising a tool body of one of the materials
- high speed steel (HSS);
- cemented carbide
and a wear resistant layer system, which comprises at least one hard material layer MeX wherein Me comprises titanium and aluminium and X is at least one of nitrogen and of carbon and is introduced to a reactive cathodic arc evaporation with reactive gas comprising

the steps of
- depositing said at least one layer in a vacuum chamber by means of said reactive cathodic arc evaporation;
- selecting predetermined process parameter values for said reactive cathodic arc evaporation;
- realizing said layer with a desired Q_I value by lowering a bias voltage of the tool body with respect to a predetermined reference potential at a given partial pressure of reactive gas;
characterized by realizing said desired Q_I value to be at least 5 by increasing the partial pressure of the reactive gas, thereby selecting the I(200) value to be at least 20 times larger than the average intensity noise value, whereby I(200) and I(111) as well as the average intensity noise value are measured with the following equipment and settings:

Siemens Diffractometer D500	
Power	Operating voltage: 30 kV Operating current: 25 mA
Aperture Diaphragms	Diaphragm position I: 1° Diaphragm position II: 0.1°
Detector Diaphragm	Soller slit
Time constant	4 s
2 angular speed	0.05°/mm
Radiation	Cu-Kα(0.15406 nm)

."

X. Claims 1 and 12 of auxiliary request I differ from the respective claims 1 and 12 of the main request in that in claim 1 the feature "and wherein the stress within said at least one layer, σ, is 1 GPa ≤ σ ≤ 6 GPa" and in claim 12 the feature "and establishing within said

at least one layer the stress, σ, to be: 1 GPa ≤ σ ≤ 6 GPa" have been added.

XI. Independent product claim 1 and process claim 9 of auxiliary request II differ from the respective claims 1 and 12 of the main request in that claim 1 has been restricted to "- Me consists of titanium and aluminum; - X is nitrogen" and that the Q_I range has been restricted to "said Q_I value is: $5 \leq Q_I \leq 22.5$" while claim 9 has been restricted by specifying that the at least one hard material layer is "of (Ti,Al)N".

XII. Process claim 1 of auxiliary request III is identical with process claim 9 of auxiliary request II.

XIII. The appellant argued essentially as follows:

The two requests filed with letter of 20 May 2009 shall be replaced by the new main and auxiliary requests I and II which independent claims have been further restricted as a response to the objections raised by the respondent by defining the material in the process claims. According to auxiliary request II the material has been restricted to (Ti,Al)N based on further thoughts of the proprietor.

With respect to Article 83 EPC and the objected feature "average intensity noise" there exists a clear indication to consider only signals which are 20 times larger than the noise. A signal to noise ratio is always measured against a standard. Noise is a measured random signal and the person skilled in the art knows how to extract noise from the signals to be measured. Fluorescence does not fall under the definition of

noise and that according to annex B of the respondent would be considered as a drift.

The Siemens D500 diffractometer was a common instrument used by several institutions in Germany at the time when the application underlying the patent in suit had been filed. It cannot be taken to the disadvantage of the patent proprietor that nowadays this instrument is no longer available. The scope of the claim is an issue of infringement proceedings which are not to be decided here. In scientific papers measuring results are presented without any indication as to how the measurements were carried out.

With respect to the "missing examples" of materials containing carbon it should be considered that E2A applies its teaching onto a huge number of compounds without giving examples for all of them but the person skilled in the art is able to put into practice its teaching. The factor Q_I characterizes the layer structure but not the process.

E2A represents the closest prior art. The objective problem to be solved is to further improve the wear resistance of tools. The difference between claim 1 of the main request and the product of E2A is that the Q_I value is at least 5. Taking account of the teaching of E2A the person skilled in the art would not reach such a Q_I value as proven by the linear extrapolation of the Q_I and bias voltage values taken from Tables 1 and 2 of E2A (see sketch B and diagram of the Board). E2A teaches a range of Q_I of between 1.5 up to 2.3 for (Ti,Al)N and no examples with a bias voltage lower than 80 V were made although they investigated what would

happen in the voltage range of 50-100 V. Therefore the person skilled in the art would refrain from lowering the voltage because if it would have lowered the stress of the coating then the authors of E2A would have done it. Even if he would have done so he would not have obtained a Q_I value of at least 5 since he does not know the discharge current of the experiments of E2A. If the discharge current is reduced from 200 A to 150 A with the other conditions being held constant the Q_I value increases from 5.4 to 10.2 (compare the examples 36 and 4 of the patent in suit). Thus it is possible to compensate the effect of the discharge current by the pressure and the bias voltage. E2A is silent in this respect. According to T 0198/84 a new effect may help to establish that an invention has been made. As can be derived from sketch A there occurs an effect at about the same Q_I value of at least 5: there is a large increase of the wear resistance. It is also visible that the Q_I value compensates all other parameters, even the stoichiometry may vary. Therefore claim 1 of the main request involves an inventive step.

With the additional feature of claim 1 of auxiliary request I an attempt is made to overcome the problem of the Q_I value reaching infiniteness. The stress is influenced by the coating parameters e.g. the discharge current etc. It is linked with the hardness. Large Q_I values such as that of example 7 still fulfil this stress requirement. D4 does not address the discharge current and the Q_I value and thus cannot be combined with E2A. E2A had a problem with stress at bias levels below 50 V and the invention solved this problem. Therefore the subject-matter of claim 1 of auxiliary request I involves an inventive step.

Claim 1 of auxiliary request II is restricted to compounds consisting of (Ti,Al)N which reveals a special effect for this crystal orientation as can be derived from sketch A. This effect supports an inventive step in the subject-matter of claim 1 since it could not have been found in an obvious manner because it does not occur with other materials (see points 14 and 15 of sketch A). E2A teaches away from the claimed subject-matter since the linear extrapolation according to the diagram results in a value considerably lower than 5 and the value of 50 V represents a bar for the skilled person.

In case of a negative outcome with respect to inventive step of auxiliary request II it is requested to file auxiliary request III being restricted to the process claims of auxiliary request II. This request is filed at such a late stage of the proceedings because it takes account of the Board's questions concerning the product claim and how it may be obtained in other ways.

The subject-matter of claim 1 of auxiliary request III is inventive since it claims the method which allows to obtain high Q_I values for (Ti,Al)N compounds. The object is still to improve the wear resistance of tools. E2A teaches Q_I values of at least 1.5 but only suggests varying the bias potential. Nothing is said with respect to the pressure and the discharge current. Therefore the person skilled in the art would have refrained from doing so. There are further parameters, such as the discharge current or the frequency so that there exists no one-way street situation. Simply reaching a Q_I value of at least 5 is not obvious in view

of E2A which is considered not to be enabling. E1 on the other hand does not address the Q_I factor and from its figures only values of about 2 or less than 1 can be deduced (see page 104, figure 4; page 107, figure 11). D5 teaches two cases, either to change the bias voltage or to vary the pressure to change the (111) structure to the (200) one.

XIV. The respondent argued essentially as follows:

The filing of all the four amended requests at this stage of the proceedings is not objected to. Objections are only raised with respect to substantive issues.

It is not known what is meant by the feature "average intensity noise value". The appellant assumes that all diffractometers work with the same source and same principles but the patent in suit does not disclose how the noise has been measured. This information is missing. Annex B shows a large amount of fluorescence, an undesired effect of the measurement, which is considered to be encompassed by noise. A drift means something other than noise. The respondent was unable to find such an instrument and does not know if and how the used software has been modified since the time when the application had been filed. Therefore the person skilled in the art does not know how to determine the noise. Furthermore, claim 1 of the main request covers carbides and carbonitrides but there is no teaching in the patent in suit with respect to these further compounds, let alone examples. The open ended range for Q_I is objectionable because there is no clear teaching as to how high values of Q_I can be achieved or whether they are in practice beneficial. A Q_I value of 60 might

be found which could be unacceptable according to auxiliary request I if the stress level lay above 6 GPa. Consequently, there is an insufficient disclosure with respect to claims 1 and 12 of the main request.

The object to be solved by claims 1 and 12 of the main request starting from the closest prior art E2A is to provide a coating with improved hardness and adhesion which is the same as in E2A (see E2A, paragraph [0005]). E2A teaches an open ended range of Q_I being at least 1.5. Taking account of the Q_I values of examples 4 and 10 of E2A if a bias voltage of 50 V is applied then a Q_I value pretty above 5 should be obtained. The teaching of E2A is enabling. E1 discloses (Ti,Al)N coatings applied at a bias voltage of -100 V and at pressures between $1x10^{-3}$ to $9x10^{-1}$ Pa (see page 101, Table 1; page 102, Figure 2) corresponding to 10^{-5} to $9x10^{-1}$ mbar. Therefore the person skilled in the art would combine E2A with the suitable pressure range from E1 and would come to higher Q_I values. The appellant's arguments concerning the discharge current cannot be considered since the claims do not comprise a corresponding limitation. The arguments concerning the disclaimer (solid end mills etc.) are not particularly relevant as both documents E2A and E1 concern coated cutting inserts. Furthermore, the person skilled in the art knows to vary the parameters. Sketch A adds information to what was originally present in the application as originally filed. Since a higher Q_I value improves the product there is always the motivation for the person skilled in the art to go to higher values than 1.5. Therefore claims 1 and 12 of the main request lack an inventive step.

The additional feature of claims 1 and 12 of auxiliary request I concerning the stress level represents the normal working range for the person skilled in the art. The stress is linked to the hardness and E2A talks about this stress in terms of Vickers hardness H_v (see paragraph [0003]). E2A does not say that hardness is a problem (see paragraph [0009]) but only states that the bias voltage should not go beyond 50 V. E2A teaches to watch the compressive stress which increases with increasing bias voltage. Also E1 discloses Vickers hardness measurements (see page 104, last paragraph; page 106, Figure 7) while D4 discloses for a $(Ti_{50}Al_{50})N$ coating, which was deposited at a bias voltage in the range of -50 V to -200 V, an internal stress value of 1950± 50 MPa (=1,95 GPa) (see page 548, fourth paragraph; page 550, Figure 1; page 553, second paragraph). A hardness range of 2300-3000 H_v is the normal range for a (Ti,Al)N coating (see E2A, paragraph [0003]). Therefore the subject-matter of claims 1 and 12 of auxiliary request I lacks an inventive step.

The subject-matter of claim 1 of auxiliary request II, which has been restricted to a coating consisting of (Ti,Al)N, lacks an inventive step for the same reasons as claim 1 of the main request because E2A discloses such a material in its examples 1 and 7. The latter one revealing a Q_I value of 2.3 which linearly extrapolated gave a value of about 2.7 which is not so far removed from the value 5.

Process claim 1 of auxiliary request III lacks an inventive step. This claim basically defines an iteration process starting from a lower Q_I value and

changes process parameters to obtain the desired higher Q_I value. Thus the problem starting from E2A is to strive for higher Q_I values. It is agreed that E2A suggests lowering the bias voltage. However, what would the person skilled in the art do if he still wished to get higher values? One possibility would be to increase the partial pressure of nitrogen. E1 discloses a broad nitrogen pressure range of from 10^{-5} to $9x10^{-1}$ mbar (see Table 1). D4 suggests a range of from 10^{-4} to 10^{-2} mbar (see page 548, fourth paragraph). D5 discloses that the preferred orientation of unbiased films gradually changed from (111) to (200) as the nitrogen flow rate was increased whereas the biased films grow preferentially towards (111) planes (see page 218, summary, point 2). "Unbiased" means that no bias voltage has been applied but that there is still the floating (potential) bias in the chamber. D5 thus shows that the nitrogen pressure influences the structure and therefore the person skilled in the art would consider this parameter when carrying out the cathodic arc deposition process. Therefore the person skilled in the art would modify the process of E2A by increasing the nitrogen partial pressure in order to further increase the Q_I value and thereby would arrive at the subject-matter of claim 1 of auxiliary request III without any inventive skill. Therefore claim 1 of auxiliary request III lacks an inventive step.

Reasons for the Decision

1. *Admissibility of requests*

Main request and auxiliary requests I and II

1.1 The amended main request and auxiliary requests I and II were filed by the appellant at the start of the oral proceedings before the Board. Thus these three requests were filed after the time limit set by the Board in its communication annexed to the summons to oral proceedings wherein the parties were requested to make any submissions at least one month before the oral proceedings and were advised to take note that the admittance of facts and evidence was still subject to the provisions of Article 114(2) EPC and Articles 12 and 13 RPBA (see point V above).

1.1.1 From Article 13(3) RPBA it is clear that amendments to a party's case after the issue of the summons to oral proceedings shall not be admitted if they raise issues which the Board or the other party cannot reasonably be expected to deal with without adjournment of the oral proceedings.

The Board thus examined the amendments and their consequences for the appeal proceedings.

1.1.2 First of all, the respondent did **not** object to the filing of these three requests at this stage of the proceedings.

1.1.3 Claims 1 to 11 of the main request are identical with those of the former main request. Independent process claim 12 is based on claim 12 of the former main request but principally has been restricted to the materials and tools of claim 1 by incorporating the subject-matter of claims 14 and 15 as granted (see point IX, above).

Claims 1 to 11 of auxiliary request I are identical with claims 1 to 11 of the former auxiliary request while process claim 12 of auxiliary request I is based on claim 12 of the new main request which has been brought into agreement with product claim 1 by adding the feature concerning the stress (see point X, above).

1.1.4 Since the main request and auxiliary request I do not raise any new issues they are admitted into the proceedings.

1.1.5 Claims 1 to 11 of auxiliary request II are based on claims 1 to 3, 7 to 13 and 16 of the main request but the subject-matter of the independent claims 1 and 7 has been restricted to materials consisting of (Ti,Al)N and product claim 1 has been further restricted by introducing an upper limit for the Q_I value (see point XI, above). Thus this restricted embodiment was already covered by the main request.

1.1.6 Taking account of all these elements the Board therefore decides to admit the main and auxiliary requests I to II into the proceedings.

Auxiliary request III

1.2 At the end of the discussion of inventive step of the subject-matters of product claim 1 and process claim 12 of auxiliary request II, i.e. before the break for deliberation on this issue by the Board, the appellant requested to submit a new auxiliary request III. By this new request, which then was submitted after said break, it attempted to overcome the conclusion of the Board of lack of inventive step with respect to the aforementioned request.

1.2.1 Claims 1 to 3 of auxiliary request III are identical with claims 9 to 11 of auxiliary request II (see point XII, above).

1.2.2 The respondent stated that the reason for submitting this new request at this very late stage of the proceedings was that it only realised during the discussion of inventive step that the claimed product could be obtained in other ways than by the claimed method.

The fact that the appellant submitted a new main request and auxiliary requests I and II at the start of the proceedings shows that it was aware of the risk that the appeal could be dismissed. Therefore it could have filed said auxiliary request III earlier than at that stage of the oral proceedings, which is thus considered as filed very late.

1.2.3 However, since the respondent did also **not** object to the filing of this new request at the oral proceedings the Board sees no reason not to admit this auxiliary request III into the proceedings.

1.3 Thus the main request and auxiliary requests I to III were admitted into the proceedings and discussed as to their substance.

2. *Admissibility of amendments (Articles 123(2) and (3) EPC)*

Since the Board comes to the conclusion that the subject-matter of claim 1 of all requests lacks an inventive step (see points 5 below) there is no need to verify whether the amendments comply with Articles 123(2) and (3) EPC.

3. *Sufficiency of disclosure (Article 83 EPC)*

The Board comes to the conclusion that the patent in suit and particularly the subject-matter of claims 1 and 12 of the main request comply with Article 83 EPC for the following reasons:

3.1 According to feature Q_I = I(200)/I(111) of claims 1 and 12 the ratio of the intensities (I) of the (200) and (111) peaks of the X-ray diffractogram of the MeX layer is defined with the proviso that the I(200) value to be at least 20 times larger than the "average intensity noise value" which has to be measured with a specific diffractometer and specific settings thereof.

The respondent's arguments that the person skilled in the art does not know what is meant by said feature of "average intensity noise value" cannot hold since noise is a measured **random** signal and the person skilled in the art knows how to extract non-random signals to be measured from noise. Furthermore, it is specified in both claims to consider only signals which are 20 times larger than the noise and such a signal to noise ratio is always measured against a standard. The person skilled in the art is likewise able to analyse a drifting diffractogram. Fluorescence is considered **not** to fall under the definition of noise since fluorescence is a well-known physical effect which produces known non-random signals. With respect to Annex B it is remarked that the XRD conditions (see XRD operating parameters: Step: 0.007° **Step time: 3813. s**) were such that fluorescence occurred, i.e. the sample was radiated with X-rays for a certain time to induce the fluorescence. Such an angular speed of 0.007°/3813 seconds, however, does not fall under the definition of the diffractometer settings of claims 1 and 12 where the angular speed is defined to be 0.05°/min, i.e. 0.05°/60 seconds.

3.2 None of the respondent's arguments concerning the Siemens D500 diffractometer hold, either. First of all, the respondent has not submitted any evidence that on the application date of the patent in suit that this specific diffractometer was not available to the person skilled in the art. As argued by the respondent this diffractometer was a common instrument used by several institutions in Germany at that time so that the person skilled in the art was enabled to carry out measurements including the noise. Furthermore, all

diffractometers work with the same source and same principles and thus should in principal produce identical XRD spectrograms so that in scientific papers measuring results are presented without any indication as to how the measurements were carried out.

The respondent's arguments that this instrument nowadays is no longer available or that its software would have been modified and that therefore uncertainty with respect to a possible infringement would exist are not considered being particularly relevant concerning the issue of sufficiency of disclosure. Such infringement proceedings are not relevant to the decision of the Boards of Appeal. In this respect the Board notes that the relevant date for compliance with Article 83 EPC is the application date, not subsequent dates.

3.3 The respondent's arguments concerning the missing teaching with respect to the carbides and carbonitrides cannot hold for the following reasons. The application as originally filed (corresponding to the published WO-A-99 14391) discloses many examples (in total there are 47 examples and comparative examples) on how to produce a nitride film in accordance with the claims 1 and 12 of the main request. According to examples 14 to 16 outermost layers of TiCN and (TiAl)NO as well as an interlayer of TiCN (example 16) were apparently applied with the same arc ion plating apparatus and same method as the deposited interlayers of TiN and the (TiAl)N layers since the outermost Al_2O_3 layer of examples 17 and 18 is stated to have been deposited by a (different) plasma CVD technique (see WO-A-99 14391, Table 2, and page 9, lines 1 to 21).

Furthermore, the person skilled in the art generally knows how to produce carbides or carbonitrides with the same process parameters of the reactive cathodic arc evaporation technique by merely adding a carbon-containing gas to the nitrogen to obtain the corresponding metal carbonitride, or by replacing the nitrogen with a carbon-containing gas to obtain the corresponding metal carbide. E2A for example applies its teaching onto a huge number of compounds, i.e. carbides, nitrides and carbonitrides of metals from groups 4a, 5a and 6a of the periodic table and Al without giving examples for all of them - actually there are only 12 examples of binary nitrides disclosed - but the person skilled in the art is able to put into practice its teaching.

3.4 The respondent's arguments with respect to the open range of the Q_I value of at least 5 up to "infinity" cannot hold, either. The examples of the application as originally filed provide Q_I values up to 22.5 (see Table 1, example 7) and thus it has been demonstrated that high Q_I values are possible. No evidence to the contrary has been submitted by the respondent. Furthermore, the person skilled in the art is aware of the fact that in practice a Q_I value of infinity cannot be achieved. The peak for the plane (111) will always be present even if it will be very small and likewise the peak for the plane (200) will not grow to infinity. Consequently, the methods of measurement and of deposition actually set limits for these intensity values and thus for the resulting Q_I value. As the said example 7 with the high Q_I value of 22.5 discloses a

residual stress of only 1.2 GPa (see Table 1) it is not apparent that the stress range limits the Q_I value.

4. *Novelty (Article 54 EPC)*

4.1 Novelty of the subject-matter of the independent product and process claims has not been disputed by the respondent during the appeal proceedings. The Board is satisfied that none of the documents on file discloses either a tool or a method for making a tool having all the features of the independent claims 1 and 12 of the main request.

The Board therefore considers that the subject-matters of independent claims 1 and 12 of the main request are novel (Article 54 EPC).

4.2 The above conclusion applies ***mutatis mutandis*** to claims 1 and 12 of auxiliary request I (see point X above), to claims 1 and 9 of auxiliary request II (see point XI, above) and to claim 1 of auxiliary request III which is identical with independent process claim 9 of auxiliary request II (see point XII above), since these claims are narrower in scope than claims 1 and 12 of the main request. Consequently, the subject-matter of the independent claims of auxiliary requests I to III is likewise considered to be novel (Article 54 EPC).

5. *Inventive step (Article 56 EPC)*

Auxiliary request II

5.1 The Board comes to the conclusion that at least claim 1 of auxiliary request II (which is narrower in scope than claim 1 of the main request) lacks an inventive step over the disclosure of E2A for the reasons which follow:

5.2 E2A is considered to represent the closest prior art with respect to a tool comprising a tool body and a wear resistant layer system comprising at least one hard material MeX coating consisting of (Ti,Al)N, wherein said layer has a Q_I value > 1.5, with Q_I = I(200)/I(111) (see paragraphs [0006] and [0010]; Table 1, examples 1 and 7). Said layer system is superior in abrasion resistance and fracture and chipping resistance (see paragraph [0001]). Said tool body is e.g. high speed steel (HSS) (see paragraph [0010]) or a cemented carbide (see paragraph [0007]) and said tool is e.g. a cutting tool insert or tip, or can be an end mill and the like (see paragraphs [0002] and [0011]).

Examples 1 and 7 of E2A were made with a coated cemented carbide 84WC-3TiC-1TiN-3TaC-9vol%Co throw away insert having the tool shape SEE42TN-G9Y at a bias of middle voltage (50-100 V) and high voltage (150-200 V) with nitrogen as reaction gas at a pressure of 10^{-1} Pa; the material to be milled was SDK61 with a cutting speed of 250 m/min, a feed of 0.2 mm/blade and a depth of cut of 2.0 mm which for the 3 µm thick coating of (Ti, Al)N and a Q_I value of 2.3 resulted in a cutting

length of 2.9 m (at a maximum abrasion reaching "0.2 mm" [which presumably should read "0.2 **µm**"]; see paragraphs [0012] to [0014]).

5.3 The subject-matter of claim 1 of auxiliary request II is thus distinguished from the (Ti,Al)N coated tool according to E2A in that:

i) the content x of titanium in Me is: 70 at.% ≥ x ≥ 40 at.%,

ii) the content y of aluminum in said Me is: 30 at.% ≤ y ≤ 60 at.%,

iii) said Q_I value is at least 5, and

iv) the I(200) value is at least 20 times the intensity average noise value as measured with the specified equipment (Siemens diffractometer D500) and settings.

5.3.1 The patent in suit is silent with respect to the effect of all these features.

5.3.2 The Board considers that features i) and ii) are responsible for the deposited MeX (TiAl)N compound, such as e.g. $Ti_{0.4}Al_{0.6}N$ or $Ti_{0.5}Al_{0.5}N$, having the required hardness and wear resistance properties in order to be suitable as a coating for a cutting tool (compare in this context E1, page 104, second paragraph in combination with Figure 7).

Feature iii) influences the texture of the deposited MeX-compound and thereby it's cutting and wear properties.

Feature iv) is considered to be the result of the Q_I value since a better (more uniform) texture provides a higher peak (higher intensity) whereas the specified

settings of the XRD influence the quality of the resulting diffractogram but not of the product ***per se***. Therefore the definition of the diffractometer as such is not considered to be limiting since any equipment allowing for said settings can be used.

5.3.3 The objective problem is therefore the provision of a tool having an improved wear resistance (compare patent, paragraph [0009]).

5.4 This problem is solved by the coated abrasive as defined in claim 1 of auxiliary request II. Taking account of the examples of the patent in suit it is credible that the claimed measures provide a solution to said technical problem.

5.5 Considering the above objective problem the person skilled in the art would start from the closest prior art E2A wherein the wear resistance is improved by providing a hard coating of (Ti,Al)N having a Q_I value of at least 1.5 on a WC cemented carbide cutting insert. E2A teaches that lowering the bias voltage increases the Q_I value (see Table 1) and suggests working within the middle bias range of from 50 to 100 V (see paragraph [0007]). By lowering the bias voltage from 150 V to 80 V the Q_I value of the (Ti,Al)N coating is increased from 1.2 to 2.3.

Therefore in view of the Board the person skilled in the art would apply the teaching of E2A, i.e. to apply the lowest value of 50 V of said the middle range of the bias voltage. As can be deduced from the diagram annexed to the Board's communication there exists no linear increase of the Q_I value for (Ti,Al)N in the bias

region of -50 to -60 V. On the contrary, there is a steep increase of the Q_I value in this region as proven by the curves based on the bias voltage and Q_I values of the examples 12, 8 and 5, and examples 11, 9, 1 and 6 of the patent in suit, respectively, which were all made with the compound $(Ti_{0.5}Al_{0.5})N$ at an arc current of 150A, and at nitrogen pressures of $0.5x10^{-2}$ mbar and $2.0x10^{-2}$ mbar, respectively. The line drawn between the points of the examples 9, 1 and 6 (which have Q_I values of 0.7, 1.5 and 15.4 at bias voltages of -100 V, -60 V and -30V, respectively) of the patent in suit intersects the bias voltage of -50 V at a Q_I value of about 5.

Since E2A is silent with respect to the composition of the (Ti,Al)N compound the person skilled in the art by applying his common general knowledge would select either $(Ti_{0.4}Al_{0.6})N$ or $(Ti_{0.5}Al_{0.5})N$ which have the required hardness and wear resistance in order to be suitable as the coating of the cutting tool (see E1, Figure 7).

Therefore - since the line drawn between the points of examples 1 and 7 of E2A (which have Q_I values of 1.2 and 2.3 at bias voltages of -150 V and -80 V, respectively) already starts well above the said line based on the points of the examples 9 and 1 of the patent in suit - the Board considers that the application of a bias voltage of -50 V in combination with the discharge current and nitrogen pressure being held constant at those of examples 1 and 7 (i.e. starting from the line of the examples 1 and 7 of E2A) would inevitably produce a Q_I value above 5. Therefore the person skilled in the art would inevitably arrive at the subject-

matter of claim 1 of auxiliary request II without any inventive skill.

5.5.1 The appellant's arguments with respect to E2A cannot be accepted. The situation of a linear extrapolation is not given, as proven by the examples of the patent in suit. Furthermore, since E2A states that a bias voltage below 50 V cannot be used because the film will separate due to an insufficient ion bombardment (see paragraph [0009]) the person skilled in the art would conclude that the authors have carried out corresponding experiments which, however, are not described in E2A for whatever reason.

With respect to "sketch A" provided by the appellant it is remarked that no effect can be acknowledged at all since this comparison - the appellant compared the cutting distance of examples 1-2 and 4-7 (which had only a 5 µm thick Ti_xAl_yN layer on the cemented carbide substrate) with the cutting distance of examples 13-18 (which all had a first 0.4 µm TiN layer, with a second 4.6 µm thick Ti_xAl_yN layer (ex.13), or a second 4.1 µm thick Ti_xAl_yN layer with either a 0.5 µm TiCN layer (ex. 14) or a third layer of (TiAl)NO (ex.16) or a third layer of Al_2O_3 (ex. 17 and 18), or a second 4.4 µm thick Ti_xAl_yN layer and a third layer of 0.5 µm TiCN (ex. 15) relative to the Q_I value of these examples - has not been made in agreement with the established jurisprudence of the Boards of Appeal. Consequently, it has not been shown that this effect has its origin in the distinguishing feature (see Case Law of the Boards of Appeal of the European Patent Office, 5th edition 2006, chapter I.D.9.8):

Example 4 was made with Ti_xAl_yN with x=0.4 and y=0.6 while all other examples 1-2, 5-7 and 13-18 were made with x=y=0.5. Even if one ignores the slightly different composition the influence of the additional layers on the cutting distance is evident when comparing e.g. examples 1 and 13 (the latter having an additional TiN layer between the substrate and the identical Ti_xAl_yN layer having the same Q_I value of 1.5): 2.2 m to 4.5 m. Furthermore, as evident from examples 1-7 a higher Q_I value does not imply an increased cutting distance: compare example 1 (Q_I: 1.5 with a cutting distance of 2.2 m), example 3 (Q_I: 8.1 with a cutting distance of 8.8 m), example 5 (Q_I: 6.0 and 2.0 m), example 6 (Q_I: 15.4 and 4.2 m) and example 7 (Q_I: 22.5 and 3.3 m) which had all the same composition of x=y=0.5, and further example 4 (Q_I: 10.2 and 3.9 m) with the slightly different composition of x=0.4 and y=0.6 (see patent, Table 1).

5.6 Claim 1 of auxiliary request II therefore does not comply with the requirements of Article 56 EPC. Consequently, auxiliary request II is not allowable.

Main request

5.7 Since claim 1 of auxiliary request II is narrower in scope than claim 1 of the main request (compare points IX and XI) the above conclusion with respect to claim 1 of auxiliary request II applies ***mutatis mutandis*** to claim 1 of the main request.

The Board therefore concludes that claim 1 of the main request does not comply with the requirements of

Article 56, either. The main request is thus also not allowable.

Auxiliary request I

5.8 Claim 1 of auxiliary request I differs from that of the main request in that a range for the stress of the MeX layer has been added (see point X, above).

The Board comes to the conclusion that the subject-matter of claim 1 of auxiliary request I does not involve an inventive step for the following reasons:

5.8.1 This feature was incorporated into claim 1 of auxiliary request I basically in order to limit the one-side open range for Q_I as defined in claim 1 of the main request (see letter dated 20 May 2009, point 3.2).

5.8.2 The appellant did not contest that the additional feature of claim 1 covers the normal working range for the person skilled in the art and that the stress is linked to the hardness.

The Board considers in this context that the person skilled in the art would select the optimum range of the stress of the applied coating so that it is suitable for the intended purpose of a cutting insert. Thereby the person skilled in the art would choose a stress value in the range which is common in the prior art.

5.8.3 E2A talks about this stress in terms of Vickers hardness H_v and discloses a range of 2300-3000 H_v as the normal range for a (Ti,Al)N coating and teaches to

watch the compressive stress which increases with increasing bias voltage (see paragraphs [0003] and [0009]). E2A does not state that hardness is a problem but only states that the bias voltage should not go beyond 50 V since an insufficient ion bombardment is then provided, i.e. that the adhesion of the coating is not sufficient (see paragraph [0009]).

E1 similarly discloses Vickers hardness measurements for (Ti,Al)N in the range of about 2100-3000 H_v [= kg/mm^2] (see page 104, last paragraph; page 106, Figure 7).

D4 discloses for a $(Ti_{50}Al_{50})N$ coating on a HS steel substrate, which has been deposited at a bias voltage in the range of -50 V to -200 V with a steered arc technique, an internal stress value of 1950± 50 MPa (=1,95 GPa) (see page 548, last sentence of the first paragraph; page 548, fourth paragraph; page 550, Figure 1; page 553, second paragraph). D4 mentions generally a range of 1700-3200 H_v for (Ti,Al)N coatings (see page 551, last paragraph).

5.8.4 Consequently, none of the appellant's arguments hold because no particular effect can be seen which could be linked to this stress range.

Therefore the subject-matter of claim 1 of auxiliary request I lacks an inventive step. Auxiliary request I is thus not allowable.

Auxiliary request III

5.9 Process claim 1 of auxiliary request III differs from the reactive cathodic arc evaporation process of E2A by the following features in the characterizing portion (compare point 5.2 above):

i) realising said desired Q_I value to be at least 5,
ii) by increasing the partial pressure of the reactive gas, and
iii) thereby selecting the I(200) value to be at least 20 times larger than the intensity average noise value as measured with the specified equipment (Siemens diffractometer D500) and settings.

5.9.1 Feature i) influences the texture of the deposited MeX-compound and thereby it's cutting and wear properties.

Feature ii) is responsible for obtaining the desired Q_I value.

Feature iii) is considered to be the result of the Q_I value (see point 5.3.2 above).

5.9.2 Thus the objective technical problem to be solved in view of E2A is to improve the wear resistance of tools.

5.9.3 It is credible that claim 1 of auxiliary request III solves the aforementioned objective problem.

5.9.4 The Board comes, however, to the conclusion that the subject-matter of process claim 1 is obvious to the person skilled in the art.

E2A suggests lowering the bias voltage to obtain higher Q_I values. Thus the application of a bias voltage of -50 V in combination with the discharge current and nitrogen pressure being held constant at those of examples 1 and 7 of E2A inevitably produces a Q_I value above 5 (see point 5.5 above).

If the person skilled in the art wanted to get higher values then he would look to other parameters which influence the structure of the coating. D5 discloses that the preferred orientation of unbiased (TiAl)N films gradually changed from (111) to (200) as the nitrogen flow rate is increased whereas the biased films grow preferentially towards (111) planes (see page 218, summary, point 2). "Unbiased" means in this context that no bias voltage has been applied but that the so-called floating potential between the substrate and the chamber is present.

D5 thus teaches the person skilled in the art that the nitrogen pressure influences the structure and therefore he would select this parameter as another possibility to obtain a higher Q_I value when carrying out the cathodic arc deposition process.

5.9.5 The appellant's arguments with respect to D5 thus cannot hold. As D5 teaches either to change the bias voltage or to vary the pressure to change the (111) structure to the (200) one and since E2A only suggests varying the bias potential it is clear that the person skilled in the art would choose said second alternative, i.e. the variation of the pressure. In view of D5 the person skilled in the art would have refrained from

selecting another parameter such as the discharge current or the frequency.

5.9.6 Therefore the Board considers that person skilled in the art would modify the process of E2A by increasing the nitrogen partial pressure as suggested by D5 in order to further increase the Q_I value and thereby would arrive at the subject-matter of claim 1 of auxiliary request III without any inventive skills.

Therefore claim 1 of auxiliary request III lacks an inventive step. Auxiliary request III is therefore not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Nachtigall P. O'Reilly