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REQUEST FOR *EX PARTE* RE EXAMINATION TRANSMITTAL FORM

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**Mail Stop *ExParte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450****Attorney Docket No.: 00026-0001RX1****Date: December 16, 2011**

1. This is a request for ex parte reexamination pursuant to 37 CFR 1.510 of patent number 5128099 issued July 7, 1992. The request is made by:
- patent owner. third party requester.
2. The name and address of the person requesting reexamination is:
- Dorothy P. Whalen
- Fish & Richardson P.C.
- 60 South Sixth Street, Suite 3300, Minneapolis, MN 55402
3. a. A check in the amount of \$ _____ is enclosed to cover the reexamination fee, 37 CFR 1.20(c)(1);
- b. The Director is hereby authorized to charge the fee as set forth in 37 CFR 1.20(c)(1) to Deposit Account No. 06-1050; or
- c. Payment by credit card. Form PTO-2038 is attached.
4. Any refund should be made by check or credit to Deposit Account No. 06-1050. 37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.
5. A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4)
6. CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
- Landscape Table on CD
7. Nucleotide and/or Amino Acid Sequence Submission
- If applicable, items a. – c. are required.*
- a. Computer Readable Form (CRF)
- b. Specification Sequence Listing on:
- i. CD-ROM (2 copies) or CD-R (2 copies); or
- ii. paper
- c. Statements verifying identity of above copies
8. A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.
9. Reexamination of claim(s) 1-9 and 23 is requested.
10. A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.
11. An English language translation of all necessary and pertinent non-English language patents and/or printed publications is included.

[Page 1 of 2]

This collection of information is required by 37 CFR 1.510. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.

SEND TO: Mail Stop *Ex Parte* Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

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12. The attached detailed request includes at least the following items:
- a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1)
 - b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR 1.510(b)(2)
13. A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e)
14. a. It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).
The name and address of the party served and the date of service are:
Kevin Bray
Energy Conversion Devices, Inc.
2956 Waterview Drive, Rochester Hills, MI 48309

Date of Service: 12-16-2011 ; or
- b. A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner is **attached**. See MPEP 2220.

15. Correspondence Address: Direct all communication about the reexamination to:

The address associated with Customer Number: 26191

OR

Firm or individual Name Fish & Richardson P.C.

Address P.O. Box 1022

City Minneapolis State MN Zip 55440-1022

Country United States

Telephone _____ Email _____

16. The patent is currently the subject of the following concurrent proceeding(s):

- a. Copending reissue Application No. _____.
- b. Copending reexamination Control No. _____.
- c. Copending Interference No. _____.
- d. Copending litigation styled: 2:11-CV-12566.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

/Juan Zheng, Reg. No. 63,514/
Authorized Signature

December 16, 2011
Date

Juan Zheng
Typed/Printed Name

63,514 For Patent Owner Requester
Registration No. For Third Party Requester

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of Strand, *et al.*

U.S. Patent No.: 5,128,099

Issue Date: July 7, 1992

Serial No.: 07/657,170

Filing Date: February 15, 1991

Title: Congruent State Changeable Optical Memory Material and Device

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Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

REQUEST FOR EX PARTE REEXAMINATION
UNDER 35 U.S.C. § 302 AND 37 C.F.R. § 1.510

Reexamination under 35 U.S.C. § 302 and 37 C.F.R. § 1.510 is requested for claims 1-9 and 23 of U.S. Patent No. 5,128,099 (“the ‘099 patent”), which issued on July 7, 1992 to Strand *et al.* The ‘099 patent expired as of February 15, 2011. The ‘099 patent has not yet been adjudged invalid or unenforceable.

I. INTRODUCTION

This request for reexamination of the '099 patent is submitted on behalf of third party requesters CMC Magnetic Corp. and Ritek Corp., on the basis of prior art references in the form of printed publications and patents that were not of record during prosecution of the '099 patent. As set forth below, there are at least five prior art references not considered during the original prosecution that anticipate each of claims 1-9. In addition, at least one reference anticipates claim 23. These prior art references are more relevant than the prior art that was considered during prosecution.

II. CLAIMS FOR WHICH REEXAMINATION IS REQUESTED

The '099 patent contains 23 claims. Reexamination is requested for claims 1-9 and 23 in view of the publications and patents discussed below. Requesters reserve all rights regarding claims 10-22. A copy of the '099 patent is attached as Appendix A of this document. For purposes of the Patent Office's "Litigation Review," (M.P.E.P. § 2240), Requesters note that Optical Memory Storage, which claims to have exclusively licensed the patent from assignee Energy Conversion Devices, is enforcing the '099 patent in proceedings in the United States District Court for the Eastern District of Michigan, Case No. 2:11-cv-12566. Requesters are not aware of any previous requests for reexamination or disclaimers related to the '099 patent.

III. PATENTS AND PRINTED PUBLICATIONS PRESENTED TO SHOW SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

1. Yamada *et al.*, published September 16, 1987, attached as Appendix B ("Yamada"). Yamada qualifies as prior art under 35 U.S.C. §102(b) against the '099 patent because it published on September 16, 1987, which is more than one year prior to the earliest U.S. filing date to which the '099 patent claims possibly could be entitled (February 15, 1991).
2. Japanese Patent Application Publication No. 63-251290, published October 18, 1988, attached with a certified English translation as Appendix C ("Maeda"). Maeda qualifies as prior art under 35 U.S.C. § 102(b) against the '099 patent because it published on October 18, 1988, which is more than one year prior to the earliest U.S.

filing date to which the '099 patent claims possibly could be entitled (February 15, 1991).

3. Japanese Patent Application Publication No. 1-277338, published November 7, 1989, attached with a certified English translation as Appendix D ("Fujimori"). Fujimori qualifies as prior art under 35 U.S.C. § 102(b) against the '099 patent because it published on November 7, 1989, which is more than one year prior to the earliest U.S. filing date to which the '099 patent claims possibly could be entitled (February 15, 1991).
4. Morimoto *et al.*, U.S. Patent No. 4,670,345, published June 2, 1987, attached as Appendix E ("Morimoto"). Morimoto qualifies as prior art under 35 U.S.C. § 102(b) against the '099 patent because it published on June 2, 1987, which is more than one year prior to the earliest U.S. filing date to which the '099 patent claims possibly could be entitled (February 15, 1991).
5. Ovshinsky *et al.*, U.S. Patent No. 5,166,758, filed on January 18, 1991, attached as Appendix F ("Ovshinsky '758"). Ovshinsky '758 qualifies as prior art under 35 U.S.C. § 102(e) against the '099 patent because its filing date of January 18, 1991 is earlier than the earliest filing date of the '099 patent (February 15, 1991), which serves as the conception and constructive reduction to practice of the subject matter described in the '099 patent. Both named inventors in the '099 patent (e.g., David A. Strand and Stanford R. Ovshinsky) are also named inventors in Ovshinsky '758.

For convenience, these references are cited on Form PTO-1449, which is attached as Appendix G.

IV. THE '099 PATENT

A. Technological Background

The accompanying Declaration of Dr. Christiaan Steenbergen provides a description of the development of state changeable materials prior to the filing date of the '099 patent (February 15, 1991).

Industry participants have long recognized the ability of materials to undergo detectable changes in states. (*See, e.g.*, Steenbergen declaration at ¶7 and 8.) By the 1970s, industry had begun developing phase changeable materials for use in optical recording media. (*Id.* at ¶7.) Several different groups showed that tellurium (Te) based alloys could switch from an amorphous to a crystalline state upon the application of energy, for example, optical or electrical energy. (*See, e.g.*, Steenbergen declaration at ¶9.) These different states can be detected by their different optical reflectivities. (*Id.*)

By the 1980s, several companies were developing phase change optical recording media that used a wide range of suitable materials, including tellurium (Te), germanium (Ge), antimony (Sb), silver (Ag), aluminum (Al), arsenic (As), gold (Au), bismuth (Bi), copper (Cu), gallium (Ga), indium (In), lead (Pb), platinum (Pt), selenium (Se), silicon (Si), tin (Sn), zinc (Zn), barium (Ba), sulfur (S), manganese (Mn), magnesium (Mg), chromium (Cr), phosphorus (P), cobalt (Co), nickel (Ni), palladium (Pd), thallium (Tl), cadmium (Cd), mercury (Hg), and/or iron (Fe). (*See, e.g.*, Fujimori, page 2, claim 1; Maeda, pages 10 – 14.) These companies include, for example, Nippon Telegraph & Telephone Corporation (*see, e.g.*, Fujimori); Hitachi, Ltd. (*see, e.g.*, Maeda); Matsushita Electric Industrial Co., Ltd. (*see, e.g.*, Yamada); and Asahi Kasei Kogyo Kabushiki Kaisha (Asahi Chemical Industry Co., Ltd) (*see, e.g.*, Morimoto).

As an example, Yamada *et al.* of the Matsushita Electric Industrial Co. demonstrated that $\text{Ge}_2\text{Sb}_2\text{Te}_5$, GeSb_2Te_4 , and GeSb_4Te_7 underwent a rapid switch from an amorphous to a metastable crystalline state upon laser irradiation without phase separation, and that this change in states was easily detectable because of a change in optical reflectivity. (*See, e.g.*, Yamada, Abstract; page 62, §§ 3.1 and 3.2; page 64, FIG. 8.)

As another example, Maeda *et al.* of Hitachi Ltd. described a long list of ternary and quaternary alloys that could undergo a phase transformation between a crystalline state and an amorphous state upon exposure of electromagnetic energy, where the crystalline state was a single phase alloy that did not phase separate, and where the amorphous and crystalline states differed in optical properties. (*See, e.g.*, Maeda, page 2, claim 3; page 7, ¶¶ 6-9.)

As yet another example, Fujimori *et al.* of Nippon Telegraph & Telephone Corporation described an alloy having a formula of $(\text{Sb}_x\text{Te}_{1-x})_{1-y}\text{M}_y$ (where $0.4 \leq x < 0.7$, $y \leq 0.2$, and M is at least one type of element selected from Ag, Al, As, Au, Bi, Cu, Ga, Ge, In, Pb, Pt, Se, Si, Sn and Zn) that could reversibly change between a crystalline state of lower reflectivity and an amorphous state of higher reflectivity upon laser irradiation, with the crystalline state being in a single phase (e.g., no phase separation). (*See, e.g.*, Fujimori, page 6, ¶ 2; page 3, ¶ 8; page 4, 8th full paragraph.)

As a further example, Morimoto of Asahi Kasei Kogyo Kabushiki Kaisha describe a recording medium including Sb, Te, and Ge that could change in optical extinction coefficient upon exposure to an energy beam. (*See, e.g.*, Morimoto, Abstract.) Morimoto's alloys had the same compositions (*see, e.g.*, Morimoto, Examples 8, 10, 11, 12, 19) as certain exemplified alloys in the '099 patent, which could change from a first state to a second state, and where the first state has a single phase and the second state has either (1) a single phase having the same composition as said first state or (2) a plurality of phases having substantially similar crystallization temperatures and kinetics.

By 1990, the properties of phase change materials—including those comprising tellurium, germanium, and antimony—were well known. Persons of ordinary skill in the field of optical storage materials knew:

- That state change materials include phase change materials capable of existing in at least two states, for example, an amorphous and a crystalline state; (*see, e.g.*, Steenbergen declaration at ¶16.)
- That such materials were capable of switching states, for example, from an amorphous to a crystalline state, upon the input of energy, for example, optical, electrical, or thermal energy; (*see, e.g., id.* at ¶19)
- That the state change in these materials could be detected by a change in reflectivity between the two states; (*see, e.g., id.* at ¶17)
- That such materials could undergo a change in state between an amorphous state and a crystalline state without undergoing phase separation; (*see, e.g., id.* at ¶16.)
- That Ge-Sb-Te alloys (such as $\text{Ge}_2\text{Sb}_2\text{Te}_5$, GeSb_2Te_4 , GeSb_4Te_7 (*see, e.g.*, Yamada, page 62, § 3.1), $\text{Sb}_{0.15}\text{Te}_{0.35}\text{Ge}_{0.5}$; $\text{Sb}_{0.15}\text{Te}_{0.45}\text{Ge}_{0.4}$; $\text{Sb}_{0.15}\text{Te}_{0.5}\text{Ge}_{0.35}$

(see, e.g., Morimoto, Examples 8, 10, 11, 12, 19); $(\text{Sb}_{0.70}\text{Te}_{0.30})_{0.95}\text{Ge}_{0.05}$;
 $(\text{Sb}_{0.70}\text{Te}_{0.30})_{0.90}\text{Ge}_{0.10}$; $(\text{Sb}_{0.70}\text{Te}_{0.30})_{0.80}\text{Ge}_{0.20}$; $(\text{Sb}_{0.60}\text{Te}_{0.40})_{0.95}\text{Ge}_{0.05}$;
 $(\text{Sb}_{0.60}\text{Te}_{0.40})_{0.90}\text{Ge}_{0.10}$; $(\text{Sb}_{0.60}\text{Te}_{0.40})_{0.80}\text{Ge}_{0.20}$; $(\text{Sb}_{0.50}\text{Te}_{0.50})_{0.95}\text{Ge}_{0.05}$;
 $(\text{Sb}_{0.50}\text{Te}_{0.50})_{0.90}\text{Ge}_{0.10}$; $(\text{Sb}_{0.50}\text{Te}_{0.50})_{0.80}\text{Ge}_{0.20}$; $(\text{Sb}_{0.40}\text{Te}_{0.60})_{0.95}\text{Ge}_{0.05}$;
 $(\text{Sb}_{0.40}\text{Te}_{0.60})_{0.90}\text{Ge}_{0.10}$; $(\text{Sb}_{0.40}\text{Te}_{0.60})_{0.80}\text{Ge}_{0.20}$ (see, e.g., Fujimori, page 5));
could undergo a reversible change in state from an amorphous to a crystalline
state upon irradiation, where the amorphous state includes a single phase and
the crystalline state includes a single phase having the same composition as
the amorphous state, and that this state change was detectable by a change in
optical reflectivity. (See, e.g., Steenbergen declaration at ¶¶16 – 18.)

B. '099 Patent Disclosure

The '099 specification describes certain Te-Ge-Sb based alloys that are capable of changing between an amorphous state and a crystalline state without undergoing phase separation. The specification discloses certain compositions of Te-Ge-Sb alloys, which are described in atomic percentages. When these compositions undergo a state change from an amorphous to a crystalline state, the crystalline state is either in one phase or a plurality of phases having substantially similar crystallization temperatures and kinetics:

One particular class of materials comprise $\text{Te}_{50}(\text{GeSb})_{50}$ it has been found that in those instances where the Ge is present in a greater amount than the Sb, the material crystallizes into *two phases having similar crystallization temperatures and kinetics*. In those instances where the Sb is present in a higher amount than the Ge, crystallization tends to produce *one phase*. [...]

The specification explains how the proportion of germanium and antimony in the Te-Sb-Ge alloy affects crystallization and temperature stability of the $\text{Te}_{50}(\text{GeSb})_{50}$ material. For instance, “where the Sb is present in a higher amount than the Ge, crystallization tends to produce one phase.” (*Id.*, col. 7, lines 31-33.) In addition, “it has been found that presence of *Ge in the system stabilizes the Te-Sb phase and enables the congruent crystallization* of the material from the amorphous state.” (*Id.*, col. 7, lines 35-39, emphasis added.)

The '099 specification also describes certain Te-Ge-Sb based materials having optimum performance and crystallization temperatures:

The material is a compound having the composition $\text{Te}_a\text{Ge}_b\text{Sb}_c$, a, b and c being expressed in atomic percentages and selected such that, when the material is in the crystalline state, *the material is substantially crystalline and includes a major crystal phase which has the same composition as the material has when in the amorphous state.* The crystalline materials *may* further includes [*sic*] a minor portion which has the composition $\text{Te}_d\text{Ge}_e\text{Sb}_f$, d, e and f being expressed in atomic percentages, wherein the differences between a and d, b and e, and c and f respectively total not more than 16 atomic percent.

After experimenting with a range of optical recording film compositions, it has been experimentally determined that, where a is from 49 to 53 atomic percent, b is from 35 to 43 atomic percent and c is from 7 to 11 atomic percent, the compositions exhibit optimum performance when tested for sensitivity, and crystallization temperature, Tx. (*Id.*, col. 7, lines 40-61, emphasis added.)

Although the specification refers to state changeable materials and states that tin and bismuth can also be used in Te-Ge based alloys, the exemplary alloys described in the specification (summarized below) contain only tellurium, germanium, and antimony.

Table 1

'099 patent citation	Te (atomic percentage)	Ge (atomic percentage)	Sb (atomic percentage)
Table 1, sample E-1043	25	60	15
Table 1, sample E-1045	30	55	15
Table 1, sample E-1036	35	50	15
Table 1, sample E-1038	40	45	15
Table 1, sample E-1039	45	40	15
Table 1, sample E-1051	50	35	15
Table 1, sample E-1041	55	30	15
Table 1, sample E-1044	60	25	15
Table 1, sample E-1046	45	30	25
Table 1, sample E-1047	47	33	20
Table 1, sample E-1048	53	37	10
Table 1, sample E-1049	36 ¹	39	5
Col. 8, lines 47-48	51	40	9
Col. 9, line 36	51	44	5
Col. 9, line 37	51	32	17
Col. 9, line 38	51	17	32

¹ This entry appears to be a typographical error as the total atomic percentages of Te, Ge, and Sb do not add up to 100.

The specification states that the sample alloys in Table 1 of the specification were synthesized to evaluate their crystallization temperatures and thermal stability. (*See, e.g.*, '099 patent, col. 8, lines 21-44.) $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$ was synthesized to determine the structure of the crystallized phases. Specifically, $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$ showed two phases when crystallized: a major $\text{Te}_{52}\text{Ge}_{37}\text{Sb}_{11}$ phase, which was considered to be the same composition as the bulk starting alloy $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$, and a minor $\text{Te}_{51}\text{Ge}_{44}\text{Sb}_5$ phase having substantially similar crystallization temperatures and kinetics as the major phase. (*See, e.g., id.*, col. 8, line 45-col. 9, line 11.) The specification also mentions three other distinct compositions that form crystals including all three elements and having a composition similar to the composition of the bulk material: $\text{Te}_{51}\text{Ge}_{44}\text{Sb}_5$, $\text{Te}_{51}\text{Ge}_{32}\text{Sb}_{17}$, and $\text{Te}_{51}\text{Ge}_{17}\text{Sb}_{32}$. (*See, e.g., id.*, col. 9, lines 28-40.)

The specification describes certain detectable characteristics of state changeable materials, including, electrical conductivity, electrical resistivity, optical transmissivity, optical absorption, optical refraction, and/or optical reflectivity. (*See, e.g., id.*, col. 1, lines 40-53.) The claims also list band gap, magnetic susceptibility, and thermal conductivity as detectable characteristics; however, there is no disclosure in the specification of these three characteristics. (*See*, claim 1.)

C. Claims 1-9 and 23 of the '099 Patent

Although the specification only discloses the Te-Ge-Sb based alloys described above, claim 1 of the '099 patent broadly recites state changeable memory alloys changeable from a first state to a second state:

1. A state changeable memory alloy changeable from a first state to a second state in response to the input of energy,
said alloy having a first detectable characteristic when in said first state and a second detectable characteristic when in said second state, and
said first and second detectable characteristics **selected from the group** consisting of reflectivity, band gap, electrical resistance, optical absorption, magnetic susceptibility and thermal conductivity;
said alloy further characterized in that the first state comprises a single phase and said second state comprises **either** (1) a single phase having the same composition as said first state or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics. ('099 patent, claim 1)

The term “selected from the group” means the claim requires only one of the six listed detectable characteristics. The word “either” means that the claim covers state changeable memory alloys having one of the following: (1) a single phase having the same composition as the first state, or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics. As discussed below, the prior art includes state changeable alloys having a single phase of the same composition in different states (e.g., an amorphous state and a crystalline state), and which display one or more of the six detectable characteristics.

The background of the ‘099 patent states that most of the elements of claim 1 were already known in the art. For example, the background describes optical data storage systems “that record information in a state changeable material that is switchable between at least two detectable states by the application of energy, for example, projected optical beam energy, electrical energy, or thermal energy.” (*See, e.g.*, ‘099 patent, col. 1, lines 12-17.) According to the background section, these two states can be detected based on their characteristic “electrical conductivity, electrical resistivity, optical transmissivity, optical absorption, optical refraction, optical reflectivity, or combinations thereof.” (*See, e.g., id.*, col. 1., lines 45-51.) Also, the ‘099 patent summarizes prior art reporting tellurium-based state changeable materials where the change of state was detected by differences in optical reflectivity between the crystalline and amorphous states. (*See, e.g., id.*, col. 1, line 60- col. 2, line 2.)

The dependent claims further limit the scope to particular characteristics of the materials. For example, claims 2 to 4 limit the state changeable memory alloy of claim 1 to: a chalcogenide material (claim 2); at least three elements (claim 3); or Te, Ge and Sb (claim 4). Claims 5 to 7 limit claim 1 to an alloy: capable of changing from said first to second state upon input of optical (claim 5), electrical (claim 6), or thermal (claim 7) energy. Claim 8 limits the alloy of claim 1 to one where the first state is amorphous and the second is crystalline and claim 9 to a material which is “substantially entirely crystalline when in said crystalline state.”

Claim 23 of the ‘099 patent recites

23. A state changeable memory alloy changeable from a first state to a second state in response to the input of energy, said alloy having a first detectable physical characteristic or properties index when in said first

state and a second detectable physical characteristic or properties index when in said second state, said alloy having the general formula $\text{Te}_{50}(\text{GeX})_{50}$ wherein X is Sb, Sn or Bi, said alloy further characterized in that the first state comprises a single phase and said second state comprises either (1) a single phase having the same composition as said first state or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics.

Claim 23 therefore requires a state changeable alloy with a composition having the general formula of $\text{Te}_{50}(\text{GeX})_{50}$, wherein X is Sb, Sn, or Bi; and covers $\text{Te}_{50}(\text{GeX})_{50}$ alloys having one of the following: (1) a single phase having the same composition as the first state, or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics. However, claim 23 does not define what the detectable physical characteristic or properties index can be.

As set forth below, each of the elements of claims 1-9 of the '099 patent are found in Yamada, Maeda, Fujimori, Morimoto, and Ovshinsky '758. In addition, at least Morimoto anticipates claim 23.

D. The '099 Patent Prosecution History

1. Overview

The '099 patent application was filed on February 15, 1991 with 25 claims. A restriction requirement was mailed on June 21, 1991. In response, patentees selected for prosecution original claims 1-23 and 25, directed to a state changeable memory alloy.

The Examiner rejected original claims 1-3 and 5-8 under 35 U.S.C. § 102(b) as anticipated by, or under 35 U.S.C. § 103² as obvious over, U.S. Patent Nos. 4,947,372 ("Koshino") and 4,820,394 ("Young"). The Examiner also rejected claims 1-4 under 35 U.S.C. § 112, second paragraph, as indefinite. Claims 9-23 and 25 were deemed allowable if rewritten in independent form. Finally, the Examiner cited U.S. Patent Nos. 4,924,436 ("Strand '436"); 4,839,861 ("Ikegawa"); 4,744,055 ("Hennessey"); 4,726,858 ("Minemura"); 3,816,108 ("Takagi"); 4,263,573 ("Melton") as being "simulative of the level of prior art," but did not discuss these references.

² The Examiner did not specify a 35 U.S.C. § 103 subsection.

Patentees submitted an amendment and response on November 4, 1991. Patentees did not address the prior art rejections. Rather, patentees merely incorporated original dependent claim 9 into independent claim 1. The Office Action and response are discussed in more detail, *infra*.

A notice of allowance was mailed on December 19, 1991 and the '099 patent issued on July 7, 1992.

2. Information Disclosure Statement

The patentees did not submit any references as part of an Information Disclosure Statement to the Office during prosecution of the '099 application. The only references disclosed in the Background section of the '099 patent, were written by the inventors and other employees of Energy Conversion Devices, Inc. ("ECD"), or were patents assigned to ECD (the assignee listed on the '099 patent):

1. J. Feinleib, J. deNeufville, S. C. Moss, and S. R. Ovshinsky, "Rapid Reversible Light-induced Crystallization of Amorphous Semiconductors," Appl. Phys. Lett., **18**(6), 254-257 (Mar. 15, 1971);
2. U.S. Patent No. 3,530,441;
3. U.S. Patent No. 4,876,667;
4. U.S. Patent No. 4,924,436;
5. U.S. Patent No. 4,621,032;
6. U.S. Patent No. 4,667,309; and
7. U.S. Patent No. 4,744,055.

3. Office Action mailed August 9, 1991, and response filed November 4, 1991

The examined claims included independent claim 1 and dependent claim 9:

1. A state changeable memory alloy capable of changing from a first state to a second state in response to the input of energy,
said alloy having a first detectable characteristic when in said first state and a second detectable characteristic when in said second state,
said alloy further characterized in that the first state comprises a single phase and said second state comprises either (1) a single phase having the same composition as said first state or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics.

9. An alloy as in claim 1, wherein said first and second detectable characteristics are selected from the group consisting of reflectivity, band gap, electrical resistance, optical absorption, magnetic susceptibility and thermal conductivity.

(a) Rejections of claims 1-3 and 5-8 under 35 U.S.C. §§ 102 and 103

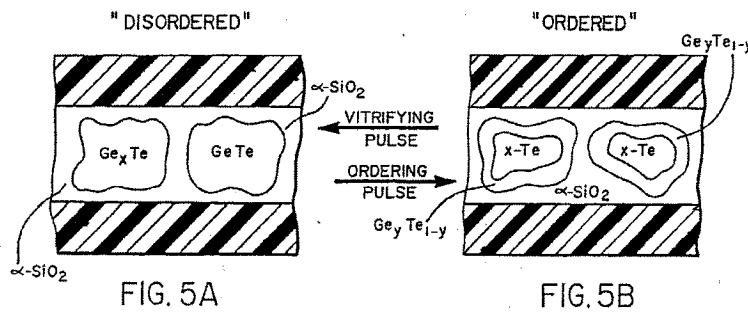
In the August 9, 1991 Office Action, the Examiner rejected claims 1-3 and 5-8 under 35 U.S.C. §§ 102 and 103. The Examiner did not provide a detailed analysis but stated that the Koshino and Young anticipate original claim 1:

“[b]roadly claimed invention is deemed met see Koshino et al, the abstract or Young et al., fig[s]. 5A-5B. The interconversion of optical, electrical and thermal energy [is] well known in the art and thus deemed obvious.” (See, Office Action mailed August 9, 1991, page 2.)

Koshino describes “an alloy film capable of forming two stable crystalline states differing in crystal texture and optical characteristics by being irradiated with optical energies under different conditions.” (See, e.g., Koshino, Abstract.) Koshino’s state changeable material switches from a first state, described as “an amorphous or extremely fine crystallite state” of a mixture of two elements, to a second state, described as “one stable crystalline state” containing mostly one of the elements. The alloys of Koshino comprise a different composition of elements than those described by the patentee.

Young describes a projected beam switchable data storage device having a state changeable memory material. (See, e.g., Young, Abstract.) The memory material is a multi-phase system that includes Te and one or more crosslinking agents. (See, e.g., *id.*, col. 5, lines 48-57.) The chalcogenide composition can reversibly switch between (1) an amorphous, first tellurium-crosslinking agent composition and (2) a composition including crystalline tellurium in the presence of an amorphous, second tellurium-crosslinking agent.

The Examiner referred to Young’s FIGS. 5A and 5B, which show a phase separation of a first “disordered” state including an amorphous Ge_xTe into a second “ordered” state including (1) a crystalline tellurium phase in the presence of (2) an amorphous $\text{Ge}_y\text{Te}_{1-y}$ phase (Ge is a crosslinking agent), upon input of an energy pulse.



FIGS. 5A and 5B, Young.

(b) Rejection of claims 1-4 under 35 U.S.C. § 112, 2nd paragraph

In the August 9, 1991 Office Action, the Examiner also stated that the expressions “capable of” and “detectable characteristics” were vague because claim 1, as originally drafted, “would read on alloys having allotropic transitions and not all combination of Te, Ge and Sb would work as amply taught by the applicant.”

(c) Amendment and allowance

In a response dated November 4, 1991, patentees amended independent claim 1 to address the Examiner’s indefiniteness rejection and incorporated the limitations of originally filed dependent claim 9 into claim 1. However, patentees did not address the §§ 102 and 103 rejections, arguing instead that, as a result of the amendment, the claims had been placed in condition for allowance. The amended claim 1, incorporating the limitations of depending claim 9, reads as follows:

1. A state changeable memory alloy changeable [[capable of changing]] from a first state to a second state in response to the input of energy, said alloy having a first detectable characteristic when in said first state and a second detectable characteristic when in said second state, and said first and second detectable characteristics selected from the group consisting of reflectivity, band gap, electrical resistance, optical absorption, magnetic susceptibility and thermal conductivity; said alloy further characterized in that the first state comprises a single phase and said second state comprises either (1) a single phase having the same composition as said first state or (2) a plurality of phases which have substantially similar crystallization temperature and kinetics.

After this response and amendment, the Examiner allowed the claims. The Examiner did not substantively discuss the references that formed the basis for the 35 U.S.C. §§ 102 and 103 rejections. Nor did the Examiner give a reason for allowance.

V. SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

The Examiner cited Koshino and Young during prosecution of the '099 patent, but Koshino and Young were not the closest art. The amendment that incorporated original claim 9 into original claim 1, and ostensibly distinguished Koshino and Young, would not have distinguished any of the references that form the basis of the present request.

Each of the five references cited in this petition is closer prior art than the references that were of record. Specifically, Yamada, Maeda, Fujimori, Morimoto, and Ovshinsky '758 each anticipate claims 1-9³ and were not of record during the original prosecution. In addition, at least Morimoto anticipates claim 23. These five references raise a substantial new question of patentability, as each of these references presents issues not raised by the references considered during the original prosecution.

A. Yamada Raises a Substantial New Question of Patentability as to Claims 1-9 of the '099 Patent

Yamada discloses every element of claims 1-9 and presents issues not raised by the references considered during the original prosecution. Specifically, it discloses single phase Ge-Sb-Te memory alloys that switch from a first state (e.g., amorphous) to a second state (e.g., a crystalline state) in response to the input of energy, without phase separation. Each state has a characteristic reflectivity.

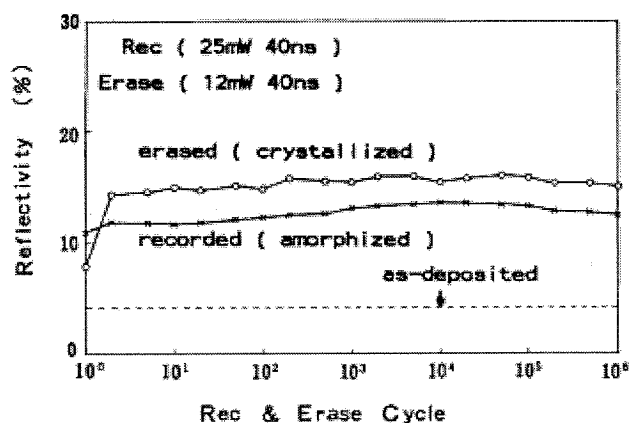
Yamada was published more than three years prior to the filing of the '099 patent, and discloses Ge-Sb-Te alloys that can undergo reversible phase change upon input of energy. Yamada is highly relevant to the claimed subject matter of the '099 patent, and was not considered by the Patent Office during prosecution of the '099 application.

³ Requesters are requesting reexamination only of claims 1-9 and 23 in the '099 patent. Requesters reserve all rights regarding claims 10-22.

1. Summary of Yamada

Yamada describes materials that are applicable to directly overwritable data storage media. (See, e.g., Yamada, Abstract.) Yamada discloses three specific stoichiometric chalcogenide alloys along a pseudo-binary line between GeTe and Sb₂Te₃ of a Ge-Sb-Te ternary alloy system: Ge₂Sb₂Te₅, GeSb₂Te₄, and GeSb₄Te₇ (see, e.g., *id*, page 63, § 3.1, ¶ 1), corresponding in atomic percentages, to Ge₂₂Sb₂₂Te₅₆, Ge₁₄Sb₂₉Te₅₇, and Ge_{8.3}Sb_{33.3}Te_{58.3}, respectively.

The alloys in Yamada have different detectable optical characteristics in the amorphous and the crystalline states. These alloys undergo reversible switching from a crystalline state to an amorphous state upon laser irradiation. (See, e.g., *id*, Abstract.) For example, Yamada discloses that “[t]he complex refractive index of the GeSb₂Te₄ thin film was 4.7-i2.6 for as deposited amorphous state and 6.9-i2.6 for annealed at 300 °C for 10 min. These values were almost the same as those of the other stoichiometric compositions.” (See, e.g., *id*, page 62, § 3.1, ¶ 2.) Yamada also discloses that the transformation between the two states was detected by reflectivity change. (See, e.g., *id*, page 62, § 2.3, ¶ 2.) In FIG. 8 (reproduced below), Yamada shows differences in percent reflectivity between an erased (crystallized) state and a recorded (amorphous) state for GeSb₂Te₄ in cycle tests, where the record/erase cycles could be carried out up to one million times. (See, e.g., *id*, page 64, § 3.3, ¶ 3.)



Yamada, FIG. 8. Static record/erase cycle test result for GeSb₂Te₄ thin films, percent reflectivity shown on y-axis.

During the recording (crystalline \rightarrow amorphous) process, the alloys disclosed in Yamada have no phase separation. Yamada presents results from thermal analysis for certain alloys. In FIG. 4 (reproduced below), differential scanning calorimetry (DSC) data is shown for a representative alloy, GeSb_2Te_4 (composition B). Yamada discloses that a single endothermic peak at 610°C , corresponding to the melting of the alloy, indicated that *no phase separation would occur* during the recording (crystalline \rightarrow amorphous) process. (See, e.g., *id*, page 62, § 3.2, ¶ 1.) A crystallization temperature of about 130°C , corresponding to an optically measured phase transition temperature of 160°C , is also described. (*Id.*) Similar experiments and results are described for $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (composition A) and GeSb_4Te_7 (composition C): no phase separation occurs during the recording process. (See, e.g., Yamada, § 3.2, ¶ 2.)

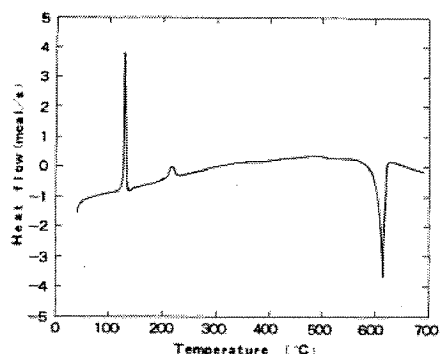


Fig. 4. DSC curve for GeSb_2Te_4 thin film.
Heating rate is $10^\circ\text{C}/\text{min}$.

Yamada also presents structural analysis of the alloys, confirming that there is no phase separation. X-ray diffraction results for GeSb_2Te_4 at various annealing temperatures are shown in FIG. 5 (reproduced below). The diffraction peaks of a sample annealed at 150°C correspond to a face centered cubic (fcc) crystal lattice arrangement of the atoms in the alloy. (See, e.g., *id*, § 3.2, ¶ 3.) Yamada discloses that the crystalline fcc phase is metastable and appears at the first stage of the crystallization process (i.e., transition at 130°C in the DSC measurement); in addition, Yamada emphasizes that “remarkabl[y] *phase separation did not occur* just at the stoichiometric compositions.” (See, e.g., *id*, § 3.2, ¶ 4.) The same process is also described for $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (composition A) and GeSb_4Te_7 (composition C). (See, e.g., *id*, § 3.2, ¶ 3.)

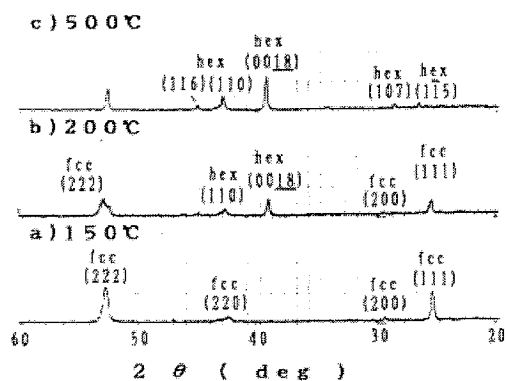


Fig. 5. X-ray diffraction results for annealed GeSb₂Te₄ thin films. Annealed temperatures were a) 150 °C b) 200 °C and c) 500 °C, respectively.

More explicitly, Yamada discloses a metastable crystalline phase of the same composition as that of the amorphous phase:

the metastable state is the crystallization *single phase*, even if the other composition is not just stoichiometric compounds but mixtures of stoichiometric compounds in this pseud[o]-binary system.

[...]

The randomly distributed structure has a large entropy and the structure is near the liquid or amorphous state thermodynamically. *It is natural that the metastable crystalline phase, which resemble[s] to the amorphous structure, appears in the first stage of crystallization process.*

[...]

Optical constants of the metastable crystalline phase is almost the same as that of stable compounds and larger enough in comparison with amorphous one. Therefore the phase change is finished optically at the first stage in crystallization process corresponding to the formation of the metastable phase.

[...]

Through structural analysis, it was found that *fast crystallization was caused by the appearance of metastable single crystalline phase.* (See, Yamada, page 66, § 4.2, ¶¶ 4 and 7; § 5, ¶ 1.)

Yamada discloses that the amorphous and crystalline states of Yamada's alloys are also sufficiently stable for use in optical disk media:

As listed in Table 1, the Tx's [crystallization temperatures] are more than 130 °C, and activation energies are more than 1.8eV. Therefore, the thermal stability of the amorphous state may be satisfactory. Preliminary aging test at 80 °C showed no remarkable change of reproducing signal amplitude for 1 month. (See, Yamada, page 66, § 4.2, ¶ 8.)

In other words, Yamada's alloy compositions do not change as the alloy is switched reversibly from an amorphous state to a crystalline state. Rather, the atoms merely rearrange over a short distance in space, thus, the alloy composition is maintained in both states. In addition, both the amorphous and crystalline states are stable and have a single phase – there is no phase separation.

Therefore, Yamada discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states has a detectable characteristic, such as reflectivity. The alloys have a single phase in the first state (e.g., amorphous). The alloys also have a second state (e.g., crystalline) that has a single phase having the same composition as the first state.

2. Claim chart comparing Yamada to claims 1-9 of the '099 patent

A claim chart based upon Yamada is included in Appendix H. The chart demonstrates how Yamada anticipates and thus raises a substantial new question of patentability as to claims 1-9 of the '099 patent.

Although Yamada does not specifically disclose that electrical energy can be used to cause a change in state in the disclosed alloys, Yamada does disclose the use of optical and thermal energy. A person of ordinary skill in the art would know that electrical energy would necessarily cause crystallization of the disclosed alloys, since it would provide the amount of activation energy (e.g. disclosed in Yamada, § 3.2, as 1.8eV) necessary for causing the switch from amorphous to crystalline states and vice versa. (See, e.g., Steenbergen declaration at ¶19.) Furthermore, in the Background of the Invention section, patentees acknowledge the known use of “projected optical beam energy, electrical energy, or thermal energy” in prior art optical data storage systems. ('099 patent, col. 1, lines 17-18.) Indeed, the Examiner acknowledged in the August 9, 1991 Office Action, that “[t]he interconversion of optical, electrical and thermal energy [is] well known in the art.” Thus, Yamada inherently anticipates claim 6.

B. Maeda Raises a Substantial New Question of Patentability as to Claims 1-9 of the '099 Patent

Maeda discloses every element of claims 1-9 and presents issues not raised by the references considered during the original prosecution. Maeda discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. As the crystalline state is a single phase, the state change occurs without phase separation. Also, each of the first and second states of Maeda has a characteristic reflectivity. Maeda is highly relevant to the claimed subject matter of the '099 patent, and was not considered by the Patent Office during prosecution of the '099 application.

1. Summary of Maeda

Maeda discloses a recording medium including a recording layer that reversibly undergoes a state transformation between a crystalline state and an amorphous state, where the crystalline state is a ternary compound having a single phase. (*See, e.g., Maeda*, page 2, claim 3; page 5, ¶11.) The crystalline and amorphous states can be detected, for example, by a change in reflectivity and/or absorptivity. (*See, e.g., id*, page 3, claims 12-14, page 7, ¶8.) The recording medium can record (e.g., crystalline→amorphous) and delete (e.g., amorphous→crystalline) information using light and heat (*see, e.g., id*, page 7, ¶6; page 4, 7th full paragraph), electromagnetic energy, light energy, or electron energy. (*See, e.g., id*, page 7, ¶5, ¶9.)

Maeda discloses that long distance diffusion of atoms is not necessary when the crystallization phase is a single phase, as “[c]rystallization is rapid even at diffusion of short distances on the order of the length of a bond. Because *the crystal structure is the same during crystallization*, there is little strain and nucleus generation is easy.” (*See, e.g., id*, page 9, ¶1, emphasis added.)

Maeda discloses chalcogenide materials (*see, e.g., id*, pages 9-10, bridging paragraph) including at least three elements, such as $\text{Bi}_2\text{Ge}_3\text{Te}_6$, Bi_4GeTe_7 , $\text{Pd}(\text{Sb},\text{Bi})\text{Te}$, and Ge_2SeTe . (*See, e.g., id*, page 10, ¶3; page 13, line 2, page 14, line 5). In Working Example 8, Maeda discloses Ge-Sb-Te alloys such as GeSb_4Te_7 , GeSb_2Te_4 , and $\text{Ge}_2\text{Sb}_2\text{Te}_5$, and specifically describes a sharp change in reflectivity upon heating of an

amorphous film, indicating that high-speed deletion (e.g., amorphous→crystalline) is possible. (*See, e.g., id*, pages 18-19, Working Example 8; page 29, FIG. 16.)

Thus, Maeda discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of thermal, optical, or electrical energy. Each of the first and second states has a detectable characteristic, such as reflectivity and absorptivity (i.e., optical absorption). Furthermore, Maeda discloses alloys having a first state (e.g., amorphous) including a single phase and a second state (e.g., crystalline) including a single phase having the same composition as the first state, as claim 1 of the '099 patent recites. Therefore, for all the reasons above, Maeda anticipates at least claims 1-9 of the '099 patent.

2. Claim chart comparing Maeda to claims 1-9 of the '099 patent

A claim chart based upon Maeda is included in Appendix I. The chart demonstrates how Maeda anticipates and thus raises a substantial new question of patentability as to claims 1-9 of the '099 patent.

C. Fujimori Raises a Substantial New Question of Patentability as to Claims 1-9 of the '099 Patent

Fujimori discloses every element of claims 1-9 and presents issues not raised by the references considered during the original prosecution. Fujimori discloses single phase Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. As the state-changeable alloys remains in a single phase during the state change, the state change occurs without phase separation. Also, each of the first and second states of Fujimori has a characteristic reflectivity. Fujimori is highly relevant to the claimed subject matter of the '099 patent, and was not considered by the Patent Office during prosecution of the '099 application.

1. Summary of Fujimori

Fujimori discloses rewritable laser optical recording media that can undergo an amorphous to crystalline state change. (*See, e.g., the Japanese '338 translation, page 6,*

1st-3rd full paragraphs.) The crystalline state has a lower reflectivity than the amorphous state, thus each state can be detected as a result of its characteristic optical reflectivity. (See, e.g., *id*, page 6, 1st full paragraph.) Fujimori discloses that writing and deletion can be repeated because the alloy is believed to remain in a single phase state. (See, e.g., *id*, page 4, 8th full paragraph.) The state change occurs in response to an input of energy, such as heating by a laser beam. (See, e.g., *id*, page 4, 2nd full paragraph.)

Fujimori's Formula (I) discloses an alloy with a chalcogenide composition having at least three elements: $(Sb_xTe_{1-x})_{1-y}M_y$, where $0.4 \leq x < 0.7$, $y \leq 0.2$, where M is at least one element selected from a variety of elements, including Ge. (See, e.g., *id*, page 3, ¶4.) Indeed, Ge-Sb-Te alloys were studied in Working Example 1. (See, e.g., pages 5-7, Working Example 1.)

Thus, Fujimori discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states has a detectable characteristic, such as reflectivity. Furthermore, Fujimori discloses alloys having a first state (e.g., amorphous) including a single phase and a second state (e.g., crystalline) including a single phase having the same composition as the first state, as claim 1 of the '099 patent recites. Therefore, for all the reasons above, Fujimori anticipates at least claims 1-9 of the '099 patent.

2. Claim chart comparing Fujimori to claims 1-9 of the '099 patent

A claim chart based upon Fujimori is included in Appendix J. The chart demonstrates how Fujimori anticipates and thus raises a substantial new question of patentability as to claims 1-9 of the '099 patent.

Although Fujimori does not specifically disclose that electrical energy can be used to cause a change in state in the disclosed alloys, a person of ordinary skill in the art would know that electrical energy would necessarily cause a state change in the disclosed alloys. (See, e.g., Steenbergen declaration at ¶19.) Furthermore, in the Background of the Invention section, patentees acknowledge the known use of "projected optical beam energy, electrical energy, or thermal energy" in prior art optical data storage systems. ('099 patent, col. 1, lines 17-18.) Indeed, the Examiner acknowledged in the August 9,

1991 Office Action that “[t]he interconversion of optical, electrical and thermal energy [is] well known in the art.”

D. Morimoto Raises a Substantial New Question of Patentability as to Claims 1-9 and 23 of the ‘099 Patent

Morimoto discloses every element of claims 1-9 and 23 and presents issues not raised by the references considered during the original prosecution. Morimoto discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states of Morimoto has a characteristic optical absorption. Morimoto discloses specific alloys having identical compositions as those in the ‘099 patent. Also, these alloys are made in the same manner as the exemplified compounds of the ‘099 patent. Morimoto’s alloys inherently possess a first state including a single phase and a second state including either (1) a single phase having the same composition as the first state or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics. Morimoto is highly relevant to the claimed subject matter of the ‘099 patent, and was not considered by the Patent Office during prosecution of the ‘099 application.

1. Summary of Morimoto

Morimoto discloses an information recording alloy including Sb, Te, and Ge. (*See, e.g.*, Morimoto, Abstract.) The alloy can be used for recording information by exposure to an energy beam, such that upon heating, the optical extinction coefficient (i.e., optical absorption) of the exposed areas changes. (*See, e.g., id*, col. 3, line 32 – col. 4, line 2.) Heating the alloy can be effected using an energy beam such as a laser beam or an electron beam.

Morimoto discloses that the recording alloy has a formula of $(Sb_XTe_{1-X})_YGe_{1-Y}$, wherein $0.05 \leq X \leq 0.7$, more preferably $0.1 \leq X \leq 0.6$ and $0.4 \leq Y \leq 0.8$. (*See, e.g., id*, col. 5, lines 5-12.) Of the exemplified alloys, several are *identical* to the specifically disclosed alloys in the ‘099 patent: $Sb_{0.15}Te_{0.35}Ge_{0.5}$ (*see, e.g., id*, col. 16, Example 8); $Sb_{0.15}Te_{0.45}Ge_{0.4}$ (*see, e.g., id*, col. 17, Example 10; col. 17, Example 12; col. 21, Example

19); and $\text{Sb}_{0.15}\text{Te}_{0.5}\text{Ge}_{0.35}$ (*see, e.g., id*, col. 17, Example 11), which correspond, respectively, to Samples E-1036, E-1039, and E-1051 in Table 1 of the '099 patent. Furthermore, Morimoto's recording layer including Sb, Te, and Ge can be formed on a substrate by ordinary deposition methods such as vacuum deposition and *sputtering* (*see, e.g., id*, col. 5, lines 59-61), which are the same deposition methods (e.g., deposition by evaporative deposition, chemical vapor deposition, and/or plasma deposition including *sputtering*) that the '099 patent employs. (*See, e.g., '099 patent*, col. 1, lines 54-59.)

Thus, Morimoto discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states has a detectable characteristic, such as optical absorption. Since Morimoto discloses specific alloys having identical compositions that can be made in the same manner as the exemplified compounds of the '099 patent, Morimoto's alloys inherently possess a first state including a single phase and a second state including either (1) a single phase having the same composition as the first state or (2) a plurality of phases which have substantially similar crystallization temperatures and kinetics, as claim 1 of the '099 patent recites. In addition, Morimoto discloses $\text{Sb}_{0.15}\text{Te}_{0.5}\text{Ge}_{0.35}$, which corresponds to $\text{Te}_{50}(\text{GeX})_{50}$, as recited by claim 23 of the '099 patent. Therefore, for all the reasons above, Morimoto anticipates at least claims 1-9 and 23 of the '099 patent.

2. Claim chart comparing Morimoto to claims 1-9 and 23 of the '099 patent

A claim chart based upon Morimoto is included in Appendix K. The chart demonstrates how Morimoto raises a substantial new question of patentability. Specifically, the chart demonstrates that claims 1-9 and 23 are inherently anticipated by Morimoto because Morimoto discloses alloys that are identical in composition to, and made using the same methods as, the specific exemplified alloys covered by claims 1-9 and 23 of the '099 patent.

E. Ovshinsky '758 Raises a Substantial New Question of Patentability as to Claims 1-9 of the '099 Patent

Claims 1-9 are broad enough to also encompass electrically erasable phase change alloys used in semiconductors memories, such as the alloys disclosed in Ovshinsky '758.

Both named inventors in the '099 patent (e.g., David A. Strand and Stanford R. Ovshinsky) are also named inventors in Ovshinsky '758. Ovshinsky '758 discloses every element in claims 1-9 of the '099 patent and presents issues not raised by the references considered during the original prosecution. It discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states has a detectable characteristic, such as band gap and electrical resistance. Furthermore, the alloys have a single phase in the first state and a single phase of the same composition in the second state; or the alloys have a single phase in the first state and a plurality of phases of substantially similar crystallization temperatures and kinetics in the second state. Ovshinsky '758 is highly relevant to the claimed subject matter of the '099 patent and discloses, *inter alia*, similar or identical materials as the '099 patent. Ovshinsky '758 was not considered by the Office during prosecution of the '099 application.

1. Summary of Ovshinsky '758

Ovshinsky '758 discloses electrically erasable phase change memory alloys that can reversibly switch between amorphous and crystalline states (*see, e.g.*, Ovshinsky '758, Abstract), with substantial reduction in the semiconductor band gap. (*See, e.g.*, Ovshinsky '758, col. 5, lines 20-26.) If the band gap is very small in the crystalline state relative to the amorphous state, thermally generated carriers can provide good conductivity and low resistance in the crystalline state compared to the amorphous state. (*See, e.g., id*, col. 5, lines 26-30.) Moreover, the electrically switchable materials are “of a composition and volumetric stoichiometry such that the elements of the material are *distributed* within the material in the amorphous state and are substantially *fully absorbed* per unit volume of the material in *one or more stable crystalline phases* in the crystalline state.” (*See, e.g., id*, col. 3, lines 17-23, emphasis added.) In other words, the materials have a single phase in the amorphous state since the elements are distributed within the

material; the materials also have a single phase or multiple phases in the crystalline state; and the amorphous and crystalline states have substantially the same compositions since the elements are fully absorbed per unit volume of the material.

Ovshinsky '758 describes that the materials have a formula of " $\text{Te}_a\text{Ge}_b\text{Sb}_{100-(a+b)}$ ", where a is equal or less than about 70% and preferably less than 60%, b is above about 15% and less than 50 %, preferably between about 17% to about 44% and the remainder is Sb." (See, e.g., *id.*, col. 8, lines 61-66.) Ovshinsky '758 discloses specific materials, including $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$.

The same $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$ alloy is also disclosed at col. 8, line 46 – col. 9, line 9 of the '099 patent, where the alloy was described in the '099 patent to be "encompassed by the claims of the present invention." For $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$, Ovshinsky '758 discloses that this material "forms a single crystalline phase of substantially the same composition as the elements in the amorphous state. Thus, the material is compositionally substantially the same in the amorphous state and in the single crystalline phase which is formed when the material is electrically switched to the crystalline state." (See, e.g., *id.*, col. 5, lines 31-38.) Ovshinsky '758 also discloses that the material undergoes a collapse in its electronic band gap as it transitions from an amorphous to a crystalline state, thereby providing a very high electrical conductivity. (See, e.g., *id.*, col. 5, lines 38-43.) The material has very high ratio of resistances between the on/off conditions. (See, e.g., *id.*, col. 5, lines 48-49.)

Thus, Ovshinsky '758 discloses Ge-Sb-Te state-changeable memory alloys changeable from a first state (e.g., amorphous) to a second state (e.g., crystalline) in response to the input of energy. Each of the first and second states has a detectable characteristic, such as band gap and electrical resistance. The $\text{Te}_{51}\text{Ge}_{40}\text{Sb}_9$ alloy (has a single phase in the first state (e.g., amorphous) and also has a second state (e.g., crystalline) that has a single phase having the same composition as the first state.

2. Claim chart comparing Ovshinsky '758 to claims 1-9 of the '099 patent

A claim chart based upon Ovshinsky '758 is included in Appendix L. The chart demonstrates how Ovshinsky '758 anticipates and thus raises a substantial new question of patentability as to claims 1-9 of the '099 patent.

Although Ovshinsky '758 does not specifically disclose that optical energy can be used to cause a change in state in the disclosed alloys, a person of ordinary skill in the art would know that optical energy (such as that provided by a laser) would necessarily cause crystallization of the disclosed alloys since it would heat the material sufficiently to cause the switch from amorphous to crystalline states and vice versa. (*See, e.g.*, Steenbergen declaration at ¶19.) Furthermore, in the Background of the Invention section, patentees acknowledge the known use of “projected optical beam energy, electrical energy, or thermal energy” in prior art optical data storage systems. ('099 patent, col. 1, lines 17-18.) Indeed, the Examiner acknowledged in the August 9, 1991 Office Action that “[t]he interconversion of optical, electrical and thermal energy [is] well known in the art.” Thus, Ovshinsky '758 inherently anticipates claim 5.

VI. CONCLUSION

For the foregoing reasons, substantial and new questions of patentability with respect to claims 1-9 and 23 of the '099 patent have been raised. Reexamination of the subject claims is respectfully requested in light of the aforementioned references.

The Director is authorized to charge any fees or credit any overpayments to
Deposit Account No. 06-1050.

Respectfully submitted,

Dated: /December 15, 2011/

/Dorothy P. Whelan/

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