

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* HECTOR COTAL, DIMITRI D. KRUT and RAED A. SHERIF

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Appeal 2008-3344  
Application 10/603,703  
Technology Center 1700

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Decided: September 30, 2008

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Before CHUNG K. PAK, CHARLES F. WARREN, and  
THOMAS A. WALTZ, *Administrative Patent Judges*.

WALTZ, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants seek review under 35 U.S.C. § 134 from the Examiner's rejections of claims 1-4, 7-12 and 14-23 in the final Office Action, dated October 4, 2006. This Board has jurisdiction under 35 U.S.C. § 6(b).

The present invention is directed to a solar cell for collecting solar energy and converting the solar energy into electrical energy. Claims 1 and 18 are illustrative and reproduced below:

1. A solar cell comprising:  
a photovoltaic energy source having a front face and an oppositely disposed back face;  
a frontside array of metallic gridlines deposited upon the front face of the photovoltaic energy source; and  
a busbar structure in electrical continuity with the frontside array of metallic gridlines, the busbar structure comprising  
an electrical insulator layer overlying and contacting the front face of the photovoltaic energy source, wherein the electrical insulator layer is an oxide or a nitride having a thickness of from about 0.3 to about 2 micrometers, and  
a metallic busbar layer overlying and contacting the electrical insulator layer, wherein the metallic busbar layer is in electrical continuity with the frontside array of metallic gridlines.

18. A solar cell comprising:  
a photovoltaic energy source having a front face and an oppositely disposed back face;  
a frontside array of metallic gridlines deposited upon the front face of the photovoltaic energy source; and  
a busbar structure in electrical continuity with the frontside array of metallic gridlines, the busbar structure comprising  
an electrical insulator layer overlying and contacting the front face of the photovoltaic energy

source, wherein the electrical insulator layer has a thickness of from about 0.3 to about 2 micrometers, and

a metallic busbar layer overlying and contacting the electrical insulator layer, wherein the metallic busbar layer is in electrical continuity with the frontside array of metallic gridlines.

The Examiner relies on the following prior art references as evidence of obviousness of the rejected claims:

Mowles	2002/0062858 A1	May 30, 2002
Takada	6,291,761 B1	Sep. 18, 2001
Kaplow	4,242,580	Dec. 30, 1980

The pending claims stand rejected as follows:

1. Claims 1-4, 7, 8 and 18-21 stand rejected under 35 U.S.C. § 103(a) as obvious over Takada in view of Mowles.
2. Claims 9-11, 22, and 23 stand rejected under 35 U.S.C. § 103(a) over Takada in view of Mowles and further in view of Kaplow.
3. Claims 12 and 14-17 stand rejected under 35 U.S.C. § 103(a) as obvious over Takada in view of Mowles and further in view of Kaplow.

#### FINDINGS OF FACT (FF)

The followings findings of fact are supported by a preponderance of the evidence. Additional findings, as necessary, appear in the Discussion section of this opinion.

1. Takada discloses a photovoltaic cell module. The module has a photovoltaic energy source (semiconductor photoactive layer 303), having a front face and an opposing back face, (*see* Fig. 3B), a frontside array of

metallic gridlines (collector electrode 305) and a busbar structure having an electrical insulator layer (insulating layer 308) disposed on the front face of the photovoltaic energy source, (col. 18, ll. 21-25), and a metallic busbar layer overlying and contacting the electrical insulator layer, wherein the metallic busbar layer is in electrical continuity with the frontside array of metallic gridlines. ( *see* Figs. 3A and 3C).

2. Takada, Fig. 3A, illustrates a metallic busbar layer (collector electrode 306) overlying an insulating layer 308, in which the insulating layer extends laterally beyond the edges or perimeter of the metallic busbar layer.

3. Mowles discloses a photovoltaic cell having a photovoltaic cell having a photovoltaic layer of zinc diphosphide. The photovoltaic layer has two layers of semiconductor material to produce a p/n junction. (§ 0052).

4. Mowles discloses an electrical insulating layer made preferably of silicon dioxide. Its thickness is typically 500-5000 Å (0.05-0.5 µm). (§ 0049).

5. Kaplow teaches a solar collection apparatus having a collection ratio of up to greater than 500 suns. (col. 1, ll. 5-9). The solar collection apparatus uses an unspecified photovoltaic cell. (col. 2, l. 46).

## PRINCIPLES OF LAW

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains.” *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1734 (2007)

The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of ordinary skill in the art, and (4) where in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR*, 127 S.Ct. at 1739.

The test for obviousness is what the *combined* teachings of the references would suggest to those of ordinary skill in the art. *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

“Description for the purposes of anticipation can be by drawings alone as well as by words.” *In re Mraz*, 455 F.2d 1069, 1072 (CCPA 1972). [quoting *In re Bager*, 47 F.2d 951, 952-53 (CCPA 1931)]

“Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.” *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will

of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant.” *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).

“The prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed in the ... application ... [M]ere disclosure of alternative designs does not teach away.” *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

## DISCUSSION

### *1. Obviousness over Takada in view of Mowles*

In the Final Office Action, the Examiner found that Takada teaches all limitations of independent claims 1, 12 and 18, except the limitations of the material and dimensions of the insulating layer. The Examiner found that Mowles discloses an insulating layer of silicon dioxide and an insulating layer extending laterally beyond an overlying metallic busbar layer. (Ans. 4). Appellants only dispute disclosure of the limitation of the insulation layer's thickness and its extension beyond the metallic busbar layer, the number of semiconductor layers in a photovoltaic energy source, and the obviousness of combining the elements of Takada and Mowles. Otherwise, Appellants do not dispute the other teachings with respect to the independent claims. (App. Br. 10-11, 14). We thus determine the elements of the invention, except as to the foregoing, as undisputed facts. (*see* FF 1, 4).

Claims 1-4, 7, 8 and 18-21 stand rejected under 35 U.S.C. § 103(a) as obvious over Takada in view of Mowles. In maintaining the rejection, the

Examiner contends Takada discloses a solar cell module, comprising elements corresponding to all elements of the present claims except the limitations of exactly two layers of semiconductor material, and requirements of the insulator layer composition and thickness. (Ans. 2-3). The Examiner then contends Mowles discloses a high efficiency solar cell produced with inexpensive materials, comprising a photovoltaic layer with two semiconductor layers to produce a p/n junction. Mowles further teaches the use of an insulating layer to electrically isolate the device, made of silicon dioxide 0.5 micrometers thick. (Ans. 3). The Examiner finally contends it would have been obvious to utilize the material and thickness of the insulating layer taught in Mowles within the device of Takada, for the reasons of improved performance and less cost. (Ans. 3).

Appellants traverse the rejection with several arguments common to the individual claims of this rejection. We therefore address Appellants' arguments by the issue raised rather than by the claim.

*Teaching against the combination*

With respect to claims 1, 4, 18 and 20, Appellants note that each of the claims is limited to a photovoltaic cell with an insulating layer overlying and contacting the front face of the photovoltaic energy source, and an insulating layer that is an oxide or nitride having a thickness of from about 0.3 to 2 micrometers. (App. Br. 8, 11 and 13). Appellants then argue that Takada, with its polyimide insulating layer, and Mowles with its insulating layer disposed on the substrate and not the front face of the photovoltaic energy source, teach against the Examiner's asserted obvious combination. *Id.*

We disagree. The test for obviousness is what the *combined* teachings of the references would have suggested to those of ordinary skill in the art. *Young*, 927 F.2d at 591. Appellants are attacking the obviousness of the combination merely by improperly attacking references individually. *See Merck*, 800 F.2d at 1097.

Appellants have not cited anything in the prior art references that would discourage or dissuade one from the path followed by Appellants. *Gurley*, 27 F. 3d at 552-53. The possibility of more than one alternative in the prior art for the insulator layer material and its location does not teach away from any of these alternatives because Appellants have not pointed to anything which criticizes, discredits or otherwise discourages the solution claimed in the application. *Fulton*, 391 F.3d at 1201. Accordingly, we adopt the Examiner's findings and conclusion of obviousness directed to the subject matter defined by claims 1, 4, 18, and 20 as our own.

*No teaching of Limitations*

In regards to dependent claims 8 and 21, Appellants claim the prior art references do not teach the limitation of an electrical insulator layer which extends laterally beyond the metallic busbar layer. (App. Br. 11, 14). We disagree. Takada in Fig. 3A illustrates the insulator layer 308 extending beyond the metallic busbar layer 306 (FF 4), and therefore discloses this limitation. *Mraz*, 455 F.2d at 1072.

With regards to claim 2, Appellants contend neither reference teaches the limitation of a photovoltaic energy source comprising exactly two layers of semiconductor material. (App. Br. 9-10). We disagree. Mowles discloses a photovoltaic layer having a p/n junction formed by two layers of semiconductor material. (FF 4).

*Inconsistent Use of References*

Regarding claims 3 and 19, Appellants allege an inconsistency between relying on Mowles for a teaching of exactly two semiconductor layers and on Tanaka for more than two semiconductor layers, and that only one or the other, but not both, can be used in a rejection. We disagree. A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art, including nonpreferred embodiments. *Merck & Co.*, 874 F.2d 804, 807 (Fed. Cir. 1989).

We therefore find Appellants' argument unpersuasive. We determine that Tanaka and Mowles teach all the limitations of the claims of this rejection. (FFs 1-4). We also determine the combination of the teachings to be obvious to one of ordinary skill in the art at the time of the invention, as a combination of familiar elements by known methods expected to yield predictable results. *KSR*, 127 S.Ct. at 1739.

2. *Obviousness over Tanaka in view of Mowles and Kaplow*

Claims 9-11, 22 and 23 stand rejected under 35 U.S.C. § 103(a) as obvious over Tanaka in view of Mowles and further in view of Kaplow. Claims 9-11 depend on claim 1, and claims 22 and 23 depend on claim 18.

Tanaka teaches the elements as described under the first rejection. (*see* FF 1). The difference between the claims of this second rejection and Tanaka are the requirements of the insulating layer composition and of a solar collector. (Ans. 7). Kaplow discloses a solar collector with a photovoltaic cell, (FF 5), which Appellants do not dispute.

Appellants traverse the rejection with two arguments common to the individual claims of this rejection. We therefore address Appellants' arguments by the issue raised rather than by the claim.

From the foregoing, we find that all the elements of the claimed invention are found in the Tanaka, Mowles and Kaplow references, and that the invention would be obvious to one of ordinary skill in the art at the time of the invention, being a combination of familiar elements by known methods expected to yield predictable results. *KSR*, 127 S.Ct. at 1739.

*Teaching against the combination*

With respect to claims 9-11, 22 and 23, Appellants note that each of the claims are limited to a photovoltaic cell with an insulating layer overlying and contacting the front face of the photovoltaic energy source, and an insulating layer that is an oxide or nitride having a thickness of from about 0.3 to 2 micrometers, based on their dependency from parent claims 1 or 18. (*See App. Br. 15-18*). Appellants then argue that Takada, with its polyimide insulating layer, and Mowles with its insulating layer disposed on the substrate and not the front face of the photovoltaic energy source, teach against the Examiner's asserted obvious combination. (*Id.*)

We disagree. Appellants are essentially attacking the teachings of the references individually and not considering the teachings as a whole. The test for obviousness is what the *combined* teachings of the references would have suggested to those of ordinary skill in the art. *Young*, 927 F.2d at 591. Appellants are attacking the obviousness of the combination merely by improperly attacking references individually. *See Merck*, 800 F.2d at 1097.

Appellants have not cited anything in the prior art references that would discourage or dissuade one from the path followed by Appellants.

*Gurley*, 27 F. 3d 552-53. The possibility of more than one alternative in the prior art for the insulator layer material and its location does not teach away from any of these alternatives because Appellants have not pointed to anything which criticizes, discredits or otherwise discourages the solution claimed in the application. *Fulton*, 391 F.3d at 1201.

*Incompatible Approach in the References.*

Appellants then argue, with respect to claims 9-11, 22 and 23, that the approach taught by the prior art references are not compatible with the heat and temperature produced in a solar concentrator solar cell. (See App. Br. 15-18). However, Appellants do not cite any reference in the prior art indicating the silicon dioxide insulator layer of Mowles, relied on by the Examiner, would be incompatible, nor do Appellants provide any additional evidence of this alleged incompatibility. Kaplow teaches a solar collector having a collection ratio > 500 suns, but refers to use of a photovoltaic cell 10 generally, without any limitations or specifications on an acceptable cell design. (FF 5). We determine Appellants' argument conclusory, without evidentiary support and thus unpersuasive.

We therefore find all of Appellants' arguments unpersuasive. We determine that Tanaka, Mowles and Kaplow teach all the limitations of the claims of this rejection. We also determine the combination of the teachings would have been obvious to one of ordinary skill in the art at the time of the invention, as a combination by known methods expected to yield predictable results. *KSR*, 127 S.Ct. at 1740.

3. *Obviousness over Takada in view of Mowles and Kaplow*

In the third rejection, claims 12 and 14-17 stand rejected as obvious over Takada in view of Mowles and further in view of Kaplow. Independent claim 12 contains similar limitations as of claim 1, plus an additional limitation of a solar concentrator and at least 2 layers of semiconductor material, but without a limitation on the insulator layer thickness in the independent claim. Claims 14-17 depend on claim 12, adding limitations on the dimensions of the insulating layer, and the concentration ratio of the solar concentrator.

As in the first rejection, the Examiner contends Takada teaches the limitations of the claims except the insulator layer thickness and composition and the limitation of a solar collector. According to the Examiner, Mowles teaches a photovoltaic cell with two semiconductor layers and an insulator layer made of silicon dioxide with a thickness of 0.5 micrometers. (Ans. 7). In fact, Mowles teaches a thickness of the insulating layer between 0.05 and 0.5 micrometers. (*see* FF 4).

From the foregoing, we find that all the elements of the claimed invention are found in the Tanaka, Mowles and Kaplow references, and that the invention would be obvious to one of ordinary skill in the art at the time of the invention, being a combination of familiar elements by known methods expected to yield predictable results. *KSR*, 127 S.Ct. at 1739.

Appellants traverse the rejection with common arguments for the individual claims of this rejection. We therefore address Appellants' arguments by the issue raised rather than by the claim.

*Incompatible Approach in References*

Appellants argue generally for claims 12 and 14-17, (App. Br. 18, and separately for claim 17, App. Br. 21), that the approaches taught by these references are not compatible with the heat and resulting high temperature produced in a solar concentrator solar cell. However, Appellants do not cite any reference in the prior art indicating the silicon dioxide insulator layer of Mowles, relied on by the Examiner, would be incompatible, nor do Appellants provide any additional evidence of this alleged incompatibility. Kaplow teaches a solar collector having a collection ration  $> 500$  suns, but refers to a photovoltaic cell 10 generally, without any limitations or specifications on an acceptable cell design. (FF 5). We determine Appellants' argument conclusory, without evidentiary support and thus unpersuasive.

*Non-disclosure of claim elements*

Appellants argue that, for claims 14-16, the cited prior art references do not teach an additional limitation of each claim, e.g., a specified insulator layer thickness or lateral dimensional extent. (App. Br. 19-21). The Examiner contends the thickness of the insulator layer is a matter of optimization to be sufficiently electrically insulating and pinhole-free. (Ans. 21). The Examiner also contends Takada in Fig. 3A shows the insulating layer extending beyond the perimeter of the busbar layer. (Ans. 23).

As to the lateral dimensions of the insulator layer, we agree that Takada in Fig. 3A illustrates the insulator layer extending beyond the busbar layer (FF 2), and therefore discloses this limitation. *Mraz*, 455 F.2d at 1072. As to the thickness of the insulating layer, the claims recite either a range of  $0.3 - 2.0 \mu\text{m}$  (claim 14), or a value of  $0.5 \mu\text{m}$  (claim 15). In either case, the value overlaps or at least touches the range disclosed in Takada. (FF 4).

Overlapping ranges or ones that touch establish a case of *prima facie* obviousness. *Geisler*, 116 F.3d 1465, 1469 (Fed. Cir. 1997). Appellants have not shown that their ranges or values for the thickness of the insulator layer provide unexpected results, or exhibit a superior property or advantage that a person of ordinary skill would have found surprising or unexpected. *Id.* Thus, we find Appellants' arguments unpersuasive.

Teaching away

Appellants argue for each of claims 12, 14, 15 and 17 that each reference teaches elements with values different than the claimed limitations. For example, Appellants argue that Takada discloses a polyimide insulating layer, not an oxide or nitride, (App. Br. 19), or that Mowles discloses an insulating layer over a substrate and not the front face of a photovoltaic cell (*id.*), or that the insulating layer of Mowles has a differing thickness, (App. Br. 15). As a result, Appellants argue in each case these differences teach away from the combination asserted by the Examiner.

We disagree. Appellants are essentially attacking the teachings of the references individually and not considering the teachings as a whole. The test for obviousness is what the *combined* teachings of the references would have suggested to those of ordinary skill in the art. *Young*, 927 F.2d at 591 [emphasis provided].

Appellants have not cited anything in the prior art references that would discourage or dissuade one from the path followed by Appellants. *Gurley*, 27 F. 3d 552-53. The possibility of more than one alternative in the prior art for the insulator layer material or its location does not teach away from any of these alternatives because Appellants have not pointed to

Appeal 2008-3344  
Application 10/603,703

anything which criticizes, discredits or otherwise discourages the solution claimed in the application. *Fulton*, 391 F.3d at 1201.

We therefore find Appellants' argument unpersuasive. We determine that Tanaka, Mowles and Kaplow teach all the limitations of the claims of this rejection. We also determine the combination of the teachings would have been obvious to one of ordinary skill in the art at the time of the invention, as a combination by known methods expected to yield predictable results. *KSR*, 127 S.Ct. at 1740.

### CONCLUSION

For the foregoing reasons, the three rejections of the Examiner of all pending claims are sustained.

### TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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