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D E C I S I O N
of 21 December 2004

Case Number: T 0035/03 - 3.2.7

Application Number: 96924987.9

Publication Number: 0842306

IPC: C23C 14/06

Language of the proceedings: EN

Title of invention:
Improvements in and relating to methods for improving the sputter desposition of metal-sulphur coatings, e.g. molybdenum disulphide coatings and to improved coatings

Patentee:
TEER COATINGS LIMITED

Opponent:
PLATIT AG

Headword:
-

Relevant legal provisions:
54, 56, 113(1)

Keyword:
"Novelty (yes)"
"Inventive step (yes)"
"Requests submitted late (admitted)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0035/03 - 3.2.7

D E C I S I O N
of the Technical Board of Appeal 3.2.7
of 21 December 2004

Appellant: (Proprietor of the patent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 31 October 2002 revoking European patent No. 0842306 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: P. A. O'Reilly
Members: H. E. Felgenhauer
E. Lachacinski

Summary of Facts and Submissions

I. The appellant (patent proprietor) filed an appeal against the decision of the Opposition Division revoking the European patent No. 0 842 306.

Opposition had been filed by the opponent I against the patent as a whole based on the grounds of opposition of Article 100(a), (b) and (c) EPC. Opponent II withdrew its opposition.

The Opposition Division held that the patent had to be revoked since the subject-matter of claim 1 lacks inventive step in view of the documents

E5: Bernard C. Stupp, 1981 "Synergistic Effects of Metals co-sputtered with MoS_2"

E7: EP-A-0 534 905

E8: Adibi et al., "Design and characterization of a compact two-target ultrahigh vacuum magnetron sputter deposition system: Application to the growth of epitaxial $Ti_{1-x}AI_xN$ alloys and $TiN/Ti_{1-x}AI_xN$ superlattices", Journal of Vacuum Science & Technology, Jan/Feb 1993, pages 136 to 142.

II. Oral proceedings before the Board of Appeal were held on 21 December 2004.

(i) The appellant (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained in amended form with amended claims 1 to 15 and an

amended description (pages 3 to 9) as filed during the oral proceedings of 21 December 2004, and drawings (sheets 17 to 20) as granted.

(ii) The respondent (opponent) requested that the appeal be dismissed.

Amended claim 1 (in the following: claim 1) reads as follows:

"A method for improving the sputter depositing of a coating onto a substrate, such as MoS2 coatings, comprising operating a sputter ion plating system in cleaning operation prior to a coating operation, the sputter ion plating system having a first magnetron with a target of MoS2 or WS2 to be coated onto the substrate and a second, magnetron with a cleaning target of reactive metal selected from titanium, vanadium, chromium, zirconium, niobium, molybdenum, tantalum, hafnium or tungsten, and in which, in the cleaning operation the second target is energized to produce a flux of reactive cleaning metal which reacts with impurities in the sputter chamber so as to remove them from having an active presence during the ion bombardment cleaning of the substrate and in the coating operation, and in the coating operation the first and second targets are selectively energized and as the initial part of the coating operation a layer of the reactive metal is deposited on the substrate followed by the energisation of the first and second targets to deposit material simultaneously on the substrate, a bias voltage is applied to the substrate throughout the cleaning and coating operations and the

level of bias voltage applied during the cleaning operation is reduced to a lower bias voltage level during the coating operation".

Amended claim 11 (in the following: claim 11) reads as follows:

"An article coated using the method of any one of claims 1 to 10 characterised in that the coating has an adhesive critical load Lc of 70 N or greater, a Vickers hardness under Vickers Microhardness tests of 500 Hv or more, a coefficient of friction of 0.02 or less, a wear resistance to withstand a load of 80 N and a linear speed of 5000mm/min under ball on disc test, using a 6mm steel ball, for a period of 3 hours".

III. The arguments of the appellant can be summarised as follows:

(i) The amended claims as filed during the oral proceedings are based on the ones filed with facsimile dated 15.12.04. Although these claims have been filed shortly before the oral proceedings they should be admitted since with these claims it is attempted to meet objections raised in the Communication of the Board dated 06.09.04 as well as in the response of the respondent dated 7.10.03. This applies correspondingly with respect to claims 1 to 15 filed during the oral proceedings, since with these claims an objection of the respondent according to which claim 1 filed with facsimile dated 15.12.04 does not satisfy the requirement of

Article 123(3) EPC is now moot. Claims 1 to 15 filed during the oral proceedings should be admitted also for the reason that they are patentable at first sight and do not lead to new issues having to be dealt with.

(ii) The amended claims furthermore distinguish the subject-matters concerned more precisely from the closest prior art given by document E5. The amendments thus narrow the claims, without changing the subject-matter of these claims by giving it a new direction. Correspondingly the arguments brought forward with respect to the amended claims involving an inventive step are essentially the ones given already with respect to the claims on which the decision under appeal is based.

(iii) Since the method according to document E5 concerns exclusively co-sputtering this document cannot be considered as suggesting the method according to claim 1 comprising in addition to the simultaneous deposition of material from the first and second target (co-sputtering) a previous cleaning operation, in which the second target is energized to produce a flux of reactive cleaning metal, and an initial deposition of a layer of reactive metal.

(iv) Consideration of documents E7 or E8 in combination with document E5 likewise does not lead to the method according to claim 1.

(v) Claim 11 is directed to an article coated using the method of any one of claims 1 to 10. Consequently this article comprises a layer of reactive material which is deposited on the substrate prior to the layer deposited simultaneously by energisation of the first and second targets. The article is furthermore defined by features relating to properties of its coating, among them the hardness and coefficient of friction. The coated article according to claim 11 is novel since none of the documents E5, E7 or E8 discloses all features of this claim.

(vi) Claim 11 furthermore involves an inventive step since none of the available documents suggests coating a substrate such that the coating comprises a layer of reactive material, material deposited simultaneously by both targets and additionally such that the coating has the values defined for the properties of the coating, in particular its hardness and coefficient of friction.

IV. The arguments of the respondent can be summarised as follows:

(i) The amended claims as filed with facsimile dated 15.12.04 and more so as filed during

the oral proceedings have been filed late and should thus not be admitted. The time for an appropriate evaluation of these claims has been too short so that in the case that these claims are considered as admissible, the right to be heard will be violated.

(ii) Having regard to the method of claim 1 it is questionable which technical problem is solved by the method steps defined in this claim. Concerning the cleaning step it remains undefined to what extent cleaning has to be performed such that coatings of consistently high quality with improved coating properties will be deposited.

(iii) The article according to claim 11 lacks novelty with respect to documents E5, E7 or E8 since the methods referred to in this claim do not lead to features distinguishing the product from the articles with coatings known from these documents and since the material properties for the coating defined in this claim are common to these known coatings.

(iv) The only difference between the article according to claim 11 and the articles known from documents E5, E7 or E8 can be seen in different parameters being used to define properties of the coating. The article according to claim 11 lacks novelty since the values for the properties defined in

claim 11 correspond essentially with the values given with respect to these properties for the articles according to documents E5, E7 or E8.

(v) The article according to claim 11 likewise does not involve an inventive step since the values given for the properties of the coating are those which are desirable for this kind of article and ones which can be obtained by applying known methods of coating with appropriate settings of the parameters governing the method and influencing the properties of the resulting coating.

Reasons for the Decision

1. Amended claims filed during the appeal proceedings

Amended claims 1 to 15 have been filed with facsimile dated 15.12.04 and thus only six days prior to the oral proceedings of 21.12.04. After an objection of the respondent with respect to claim 1 not satisfying the requirement according to Article 123(3) EPC this claim has been amended and amended claims 1 to 15, based on claims 1 to 15 filed with facsimile, have been filed during the oral proceedings.

These claims have not been objected to by the respondent with respect to the requirements of the EPC other than novelty and inventive step. The Board likewise is satisfied that these claims fulfil these

requirements of the EPC, in particular those of Articles 84, 123(2) and (3) EPC.

According to the appellant these claims should, although having been filed at a late stage in the appeal proceedings, be considered as being admissible. The reasons being that claim 1 of these claims has been narrowed by introducing features which have already been referred to in the arguments given within the grounds of appeal, but which previously did not form part of the subject-matter of claim 1. Consequently the amendments of the claims have been made to overcome objections raised in this regard in the Communication pursuant to Article 11(1) RPBA and also referred to in the response to the grounds of appeal with letter dated 7.10.03 (cf. section 9.). Furthermore the amended claims are patentable at first sight in view of the arguments given with the grounds of appeal and do not raise new issues to be dealt with.

According to the respondent the late filing of the amended claims six days prior to the oral proceedings and the further amendment in the oral proceedings has meant that there has not been sufficient time to evaluate these claims appropriately. Admission of these claims would thus lead to the right to be heard being violated.

In view of the fact that amended claims 1 and 11 appear to be patentable at first sight, the Board indicated in the oral proceedings its intention to consider the claims as admissible. In reaching at this view the Board took into account that claim 1 has been amended by narrowing its subject-matter in a clear way, that

the features introduced concerning application of a bias voltage to the substrate have already been considered as being implicitly comprised within claim 1 in the decision under appeal, and that the arguments already brought forward by the appellant required no change in view of the amendment of the claims. The Board further took into account that the respondent in its letter dated 7.10.03 responding to the grounds of appeal correctly noted that arguments given by the appellant concerned features not comprised within the claims (cf. page 2, section titled "Anmerkung" and sections 2., 9.). In the oral proceeding the respondent was asked for the further time required to evaluate these claims with respect to novelty and inventive step and the requested period of 30 minutes was accorded. The respondent thus had the opportunity which it considered necessary to evaluate the claims and in the ensuing discussion to present its comments (Article 113(1) EPC).

2. Novelty of claim 1 is undisputed. As can be derived from the following reasoning with respect to inventive step the method according to claim 1 is novel in the sense of Article 54 EPC since none of the prior art documents relied upon by the respondent discloses a method comprising all steps as defined in claim 1.

3. *Inventive step*

3.1 It is undisputed that document E5 constitutes the closest prior art.

The Board shares this view since claim 1 of the patent in suit is directed to a method of improving the

sputter deposition of a coating onto a substrate, such as MoS2 coatings; the problem to be solved by the patent in suit concerns the consistency of the quality of the coating and improvement of the coating properties (cf. patent in suit, page 3, lines 35, 36), and document E5 is likewise concerned with methods for the deposition of coatings and their properties (cf. e.g. page 263, paragraph 2 - page 266, last paragraph).

Document E5 solely discloses co-sputtering of metals from one target with MoS2 from a further target (cf. e.g. page 266, last paragraph); selective energisation of one of the two targets is not referred to.

The method according to claim 1 thus differs with respect to the energisation of the first and second target from the one according to document E5 in that

(a) in the cleaning operation the second target is energized to produce a flux of reactive cleaning metal which reacts with impurities in the sputter chamber so as to remove them from having an active presence during the ion bombardment cleaning of the substrate and in the coating operation,

(b) in the coating operation the first and second targets are selectively energized and

(c) as the initial part of the coating operation a layer of the reactive metal is deposited on the substrate.

Concerning deposition of material on the substrate the method according to claim 1 and the one according to document E5 have in common

(d) the energisation of the first and second targets to deposit material simultaneously on the substrate.

The method according to claim 1 differs from the one according to document E5 furthermore in that

(e) a bias voltage is applied to the substrate throughout the cleaning and coating operations and

(f) the level of bias voltage applied during the cleaning operation is reduced to a lower bias voltage level during the coating operation.

Although document E5 refers in a general manner to the application of a bias to the substrate as a process parameter (page 258, paragraph 3 from bottom) this parameter is not among the ones considered in connection with the sputtered coatings presented and evaluated in this document (cf. page 259, Table I).

3.2 Based on features (a) - (c), (e) and (f) distinguishing the method according to claim 1 from the one disclosed in document E5, the problem underlying the patent in suit can be considered as being the one stated in the description (page 3, lines 35, 36), namely depositing coatings of consistently high quality and improving the coating properties.

3.3 This problem is solved by the combination of features of claim 1 including features (a) to (f) referred to above. According to the appellant claim 1, and correspondingly claim 11, lacks a definition concerning the extent within which impurities are removed by the cleaning step according to feature (a). The Board however is of the opinion that energising the second target during the ion bombardment cleaning of the substrate and in the coating operation leads to a removal of impurities in the sputter chamber which, irrespective of the degree in which the impurities are removed, contributes to the problem being solved.

3.4 Obviousness

Document E8 discloses a portable two-target magnetron sputter deposition system (page 136, paragraph 1) with negative substrate bias and a shutter system to allow deposition from either target, as well as from both targets operating simultaneously or sequentially (page 137, paragraph 2). No indication is given with respect to different levels of bias according to feature (f), to the cleaning operation according to feature (a), within which the second target is energized to produce a flux of reactive cleaning metal, or to the deposition of a layer of the reactive metal on the substrate as the initial part of the coating operation according to feature (c).

Thus starting from the method according to document E5 and considering the system according to document E8 in an attempt to solve the problem underlying the patent in suit, no indication is given which would lead to a modification of the known method of co-sputtering such

that a bias according to features (e) and (f) is provided. In addition no indication is given which would lead to the co-sputtering by energisation of both targets according to feature (d), and the second target being energized according to features (a) and (c).

The method according to claim 1 thus involves an inventive step (Article 56 EPC), since none of the available documents gives an indication leading to a method comprising features (a) - (c), (e) and (f), which results in coatings of consistently high quality with improved coating properties.

4. Claim 11 is directed to an article coated using the method of any one of claims 1 to 10, the coating being further being identified by values for some of its properties, defining *inter alia*

(g) a Vickers hardness under Vickers Microhardness tests of 500 Hv or more and

(h) a coefficient of friction of 0.02 or less.

4.1 According to the respondent the article according to claim 11 lacks novelty in view of any one of documents E5, E7 or E8. The respondent is of the opinion that the definition of claim 11 due to its reference to method claims 1 to 10 in the form of a product-by-process claim is inappropriate, since in its view the reference to method features does not result in structural features identifiable on the article claim 11 is directed to. The respondent is further of the opinion, that the values of the Vickers hardness and of the coefficient of friction defined by features (g) and (h)

are, although not explicitly mentioned, implicitly disclosed in any of documents E5, E7 and E8.

4.2 In the view of the Board features (c) and (d) of claim 1 result in structural features identifying the coating of the article according to claim 11, since according to these features the coating comprises an initial layer of the reactive metal on the substrate, this layer being followed by a layer formed by deposition from both targets.

These features furthermore lead to the article according to claim 11 being novel in view of documents E5 and E8 since, as indicated above with respect to claim 1, none of these documents discloses a method step within which an initial layer of the reactive metal is deposited.

These features furthermore lead to the article according to claim 11 being novel in view of document E7 since according to this document simultaneous deposition by energisation of the first and second target according to feature (d) is not provided for.

Furthermore despite its allegations the respondent failed to give evidence for the coatings according to documents E5, E7 or E8 having the Vickers hardness and the coefficient of friction as defined by features (g) and (h).

4.3 The article according to claim 11 is thus novel in the sense of Article 54 EPC.

5. *Inventive step*

5.1 Starting from document E5 as closest prior art also with respect to the article according to claim 11, this article is distinguished from one according to this document by the method step according to feature (b) of claim 1 resulting in an initial layer of the reactive material and by properties of its coating defined, *inter alia*, by features (g) and (h).

5.2 The problem to be solved in view of the article obtained according to document E5 can be seen in providing an article with improved coating properties.

5.3 This problem is solved by the article according to claim 11 which, by reference to the method of any one of claims 1 to 10, is defined by the method steps according to features (c) and (d) resulting in corresponding structural features and furthermore by values defined for properties of the coating, *inter alia* by features (g) and (h).

5.4 Document E5 which, as indicated above with respect to claim 1, solely concerns methods with co-sputtering corresponding to feature (d), does not suggest an article whose coating has a layer as produced by sputtering with one of the targets according to feature (c). This document furthermore does not suggest provision of a coating having properties as defined by features (g) and (h), namely a high Vickers hardness and at the same time a low friction coefficient. As indicated in document E5 "depending on the sputtering parameters, results can vary from hard and glassy non-lubricating film to soft and burnishable lubricating

films" (paragraph bridging pages 258 and 259). According to this statement a high hardness on the one side and a low friction coefficient on the other side are properties of the coating which mutually exclude each other. Thus starting from document E5 it is not obvious to arrive at an article with a coating having simultaneously properties as defined by features (g) and (h).

This correspondingly holds true considering documents E7 and E8 since, as indicated above with respect to novelty of claim 11, none of these documents suggests an article having a coating with a structure resulting from method steps according to features (c) and (d) of claim 1. Furthermore the respondent has not provided any evidence that the coatings known from documents E7 and E8 have properties corresponding to features (g) and (h) or that - contrary to the statement according to document E5, according to which high hardness and low friction coefficient are properties mutually excluding each other - these documents suggest such properties as simultaneously being provided.

5.5 The article according to claim 11 thus involves an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent as amended in the following version:

Claims:	1 to 15 received during the oral proceedings of 21 December 2004
Description:	pages 3 to 9 received during the oral proceedings of 21 December 2004
Drawings:	Sheets 17 to 20 of the patent specification.

The Registrar: The Chairman

G. Nachtigall P. O'Reilly