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Datasheet for the decision of 29 April 2008

Case Number: T 0640/05 - 3.2.07

Application Number: 95913564.1

Publication Number: 0748260

IPC: B05D 3/06

Language of the proceedings: EN

Title of invention:
Ion beam process for deposition of highly abrasion-resistant coatings

Patentee:
Morgan Advanced Ceramics, Inc.

Opponent:
LEYBOLD OPTICS GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 104(1), 123(2), 123(3)

Relevant legal provisions (EPC 1973):
-

Keyword:
"Novelty (main and second auxiliary request - yes)"
"Admissibility of amendment of second auxiliary request (yes)"
"Inventive step (main request - no, second auxiliary request - yes)"
"Request for apportionment of costs (refused)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0640/05 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 29 April 2008

Appellant: (Opponent)
LEYBOLD OPTICS GmbH
Siemensstrasse 88
D-63755 Alzenau (DE)

Representative:
Pohlmann, Bernd Michael
Reinhardt & Pohlmann
Patentanwälte
Am Rossmarkt 12
D-60311 Frankfurt am Main (DE)

Respondent: (Patent Proprietor)
Morgan Advanced Ceramics, Inc.
2425 Whipple Road
Hayward
California 94544 (US)

Representative:
Boff, James Charles
Phillips & Leigh
5 Pemberton Row
London EC4A 3BA (GB)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 29 March 2005 rejecting the opposition filed against European patent No. 0748260 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: H. Meinders
Members: H. Hahn
I. Beckedorf

Summary of Facts and Submissions

I. The Opponent lodged an appeal against the decision of the Opposition Division to reject the opposition against European patent No. 0 748 260. It requested that the decision be set aside and the patent be revoked.

II. Its opposition had been filed against the patent as a whole under Article 100(a) EPC on the grounds of lack of novelty and inventive step.

The Opposition Division held that claim 1 as granted was novel, particularly with respect to an oral disclosure based on E1 (Transcript of Leybold Seminar, Latest developments in plasma-assisted deposition processes, November 15-16, 1993, Chosun Hotel/Samsung Electronics, Seoul, South Korea), and was considered to involve an inventive step, particularly in view of combinations of D1 (US-A-5 135 808) and D8 (Klaus Telgenbüscher "Mikrowellen-Plasmapolymerisation", Aachen 1994), D1 and D5 (US-A-5 093 152), or D2 (US-A-4 862 032) and D5. With respect to the witnesses offered by the opponent to prove the allegations concerning E1 the Opposition Division stated that there was no need to hear these witnesses on the public availability of E1 since it had not been disputed, and that this fact had been mentioned in the summons to oral proceedings dated 22 September 2004 (see Facts and Submissions, point 6). The oral proceedings set for 8 March 2005 were cancelled upon the opponent's notification that it would not attend them

III. Claim 1 as granted reads as follows:

"1. A method for producing a protective, abrasion-resistant coating on the surface of a substrate comprising the steps of:

(a) chemically cleaning the surface of said substrate to remove contaminants;
(b) sputter-etching the surface of said substrate in an evacuated deposition chamber with a beam of energetic ions to further remove residual contaminants and to activate said surface;
(c) ion beam depositing a layer of abrasion-resistant coating material using an ion beam from an ion source, said ion beam comprising reactive gases containing one of the following combinations of elements: Si and C; Si, C and H; Si and N; Si, N and H; Si and 0; Si, 0 and H; Si, 0 and N; Si, 0, N and H; Si, C and N; Si, C, H and N; Si, C and 0; Si, C, H and 0; Si, C, 0 and N; Si, C, H, 0 and N;
(d) increasing the vacuum chamber pressure to substantially atmospheric pressure and recovering a coated substrate product having improved wear and abrasion resistance;
characterized in that
at least a portion of the reactive gases in the ion beam are introduced into the ion beam downstream of the ion source;
and in that the ion energy used in the ion beam deposition process is in the range 20eV to 300eV."

IV. With a communication annexed to the summons to oral proceedings dated 4 October 2007 the Board presented its preliminary opinion based on claim 1 of the patent

as granted and particularly on the objections made by the appellant in its grounds of appeal of 1 August 2005, in respect of the fulfilment of the requirements of Articles 54 and 56 EPC, and made reference to D1, E1 and E3 (EP-A-0 308 680), the latter having been filed by the appellant with its grounds of appeal.

With respect to a hearing of the offered witnesses in the context of the oral disclosure of E1 the Board stated that it appeared that the appellant did not use the opportunity to pursue this matter before the Opposition Division and was now trying to revive this issue on appeal, without the impugned decision having addressed this issue. Therefore it might have to be discussed whether the request to hear the witnesses at this stage of proceedings had to be disregarded.

With respect to novelty of the method of claim 1 it stated among others:

"3.1 With respect to the written disclosure E1 it seems that the plasma CVD process according to page 15 of E1 represents no (direct) ion beam deposition process since the plasma is not remote from the plasma source but appears to extend to the substrate.

In a plasma the average velocity of the particles (radicals, excited and/or dissociated particles, ions, electrons) appears to be about zero while in an ion beam there exists a clear direction of movement of the ions or of the ions and electrons (if the ions have been neutralized). Another difference between ion beam deposition (IBD) and plasma assisted ion deposition (PIAD) appears to reside in the fact that the former

uses only ions for the deposition while the latter additionally uses ions besides the other reactive species produced by the plasma which apparently results in different coating properties. A further difference could reside in the implicit pressure of the processes which should be lower for IBD (in order to prevent collisions of the ions in the beam; see patent column 12, lines 19 to 25) compared to the pressure for PIAD.

It should also be considered that the apparatuses for the ion assisted deposition (IAD) process and the PIAD process depicted on page 20 of E1 comprise no gas inlet for reactive gases such as the required silicon containing gas (=reactive gas). Furthermore, none of said embodiments of E1 appears to be described in the context that any reactive gas should be introduced into the **ion beam** downstream of the ion source. According to E1 it appears that any reactive gas is introduced into the **plasma** (see e.g. figure 10). Additionally, none of the embodiments of E1 mentions explicitly any chemical cleaning step and sputter etching step of the surfaces to be coated. Although sputter etching is pretty common in the coating field it does not seem to be conclusively comprised in such a deposition process.

Thus claim 1 seems to be novel with respect to E1.

3.2 With respect to the alleged oral disclosure and the fact that the Opposition Division has not heard the witnesses offered there are at present only allegations without any further supporting evidence. Furthermore, taking account of the written disclosure of E1, the question would arise how the witnesses can confirm the

allegation that the apparatuses discussed at the seminar produced an ion beam, whereas the apparatus according to E1 does not seem to produce an ion beam as it is normally understood."

With respect to inventive step the Board stated that this issue would be dealt with taking into consideration the problem-solution approach and the submitted prior art among which D1 appeared to represent the closest prior art. Concerning D1 it stated among others:

The process of claim 1 appeared to differ from the process according to D1 in that
i) according to feature (c) an ion beam deposition method is chosen and the ion beam comprises reactive gases comprising silicon,
ii) at least a portion of the reactive gases in the ion beam are introduced into the ion beam downstream of the ion source, and
iii) the ion energy used in the ion beam deposition process is in the range 20 eV to 300 eV.

Feature i) appeared to result in that a highly adherent DLC coating can be obtained (but claim 1 does **not** define any DLC coating) and that generally hard coatings under tensile stress or nearly stress free are obtained (see column 14, lines 29 to 33; column 21, lines 30 to 55) while feature iii) appeared to minimize heating of the substrate during deposition (see column 15, lines 45 to 48). Feature i) further resulted in a simplified process since the same ion beam deposition method utilising gaseous precursor materials

is used in all coating steps and the produced ion beam can also be used for sputter-etching of the substrates.

For feature ii) no effect appeared to be described: the effect stated by the Opposition Division in the impugned decision - minimisation of compressive stress - appeared not to be credible since the essential process parameters of the examples compared were not identical and paragraph [0063] of the patent appeared also not to support this interpretation. Likewise the application as filed appeared not to support this assumption since the quoted passage of paragraph [0026] of the patent - corresponding to page 9, lines 4 to 9 of the application as originally filed (=published WO-A-95 23652) - actually had to be seen in the context of the independent claims as originally filed which did not contain the corresponding feature of introducing the silicon gas downstream (see claims 1, 52, 65, 71, 80 and 89) but only as an alternative preferred embodiment (see e.g. claim 41) to the direct introduction into the ion source chamber (see claim 40). It was only in the set of amended claims 1-31 as filed on 25 July 1995 that said feature had been incorporated (compare WO-A-95 23652).

Therefore it should be discussed whether or not the person skilled in the art, starting from the method disclosed in D1 and aiming to solve the problem of controlling and reducing the compressive stress of the abrasion resistant coating (see column 8, lines 29 to 32) as well as attempting to provide a simpler process would foresee the same deposition process for both coating steps and whether it would be obvious to choose said range of specific ion energies, particularly when

combining the teachings of D1 and E1 or D1 and E3 as argued by the appellant.

The parties were given the opportunity to file observations to the communication which should be filed well in advance, i.e. at least one month, before the date of the oral proceedings in order to give sufficient time to the Board to prepare for the oral proceedings.

Finally the parties were advised to take note of the Rules of Procedure of the Boards of Appeal, particularly of Article 13 RPBA.

V. With a letter dated 25 March 2008 the respondent submitted comments concerning the annex to the summons to oral proceedings together with an auxiliary request.

VI. With letter dated 7 April 2008 the appellant informed the Board that it would not attend the oral proceedings and that it requested to decide the case on the basis of the written argumentation brought forward as already on file.

VII. With a further letter dated 22 April 2008 the appellant stated that it did not insist on the hearing of the witnesses and requested that the decision should be solely based on the cited documents ("es wird von der Einsprechenden und Beschwerdeführerin nicht auf der Hörung der Zeugen bestanden und beantragt, allein auf der Grundlage der angeführten Dokumente zu entscheiden").

VIII. Oral proceedings before the Board were held on 24 January 2008 in the absence of the appellant as announced in its letter dated 7 April 2008. Since the appellant has been duly summoned, the oral proceedings were held in its absence according to Rule 115(2) EPC and Article 15(3) of the Rules of Procedure of the Boards of Appeal. After discussion of the main and first auxiliary requests the respondent withdrew its first auxiliary request and continued with a second auxiliary request filed at the oral proceedings.

(a) The appellant had requested, in the written proceedings, that the decision under appeal be set aside and that the patent be revoked.

(b) The respondent requested that the appeal be dismissed (main request), i.e. that the patent be maintained as granted, or by setting aside the decision under appeal and the patent be maintained in amended form on the basis of either claim 1 filed as second or third auxiliary request during the oral proceedings. It requested in addition to either the main or the auxiliary request that the apportionment of costs be ordered.

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

IX. Claim 1 of the second auxiliary request differs from that of the main request in that step (c) has been restricted to "… using an **oxygen** ion beam from an ion source …" (amendment compared to the main request is in bold, emphasis added by the Board).

X. The appellant argued in the written procedure essentially as follows:

An oral presentation took place at the public "Leybold seminar" on 15/16 November 1993 in Chosun Hotel/Samsung Electronics, Seoul, South-Korea, wherein a process was made available to the public which included the following steps:

- chemical cleaning of the surface of a substrate to remove contaminations,
- ion etching and sputter etching of the substrate material respectively in the evacuated deposition chamber with a beam of energy rich ions in order to remove the remaining contaminations and to activate the surface,
- ion beam deposition of an abrasion resistant film using an ion beam of the so-called APS source, said ion beam containing reactive gases which contain combinations of the elements Si, C, H, O and N,
- increasing the pressure in said vacuum chamber to about atmospheric pressure and recovering the coated substrate material having improved wear and abrasion resistance,
- wherein at least a part of the reactive gas of the ion beam is introduced in the ion source into said ion beam,
- and the ion energy used during said ion beam deposition is in the range of from 20 eV to 300 eV. For this process said APS source (representing a gridless ion source) was used which allows to direct an ion beam in the sense of the patent in suit onto the surface of the substrate, i.e. the "ion beam" being a beam of ions having been formed by a plasma which is remote from the substrate material. Furthermore, said beam may be

charge neutralized. As evidence that such a process was made available to the public two witnesses are offered. In addition to said oral disclosure a written disclosure E1 including relevant state of the art based on the overhead sheets of the said seminar was made available to the public. Thus the orally disclosed process comprised all the features of the method of claim 1 as granted which therefore lacks novelty.

The features (a) to (d) of claim 1 as granted are known from D1 for producing abrasion resistant coatings including silicon (see column 2, lines 52 and 53; column 3, lines 53 ff; column 3, line 45; column 4, lines 3 to 21; column 2, lines 60 to 64). The feature of claim 1 concerning the ion energy range of 20 eV to 300 eV is also derivable from D1 since the ion energy in the context of example "A" is in the region of 75 eV. Thus the process of claim 1 differs from that according to D1 only in the feature concerning the introduction of at least a portion of the reactive gases into the ion beam downstream of the ion source. Starting from D1 the skilled person would, in order to overcome the disadvantages of the prior art described therein, use the process described in D1 and introduce the reactive gases downstream of the ion source into the ion beam as suggested in E1. He would also use energy of about 75 eV according to D1. Therefore the subject-matter of claim 1 as granted lacks an inventive step over the combination of D1 and E1.

XI. The respondent argued essentially as follows:

Since the appellant, who requested oral proceedings, again failed to appear at the oral proceedings at short

notice - as it already did during the opposition proceedings - an apportionment of costs is requested.

The issue of "introducing the gases downstream of the ion source" was addressed in the letter dated 22 March 2008 (see pages 4 and 5) by repeating the statements made in the examining procedure. This introduction of the gases downstream provides a technical effect, although it is admitted that the conditions, mainly the pressure, of the examples in the application as originally filed, were different. A lower pressure results in a lower deposition rate which would be expected to produce a lower stress, but actually a higher stress in the coating is obtained. Although there are several theories explaining this effect all that can be said is "it works" and the appellant has not challenged it at all.

D1 does not disclose an ion beam deposition step for the interlayer and generally mentions CVD processes. The several examples therein were all made using an ion beam sputter deposition for depositing said interlayer which is applied to increase the adherence of the final DLC layer on glass substrates. According to the patent in suit the applied dense layer containing Si-material may either be the final layer or the interlayer (see patent, paragraphs [0010] and [0011]). According to D1 no ion bombardment of the deposited layer takes place and the coating does not necessarily comprise Si-material. The skilled person would have to ignore the general teaching of D1 and choose ion beam deposition and to introduce the gases downstream of the ion source, which results in a different extent of ionization. Furthermore, the introduction of the precursors in the

ion source causes problems with the built-up of materials and may even result in interruption of the deposition process. D1 aims to provide the same objects, i.e. abrasion and wear resistant coated transparent substrates (see column 2, lines 28 to 40) but provides a different solution. A particular advantage of the claimed process is the coating of plastic substrates.

The use of the oxygen ion beam in combination with the introduction of the gaseous precursors into the ion beam allows to obtain hard coatings having a reduced compressive stress (see paragraphs [0063] and [0064]). Such a combination of measures is not suggested by any of the submitted documents and results in the described effect. Consequently, the subject-matter of claim 1 of the main and second auxiliary request involves an inventive step.

Reasons for the Decision

Main Request

1. *Novelty (Article 54 EPC)*

1.1 The appellant neither replied in substance to the reasoning given in the Boards communication why E1 cannot be considered to be novelty destroying (see point IV above) nor did it attend the oral proceedings before the Board. Since the appellant does not refute or overcome these objections, the Board sees no reason to depart from its preliminary opinion expressed therein.

Thus the subject-matter of claim 1 is novel with respect to the written disclosure of E1.

1.2 With respect to the arguments concerning an oral disclosure on the basis of E1, and the fact that the Opposition Division has not heard the witnesses offered, the appellant has withdrawn its request for hearing of the offered witnesses (see point VII above).

Since the appellant has not submitted any further supporting evidence its submissions remain only allegations without any proof (see point IV above). Furthermore, taking account of the written disclosure of E1, the described apparatus comprises an APS source providing only a plasma including ions but **not providing an ion beam** as it is normally understood by the skilled person. The allegation that the apparatuses discussed and presented at the Leybold Seminar in the context of E1 actually produced an **ion beam** is therefore not considered to be credible. Consequently, the alleged oral disclosure based on E1 is also not considered to be novelty destroying for claim 1 as granted.

1.3 Since there is no document on file which discloses a process having all the features of claim 1 as granted the Board considers that the subject-matter of claim 1 as granted is novel (Article 54 EPC).

2. *Inventive step (Article 56 EPC)*

2.1 D1 represents the closest prior art for disclosing a method for producing an abrasion resistant coated substrate, particularly eyeglass and sunglass lenses,

architectural glass etc., being substantially optically transparent (see abstract). In the first step of the method the substrate surface is initially chemically de-greased (=cleaned) and in the second step the surface is bombarded with energetic gas ions to assist in the removal of residual hydrocarbons, as well as alkali metals and other additives. After said sputter-etching which may preferably be performed with a beam of inert gas ions, hydrogen ions or oxygen ions of at least 200 eV, one or more interlayers are chemically vapour deposited on the substrate, followed by the deposition of a diamond-like carbon (DLC) layer which preferably is deposited by direct ion beam deposition (see column 2, lines 52 to 63; column 6, line 9 to column 7, line 14; example "A").

The said term "chemically vapour deposited" according to D1 includes thermal evaporation, electron beam evaporation, magnetron sputtering, ion beam sputtering from solid precursor materials, thermally-activated deposition from reactive gaseous precursor materials, glow discharge, plasma, or ion beam deposition from gaseous precursor materials (see column 3, lines 38 to 46). The said interlayer may comprise silicon oxide, silicon dioxide, silicon nitride, silicon carbide, etc. (see column 4, lines 3 to 21).

D1 discloses no ion energy values for the deposition of the interlayers from silicon containing reactive gases. For the DLC deposition by the preferred ion beam deposition using methane as reactive gas an ion energy of 75 eV is mentioned while for the sputter etching step an energy of at least 200 eV is suggested (see

column 6, lines 31 to 37) and according to all examples an energy of 500 eV was used (see examples "A" to "Q").

D1 aims to provide a coated substrate product with superior abrasion wear resistance and reduced chemical reactivity; to provide a DLC coating on an optically transparent substrate which is highly adherent and exhibits superior wear resistance; and to provide a low cost and efficient process for producing these coatings (see column 2, lines 28 to 40).

2.2 Thus the process of claim 1 as granted differs from the process according to D1 in that
i) according to feature (c) an ion beam deposition method is chosen and the ion beam comprises reactive gases comprising silicon,
ii) at least a portion of the reactive gases in the ion beam are introduced into the ion beam downstream of the ion source, and
iii) the ion energy used in the ion beam deposition process is in the range 20 eV to 300 eV.

2.3 Feature i) appears to result in that a highly adherent DLC coating with outstanding wear resistance properties can be obtained and that generally hard coatings (see patent, column 14, lines 29 to 33). Feature i) further results in a simplified process since the same ion beam deposition apparatus and method utilising gaseous precursor materials is used in all coating steps and the generated ion beam can also be used for sputter-etching of the substrates.

2.4 Feature iii) appears to minimize heating of the substrate during deposition (see column 15, lines 45 to 48).

2.5 For said feature ii) no effect is apparent.

2.5.1 The effect mentioned and acknowledged by the Opposition Division in its impugned decision, i.e. minimisation of compressive stress (see grounds for the decision, page 7, fifth and sixth paragraph), is **not** considered to be credible since the essential process parameters of the examples compared, i.e. a comparison of examples C and F with examples G, H and L of the application as originally filed (corresponding to the published WO-A-95 23652), are **not** identical:

Examples C, G, H and L used octamethylcyclotetra-siloxane as Si-precursor while example F used tetraethoxysilane; examples C and F used the specified Si-precursors for making the ion beam while examples G, H and L used oxygen for making the ion beam.

Additionally, different pressures, differing anode voltages and anode currents were used according to said examples. The latter differences were admitted by the respondent at the oral proceedings.

2.5.2 Furthermore, the specific description of the patent in suit also does not support this interpretation. To the contrary, it can be concluded that the use of **an oxygen ion beam** is actually responsible for this effect of stress minimisation:

"For the case of the Si-O-C-H materials produced by injecting siloxane precursors into **an oxygen ion beam**, it was unexpectedly found that by increasing the ratio of oxygen to siloxane precursor, the coating hardness was increased, while the compressive stress was simultaneously decreased. By this method, it is possible to produce hard, abrasion-resistant coatings which are under tensile stress, or are nearly stress-free" (see patent, paragraph [0063]), and
"It is believed that the reduction in compressive stress with increasing hardness is due to the etching of carbon from the growing surface by the **oxygen ions**, or activated oxygen **in the ion beam**" (see patent, paragraph [0064]).

Claim 1 as granted, however, also allows the use of e.g. an Ar ion beam so that, taking account of the above disclosure of the patent in suit, it has not been demonstrated that with such an inert gas the effect of stress minimisation will also be obtained when the Si-precursor is introduced downstream of the ion source.

2.5.3 The Opposition Division further cited paragraphs [0060] to [0062] and [0065] and [0066], which are, however, silent with respect to the compressive stress minimisation while the relevant passage of the quoted paragraph [0026] of the patent in suit concerning point (3) "controlling and minimizing excessive compressive stress in the coatings deposited by the method of the present invention allows for the deposition of highly adherent coatings" - corresponding to page 9, lines 4 to 9 and page 10, lines 7 to 9 of the application as originally filed - has actually to be seen in the context of the independent claims as

originally filed. These independent claims, however, do **not** contain the corresponding feature of introducing the silicon gas downstream (see claims 1, 52, 65, 71, 80 and 89) but only as an alternative preferred embodiment (see e.g. claim 41) to the direct introduction of the precursor into the ion source chamber (see claim 40). Likewise the application as originally filed comprised the examples B, C, F and I wherein the Si-precursor was introduced directly into the ion source and thus were in accordance with the invention as defined by the original claims. It was only in the set of amended claims 1-31 as filed on 25 July 1995 that said feature had been incorporated in the independent claims (compare WO-A-95 23652). Consequently, the application as originally filed does not support this assumption of the Opposition Division either.

2.6 The Board therefore concludes that feature ii) - since no effect can be attributed to it - need not be considered as a distinguishing feature for defining the objective technical problem.

2.7 Therefore the objective technical problem can be defined as a less ambitious one, being the provision of an alternative, simplified process for coating optically transparent substrates with a wear resistant hard coating having a highly adherent outermost DLC coating (see patent, column 7, lines 3 to 31; column 8, lines 4 to 13).

2.8 This problem is solved by the process as defined in claim 1 as granted.

2.9 The Board, however, considers that the subject-matter of claim 1 as granted is rendered obvious for the following reasons:

2.9.1 It is common general knowledge of the skilled person that the surface bombardment with ions which takes place during the ion beam deposition process produces more dense coatings and it is most presumably for that reason why the ion beam deposition processes where selected according to the examples of D1.

2.9.2 The person skilled in the art aiming to solve the problem of providing a simpler process would foresee the same deposition process for both coating steps, i.e. the interlayer and the DLC coating steps since this would allow to simplify the apparatus of D1 as described in the context of the examples. Said apparatus according to D1 comprises an ion source which is operated with Ar for the sputter etching step and with methane for the DLC deposition step. During the deposition of the Si-containing interlayer said ion source is also operated with Ar but then the thereby generated Ar ion beam is used for ion beam sputter deposition from a target such as SiO_2. By replacing said Si-containing sputter target by introducing a corresponding gaseous mixture including a Si-precursor, such as the - in vapour deposition- commonly used silanes or siloxanes, he would obtain the same deposited interlayer but with a simplified apparatus.

2.9.3 It is part to the common general knowledge of the skilled person that the ionization energy of methane is 12.6 eV. This fact was not contested by the respondent. Thus, when reading the parameters for the direct ion

beam deposition of example "A" of D1, the skilled person realizes that the energy of 75 eV applied for depositing the DLC coating is about 5-6 times the energy necessary to remove the first electron from methane.

Hence if the skilled person only considers the ionization energy of the silicon atom, which is about 8.1 eV, then it would be obvious for him to choose a specific ionization energy which is about 5-6 times the value of said silicon atom so that he would select an energy of about 40-50 eV for depositing the interlayer by (direct) ion beam deposition. Particularly, when considering that the said commonly used silane and siloxane precursors additionally contain hydrogen, carbon and oxygen atoms which have slightly higher first ionization energies of 13.6 eV, 11.3 eV and 13.6 eV, respectively, a range of about 57-82 eV can be calculated.

Consequently, it is evident that the skilled person would select an ionization energy value falling within the range of 20-300 eV as required by claim 1 as granted.

2.10 The respondent's arguments, except the one that there is no disclosure of (direct) ion beam deposition for the interlayer in the examples of D1, cannot be accepted for the following reasons.

2.10.1 First of all, the process according to claim 1 - due to its definition "A method … **comprising** the steps of …" does not exclude any further coating layer such as the DLC layer. To the contrary, such a DLC layer is

explicitly foreseen for some embodiments of the patent (see patent as granted, column, 8, lines 8 to 13; column 14, lines 16 to 36; paragraphs [0043] to [0045]; examples "E" and "F").

2.10.2 Since D1 uses either ion beam sputtering or direct ion beam deposition for depositing the coating layers according to its examples there occurs in both cases an ion bombardment of the substrate. Taking account of point 2.9.1 above the skilled person likewise does not have to ignore the general teaching ("vapour deposition") of D1 but only applies his common general knowledge.

2.10.3 The argument that the introduction of the reactive gases downstream from the ion source generates a different (higher) extent of ionization, has not been supported by any evidence.

2.10.4 It is not credible that the introduction of the Si-precursors into the ion source causes problems with the stability thereof due to the built-up of materials in the ion source, as alleged. This view is supported by the description of the application as originally filed on which the patent in suit is based and wherein it is stated that the reactive gases may be introduced via gas inlet 6 directly into the ion source plasma chamber (see, page 12, line 31 and 32; page 13, lines 4 to 9. Furthermore, there are three examples where the Si-precursor is directly introduced into the ion source but apparently without any stability problems (see the examples "C", "F" and "I" of the application as filed).

2.10.5 Although the advantage of coating plastic substrates is not mentioned in D1, the process derivable therefrom - as described above - is suitable for this purpose. In any case, claim 1 as granted is not directed to the coating of plastic substrates.

2.11 Therefore the subject-matter of claim 1 as granted lacks an inventive step, and thus does not meet the requirements of Article 56 EPC.

Consequently, the main request is not allowable.

Second auxiliary request

3. *Admissibility of amendment (Article 123(2) and(3) EPC)*

Claim 1 of the second auxiliary request is based on claim 1 as granted and the amendment thereof is based on page 29, lines 3 to 20 and examples "G", "H", "J", "K" and "L" of the application as originally filed. Thus the amendment does not contravene Article 123(2) EPC. Since the amendment restricts the method of claim 1 as granted it likewise meets the requirement of Article 123(3) EPC.

4. *Novelty (Article 54 EPC)*

The same conclusion of point 1.3 above applies *mutatis mutandis* to claim 1 of the second auxiliary request which is based on claim 1 of the main request but of which feature (c) has been limited to oxygen ion beam deposition (see point IX above). Therefore claim 1 of the second auxiliary request meets the requirement of Article 54 EPC.

5. *Inventive step (Article 56 EPC)*

D1 still represents the closest prior art but it is silent with respect to the type of ion beam used for depositing the Si-containing interlayer.

5.1 Consequently, the subject-matter of claim 1 is additionally distinguished from the process of D1 for depositing said transparent wear resistant coatings in that an oxygen ion beam is used and that at least a portion of the reactive gases including a Si-precursor are introduced into the ion beam downstream of the ion source.

5.2 Taking account of points 2.5.1 and 2.5.2 above and of claim 1 of the second auxiliary request the effect of minimisation of compressive stress, which is the result of the downstream introduction of the reactive gas(es) into an oxygen ion beam, can now be acknowledged.

5.3 Therefore the objective technical problem is defined as the provision of simplified process for coating optically transparent substrates with a wear resistant hard coating having optionally a highly adherent outermost DLC coating which allows to control and reduce the compressive stress of the abrasion resistant coating (see patent, column 7, lines 3 to 31; column 8, lines 4 to 13 and lines 29 to 32).

5.4 This problem is solved by the process as defined in claim 1 of the second auxiliary request.

5.5 The Board considers that the subject-matter of claim 1 of the second auxiliary request is not rendered obvious by the available prior art for the following reasons.

5.5.1 D1 neither discloses nor suggests to use an oxygen ion beam for depositing said Si-containing interlayer, let alone to introduce the reactive gases downstream of the ion source. The Board considers that the skilled person would either introduce the Si-precursor alone or in admixture with an inert gas directly into the ion beam source.

5.5.2 The other submitted documents are not considered to be relevant since they do not concern (direct) ion beam deposition processes.

5.5.3 The appellant has not argued on the related issue of the reduction of compressive stress raised by the Board in its annex to the summons and by not attending the oral proceedings did not use the opportunity to contest the above arguments.

5.6 The Board therefore concludes that the subject-matter of claim 1 of the second auxiliary request involves an inventive step. Claim 1 of the second auxiliary request thus meets the requirements of Article 56 EPC.

6. *Request for apportionment of costs (Article 104 EPC)*

6.1 According to the respondent the behaviour of the appellant, to request oral proceedings and then, about 3 weeks before the date of the oral proceedings, to state that it would not attend the oral proceedings, amounts to an abuse of procedure, particularly since

this had already happened before the Opposition Division.

6.2 These arguments cannot be accepted for two reasons. First of all, the date of oral proceedings was maintained by the Board in order to bring the case to a final decision. Secondly, as the Board had made remarks in its annex to the summons that the alleged effect concerning the minimisation of the compressive stress did not appear to be credible for the subject-matter of claim 1 as granted (see point IV above) it wished to hear the respondent's arguments on this issue, as it had not reacted to these remarks in its letter of 25 March 2008. In actual fact, this discussion led to the filing of the second auxiliary request, according to which the patent is presently maintained, to the benefit of the respondent.

As the oral proceedings were maintained at the instance of the Board, it sees no reason to deviate from the general principle outlined in Article 104(1) EPC, according to which each party to the proceedings shall meet the costs it has incurred.

The respondent's request for apportionment of costs of the oral proceedings before the Board of Appeal to the detriment of the appellant is thus to be refused.

Order

For these reasons it is decided that:

1. The request for apportionment of costs is refused.

2. The decision under appeal is set aside.

3. The case is remitted to the department of first instance with the order to maintain the patent on the basis of the following documents:
Description:

columns 1 to 22 as filed during the oral proceedings

Claims:

claim 1 as filed as second auxiliary request during the oral proceedings

Drawings:

Figure 1 as granted

The Registrar: The Chairman:

G. Nachtigall H. Meinders