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D E C I S I O N
of 9 January 1996

Case Number: T 0494/93 - 3.5.2

Application Number: 83302419.3

Publication Number: 0111988

IPC: G11B 11/10

Language of the proceedings: EN

Title of invention:
Magneto-optic memory device

Patentee:
SHARP KABUSHIKI KAISHA

Opponent:
BASF Aktiengesellschaft, Ludwigshafen
Hoechst Aktiengesellschaft Werk KALLE-ALBERT

Headword:
-

Relevant legal provisions:
EPC Art. 56, 100(b), 123(2), 114(2)

Keyword:
"Fresh grounds of opposition (not admitted)"
"Sufficient disclosure of invention (yes)"
"Late citation of documents (not admitted)"
"Invention step (yes)"

Decisions cited:
G 0009/91, G 0010/91

Catchword:
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Case Number: T 0494/93 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 9 January 1996

Other party: (Opponent I)
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Appellant: (Opponent II)
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Respondent: (Proprietor of the patent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 19 March 1993 concerning maintenance of European patent No. 0 111 988 in amended form.**

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: M. R. J. Villemin
C. Holtz

Summary of Facts and Submissions

I. The Appellant (Opponent II, Hoechst AG) contests the interlocutory decision of the Opposition Division that, account being taken of the amendments made during the opposition proceedings, European Patent No. 0 111 988 and the invention to which it related met the requirements of the EPC.

II. Claim 1 of the patent as amended during the opposition procedure reads as follows:

"1. A magneto-optical memory device having a layer of an optical memory recording medium (18) comprising an amorphous rare earth/transition metal alloy sandwiched between a first dielectric layer (19) and a further dielectric layer (17), said further dielectric layer (17) being disposed between said optical memory recording medium layer (18) and a transparent substrate (16) of the device, characterised in that each of said dielectric layers (17, 19) is substantially impermeable to oxygen, and also has substantially no oxygen content whereby substantially to prevent oxygen from entering said recording medium layer, and thereby to inhibit change with time of its characteristics due to selective oxidation of the rare earth component of said rare earth/transition metal alloy."

Claims 2 to 7 are dependent on Claim 1.

III. The following documents cited in the proceedings before the Opposition Division were referred to by the Appellant during the appeal proceedings:

D1: DE-A-2 303 520,
D2: DE-A-3 124 573,

D3: US-A-4 042 341,

D4: US-A-3 600 218,

D5: Journal of the Electrochemical Society, vol. 125, No. 4, April 1978, pages 601-608, A. K. Sinha et al.,

D6: Journal of the Electrochemical Society, vol. 114, No. 7, July 1967, pages 717-722, T. L. Chu et al.,

D7: IBM Technical Disclosure Bulletin, vol. 16, No. 5. October 1973, page 1442, J. J. Cuomo et al.,

D8: US-A-4 277 540,

D9: Journal of Applied Physics, 53(3), March 1982, pages 2353-2355, R. Allen et al. and

D10: DE-A-3 110 583.

Documents D9 and D10 were submitted with the letter of Opponent II (now Appellant) dated 5 January 1993, about two and a half years after the end of the 9 month period stipulated in Article 99(1) EPC. At oral proceedings held on 14 January 1993 the Opposition Division decided not to admit these documents.

IV. In the appeal proceedings, the Appellant argued essentially as follows:

Claim 1 of the contested patent as granted had been amended by replacing the expressions "does not include oxygen" and "impermeable to oxygen" by "substantially no oxygen content" and "substantially impermeable to oxygen" respectively. Since the application as originally filed did not explicitly mention the word "substantially", this amendment infringed Article 123(2) EPC because the contested patent now contained subject-matter which extended beyond the content of the application as originally filed.

Claim 1 contravened Article 100(b) EPC, because there was no sufficiently clear and complete disclosure of the invention for it to be carried out by a person skilled in the art.

It was known from D2, taken as the closest prior art, that transparent dielectric layers could be made of materials free of oxygen, for example ZnS and MgF. Therefore the subject-matter of Claim 1 was not novel over the teaching of D2.

D1 disclosed the use of oxygen-free dielectric layers for a memory layer containing Mn-Bi. Documents D1 and D2 implied that selective oxidation of RETM layers could be avoided by using oxygen-free dielectric layers.

D3 disclosed that oxygen-free silicon nitride could be used to protect the surface of an RETM alloy layer against oxidation and deterioration.

D4 taught that silicon nitride layers and aluminium nitride layers (which were oxygen-free) should be used instead of oxygen-containing layers to prevent damage to substrates by oxygen ions during sputtering.

D5 and D6 recommended the use of oxygen-free silicon nitride layers instead of silicon dioxide layers, which were sensitive to moisture and impurities.

D7 taught that the magneto-optical properties of an RETM memory layer should not be spoilt by dielectric layers and suitable layers could be made of Si_3N_4, AlN, ZnS, Si or Ge. D8 concerned a magnetic layer made of Fe, Co or Ni, or an alloy thereof, sandwiched between dielectric

layers selected from the nitrides or carbides of Si, zircon, Hf, Ti, Ta, W and Nb, to give protection against corrosion.

It was known from D9 that oxygen deteriorated the magneto-optical properties of RETM memories and a protective layer against superficial oxidation could be obtained by sputtering pure quartz or silicon dioxide onto the RETM layer. D10 described the use of a metal oxide overlayer and an underlayer made of an inorganic compound as Si_3N_4, nitrides and fluorides of Al, Si, Cr as well as calcium or magnesium fluorides. It was obvious for the skilled person to arrange these Al nitrides and Si nitrides as protective layers in a sandwich structure for protecting an RETM memory against oxidation.

VI. With the letter dated 27 January 1994 in reply to the notice of appeal, the Respondent filed five sets of amended claims constituting respectively first to fifth auxiliary requests.

The responded argued that the Appellant's objection, that the amendments relating to the use of the term "substantially" violated Article 123(2) EPC, constituted a fresh ground of opposition. The Respondent did not approve of the introduction of this fresh ground and it was submitted that in accordance with the decisions G 9/91 and G 10/91 this fresh ground should be disregarded by the Board.

As to the objection of the Appellant with regard to Article 100(b) EPC, the Respondent submitted that it appeared that the Appellant had misinterpreted this article for it was not the function of a claim to teach the skilled person how to put the invention into effect.

Moreover, as the new ground was raised and considered at the very last moment during the opposition proceedings it could not receive the detailed and thorough examination by the Opposition Division, nor the proper consideration by the patent proprietor to the extent usually allowed in opposition proceedings in the European Patent Office. Should the Board disagree with this submission, either of the amended versions of Claim 1 in the first auxiliary request and the second auxiliary request should overcome the Appellant's objections.

The skilled man reading D2 was taught nothing about any problem arising from the presence of oxygen in the two dielectric layers. All the materials except MgF and ZnS disclosed in D2 included oxygen in their chemical composition. Nothing taught the skilled man to take a specific selection of MgF for one layer and ZnS for the other layer, this being a purposive selection made on the basis of the teaching of the present invention.

Since the use of MnBi as a recording material was generally abandoned in the late 1970's the skilled person would not have, for no apparent reason, simply updated the structure known from D1 by replacing the MnBi layer by an RETM layer. D1 made no mention whatsoever of problem of oxidation of the recording layer and included no disclosure that an important feature of the dielectric layers was that they were oxygen-free. Contrary to the Appellant's assertions, D1 and D2 did not include any reference to avoiding selective oxidation of RETM layers by using oxygen-free dielectric layers.

D3 lay in the technical field of magnetic recording whereas D2 concerned the different technical field of

magneto-optic recording. There was no reason to suppose that the skilled man would have specifically extracted the example of silicon nitride disclosed in D3 for the purpose of protecting the surface of a RETM alloy and applied it to the device disclosed in D2.

The problem addressed by D4 concerned the damage which was suffered by substrates when depositing metal oxide insulating layers in the fabrication of solid state electrical devices. Both the technical field and the technical problem to which D4 related were quite different from and irrelevant to the field and problem relating to the present invention.

It was true that D5 and D6 referred to the use of SiN layers in place of SiO_2 layers as dielectric layers, but the field to which these documents related was that of silicon integrated circuits. D5 explicitly allowed the presence of oxygen during deposition. D5 and D6 had no relevance to RETM memory devices and did not address the same problem as the present invention.

D7 did not teach the selection of oxygen-free materials for dielectric layers to be used in RETM memory devices. This document at best disclosed the use of an anti-reflection coating of, for example, Si_3N_4, AlN, ZnS, Si or Ge on a RETM alloy layer but did not teach to make this coating so that it had no oxygen content.

D8 related to a magnetic recording medium requiring a protective overcoat to prevent physical damage through high-speed collisions with a floating head. It was not obvious that the teaching of this document was readily applicable to magneto-optical devices, and particularly to RETM recording layers.

Documents D9 and D10 were of no greater significance than the admitted prior art. They should not be admitted in the appeal proceedings.

VII. With the letter dated 3 February 1995 Opponent I (BASF) stated that it would abstain from submitting observations in the present Appeal.

VIII. The Appellant requested that the interlocutory decision under appeal be set aside and that the patent be revoked. The Appellant did not request oral proceedings.

IX. The Respondent requested that the Appeal be dismissed and that the Opposition Division's interlocutory decision be confirmed (main request), or the patent be maintained with the claims, in order of preference, of first to fifth auxiliary requests.

Reasons for the Decision

1. The Appeal is admissible.

2. The Board agrees with the Respondent that the objection under Article 123(2) EPC constitutes a fresh ground for opposition under Article 100(c) EPC because it has been raised for the first time at the appeal stage and concerns only amendments made to the application before grant of the patent in suit. Given the Respondent's reply that it did not agree to the introduction of this fresh ground, and following the principles for appeal review laid down by the Enlarged Board of Appeal in its decisions G 9/91 and G 10/91 (see paragraph 18 of the reasons for both cases and point 3 of the Opinion in G 10/91), this fresh ground of opposition may not be considered in appeal proceedings.

3. The objection under Article 100(b) EPC was raised by the Appellant at oral proceedings held before the Opposition Division and taken into consideration by the Opposition Division in the decision under appeal. It can therefore be reconsidered on appeal. It appears from the minutes of the oral proceedings held before the Opposition Division, that the Appellant's objection was not only that Claim 1, viewed in isolation, did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. Rather, it was also that there was no disclosure (i.e. anywhere in the patent in suit) of the invention according to the amended Claim 1 in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

3.1 The Board agrees with the Respondent that the goal of the invention is to exclude, so far as is practically possible, oxygen from the dielectric layers. The slight amount of oxygen which permeates into the outer portions of the dielectric layer (see page 11, lines 17 to 22 of the original description) is consistent with the term "substantially" in relation to oxygen content and permeability. It is clear to the skilled person that in practice, a perfect protection of the recording layer against corrosion is an unobtainable end result, but very satisfactory results approaching such a complete protection can be achieved by following the instructions contained in the description of the patent in suit:

- In particular in column 5, lines 35 to 43, column 6, line 55 to column 7, line 3 and column 8, lines 1 to 48, several target materials and deposition techniques are described for obtaining a dielectric layer which is substantially free of and impermeable to oxygen.

- The contested patent clearly defines the troubles resulting in using dielectric layers not meeting the requirements of being free of and impermeable to oxygen, e.g. column 5, lines 15 to 59 and column 8, lines 16 to 25. Furthermore, the contested patent indicates a testing method by Auger spectroscopy enabling the skilled person to verify the results of his experiments. This method is illustrated with the help of Figure 9 and column 7, lines 49 to column 8, line 6. This figure shows that free oxygen enters into the dielectric layers from the boundaries up to a certain depth whereas there is no oxide in the central region. This proves clearly that with the expression "substantially free of oxygen" not only materials free of chemically bound oxygen are meant but also materials not having foreign free oxygen atoms included in their structures.

- Measurements of the change of the coercive force with time are depicted in Figure 6 and described in the corresponding text in the description, together with the explanation of the aging process with the help of Figure 4.

3.2 The Board is therefore of the opinion that the patent in suit discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

4. The Board will now consider the Respondent's main request.

4.1 Novelty

4.1.1 The closest prior art is disclosed in document D2. It concerns a RETM magneto-optical memory device as defined in the prior art portion of Claim 1 of the patent in suit. With respect to the dielectric layers, this document discloses the use of inter alia SiO_2, SiO, MgF, ZnS and TiO_2. Even if a structure including a first layer made of MgF and a second one made of ZnS could be envisaged by a skilled person, such a structure is not specifically disclosed in this document. Moreover, there is no disclosure that such a structure should be impermeable to oxygen.

4.1.2 Thus, the subject-matter of Claim 1 is novel over D2.

4.2 Inventive step

4.2.1 In light of the description of the patent in suit and starting from the closest prior art document D2 the problem addressed by the patent in suit can be defined as providing a magneto-optical memory device showing a reduced deterioration of the opto-magnetic characteristics of its recording medium due to oxidation.

4.2.2 It appears from the description of the patent in suit that the invention mainly concerns a particular oxidation problem of RE (rare earth) in a RETM memory device. This particular oxidation problem is defined as "selective oxidation" in Claim 1 and has to be distinguished from another type of oxidation caused by atmospheric oxygen and pinhole formation. It has been observed by the inventor of the claimed magneto-optical memory, that when a RETM film is formed by way of sputtering on a dielectric film including oxygen, oxygen

atoms are separated from this film and enter into the RETM film, so that after sputtering the oxygen gradually oxidises RE in the RETM selectively, resulting in time-dependent variation in the coercive force of the RETM recording layer, thus producing a deterioration of the magneto-optical properties of this layer. According to Claim 1 of the patent in suit, selective oxidation of the RETM layer is reduced by sandwiching it between two dielectric films having substantially no oxygen content. Moreover, impermeability to oxygen of these dielectric films avoids another type of oxidation due to atmospheric oxygen and pinhole formation.

4.2.3 The Board observes that documents D1, D2 and D7 are the only prior art documents cited by the opponents relating to magneto-optical recording devices and none of the cited prior art documents deals with or suggests the problem of selective oxidation of the RE component of a RETM alloy in a recording layer sandwiched between other layers.

4.2.4 As indicated in Section 4.1 above, document D2 discloses a RETM magneto-optical memory as defined in the preamble of Claim 1 of the patent in suit. As explained in D2, RETM magneto-optical recording layers offer certain advantages, but the magnitude of the Kerr rotation angle is relatively small. D2 discloses arrangements for enhancing the Kerr rotation angle, comprising a transparent substrate (1), a thin RETM layer (2) and a reflective layer (4). Dielectric layers (3, 12) may be provided on one or both sides of the RETM layer to thermally isolate the RETM layer from the reflective layer (4) and to further increase the Kerr rotation angle and improve the signal to noise ratio.

4.2.5 In the Board's opinion, contrary to the Appellant's assertion, the passage on page 2, lines 16 to 26 of D2 means that a **thin** dielectric layer (which may be made of SiO or SiO_2) cannot protect the magnetic material from corrosion. This does not imply that SiO and SiO_2 are unsuitable materials for preventing corrosion. As far as the dielectric layers are concerned, D2 only discloses (see page 5, line 30 to page 6, line 14 and page 7, lines 15 to 23) that the transparent dielectric layer (3) may be made of SiO_2 and is provided as a thermally insulating layer to prevent heat applied to the magnetic layer (2) from escaping into the reflector (4), and that the purpose of the dielectric layer (12) is to increase the Kerr rotation angle and improve the S/N ratio. It is particularly emphasized in D2 (page 6, lines 3 to 5 and 16 to 19) that the thickness of the dielectric layer (3) has to be carefully chosen, but there is nothing in D2 which suggests that oxygen has to avoided in the dielectric layers, or that oxygen from a dioxide dielectric layer might diffuse from this layer into the recording RETM layer.

4.2.6 D1 discloses the use of ZnS dielectric layers disposed on both sides of a magneto-optical recording layer made of MnBi. The problem of oxidation of the magneto-optical recording layer is not mentioned at all. Nor is there any disclosure that the dielectric layers should be oxygen-free and/or impermeable to oxygen. Since it is apparent from other prior art documents, such as D2, that oxides are quite commonly used as dielectric materials, the fact that D1 mentions ZnS in the particular embodiment cannot be taken as a disclosure of the desirability of avoiding oxides as the dielectric material. Nor does it make it obvious to replace only the MnBi layer in the particular embodiment described in D1 by a RETM layer.

4.2.7 D7 describes another way of enhancing the Kerr rotation angle in RETM alloys, namely by means of an anti-reflection coating on an RETM layer. Among the examples of suitable coating materials are several oxides, including SiO, which are chosen because they do not degrade the magnetic properties of the magnetic film. Again, the fact that D7 also mentions some nitrides and ZnS as examples cannot be taken as a disclosure of the desirability of avoiding oxides in the anti-reflection coating.

4.2.8 It is true that D2 discloses as examples dielectric layers made of non-oxides (MgF, ZnS) as well as oxides, however this document does not teach avoiding any oxygen in these layers, nor does it disclose using dielectric layers impermeable to oxygen.

4.2.9 Given the above facts, the Board is of the opinion that D1, D2 and D7, read together, do not make it obvious that the RETM recording layer can be protected from corrosion by selecting a dielectric material which does not contain oxygen and is impermeable to oxygen (or substantially so) for the two dielectric layers.

4.2.10 The other cited prior art documents are less relevant. D3 and D8 concern **magnetic** (not magneto-optical) recording. D3 discloses an embodiment of a magnetic recording member in which the surface of a RETM layer is protected against oxidation by coating it with non-magnetic materials such as shellac or a ceramic such as silicon nitride. It is known that shellac is a resinous compound made of wax and organic acids including oxygen. D3 does not specify that the ceramic should be free of oxygen, nor does this document in general refer to the selection of materials having no oxides or oxygen content. D8 discloses the provision of a corrosion and

wear resistant protective coating of gold, tantalum, niobium, platinum, chromium, tungsten, rhodium, refractory nitrides, or refractory carbides on a magnetic recording film to prevent mechanical damage through high-speed collision with a floating head. There is no hint that these protective coatings could be used to protect a RETM layer used for magneto-optical recording, where it is necessary for the layers to be transparent to light.

4.2.11 D4 addresses the problem of avoiding damage to a substrate during deposition of a metal oxide insulating layer thereon in the fabrication of solid state electrical devices. D5 and D6 teach using SiN layers in place of SiO_2 for coating solid state electrical devices. These documents offer no help to someone seeking a means to protect a RETM magneto-optical recording layer from corrosion.

4.2.12 D9 and D10 were received by the EPO the day before the oral proceedings before the Opposition Division (about eight months after the filing of the claims according to the Respondent's main request) and constitute late submitted documents. It is true that D9 mentions (page 2355, right-hand column) that oxidation "reduces the polar Kerr rotation", but this is in the context of oxide growth on a free surface exposed to air. D9 describes experimental methods for preparing "SiO_2 films of excellent optical quality" (page 2353, Section B.) and does not advise against the use of such films in an RETM memory. Rather, it states that "the use of overcoating and interference structures in general are therefore of considerable importance for obtaining maximum and stable magneto-optical response" (page 2355, right-hand column). The dielectric layers described in D10 are not disclosed as being suitable for protecting

RETM alloy layers from corrosion. Nor does D10 suggest any preference for silicon nitride over the dielectric materials containing oxygen for the dielectric layers. The Board therefore agrees with the Opposition Division that the late filed documents D9 and D10 are not sufficiently relevant to justify their admission into the proceedings. Therefore, pursuant to Article 114(2) EPC, D9 and D10 will be disregarded.

5. In the result, the Board concludes that it would not have been obvious to the skilled person, without inventive ingenuity, to combine the prior art documents in any manner which would result in a magneto-optical memory provided with an RETM recording layer sandwiched between dielectric layers substantially impermeable to oxygen and having substantially no oxygen content, whereby substantially to prevent oxygen from entering the RETM recording layer, and thereby to inhibit change with time of its characteristics due to selective oxidation of the rare earth component of the RETM alloy. Therefore, the subject-matter of Claim 1 as maintained by the Opposition Division involves an inventive step within the meaning of Article 56 EPC and the patent may be maintained with this claim. The same applies to Claims 2 to 7, which are properly dependent on Claim 1.

6. Thus, the appeal has to be dismissed, and it is not necessary to consider the Respondent's auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

M. Kiehl

The Chairman:

W. J. L. Wheeler