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GENERAL ELECTRIC COMPANY
GLOBAL RESEARCH
ONE RESEARCH CIRCLE
BLDG. K1-3A59
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EXAMINER
MOWLA, GOLAM

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UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT TRIAL AND APPEAL BOARD

Ex parte GENERAL ELECTRIC COMPANY
(Application 11/081,967)

Appeal 2011-011772
from Technology Center 1700
Golam Mowla, Examiner

Before CHUNG K. PAK, RICHARD TORCZON and BEVERLY A. FRANKLIN, *Administrative Patent Judges*.

TORCZON, *Administrative Patent Judge*.

DECISION ON APPEAL

The appellant (GEC) seeks relief under 35 U.S.C. 134(a) from the final rejection of claims 1-24 and 43-54. We AFFIRM.

OPINION

Background

GEC has disclosed photovoltaic devices with integrated nanostructure regions.[1] GEC has three independent claims on appeal. Claim 1 illustrates one implementation of the invention:[2]

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[1] Spec. ¶ 0056.

> A photovoltaic device comprising:
>
> a) a substrate;
>
> b) a first region comprising an array of 1-dimensional nanostructures positioned on the substrate in a monolayer and in a substantially vertical orientation, wherein a majority of the nanostructures are electrically isolated from the other nanostructures within the array;
>
> c) a second region residing on top of the first region such that contact of the first and second regions forms at least one charge separating junction;
>
> d) a third region comprising a conductive transparent material residing as a layer on top of the second region; and
>
> e) top and bottom contacts operable for connecting the device to an external circuit, wherein the bottom contact is in electrical contact with the first region and the top contact is in electrical contact with the third region;
>
> wherein the first, second, and third regions are comprised exclusively of inorganic components and wherein the monolayer of 1-dimensional nanostructures traverses substantially the entirety of the thickness of the photovoltaic device so that the at least one charge separating junction within a majority of the nanostructures is accessible to both the top and bottom contacts.

Independent claim 43 defines a similar device with branched nanostructures. In independent claim 53, the components need not be inorganic and the 1-dimensional nanostructures comprise a passivation layer, which may have organic material.

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[2] All claim language comes from the Claims Appendix to the Appeal Brief. Br. 17-22.

The specification expressly defines "1-dimensional nanostructure" to mean:[3]

> nanotubes, nanorods, nanocylinders, and nanowires *of inorganic composition*, generally having sub-micron diameters and typically having diameters below 300 nm, and wherein their 1-dimensionality originates from their large aspect ratios.

The array of 1-dimensional nanostructures must be positioned on the substrate as "a monolayer". While "a" can include more than one, the prefix "mono-" requires the narrower interpretation that the array is a single layer.

The specification also expressly defines "charge separating junction", which it defines as "a junction created when two materials of opposite polarity meet."[4]

REJECTIONS

The examiner has rejected all of the claims on appeal as having been obvious[5] over the combined disclosures of (at least) a Roscheisen patent[6] and a Scher published application.[7] Independent claim 43 is rejected over this combination; independent claim 1, over the combination of Roscheisen, Scher and a Majumdar published application;[8] and independent claim 53, over the combination of Roscheisen, Scher, Majumdar and a Miller published application.[9] The dependent claims are rejected over the combination of Roscheisen and Scher, with or without additional references. Because GEC's arguments on appeal focus

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[3] Spec. ¶ 0045 (emphasis added).
[4] *Id.* ¶ 0048.
[5] Ans. 4-24, citing 35 U.S.C. 103.
[6] M.R. Roscheisen & B.M. Sager, *Polycrystalline optoelectronic devices based on templating technique*, US 7,227,066 B1 (granted 5 June 2007).
[7] E. Scher et al., *Nanostructure and nanocomposite based compositions and photovoltaic devices*, US 2004/0118448 A1.
[8] A. Majumdar et al., *Methods of fabricating nanostructures and nanowires and devices fabricated therefrom*, US 2002/0172820 A1.
[9] B.L. Miller & T.D. Krauss, *Calorimetric nanocrystal sensors, methods of making, and use thereof*, US 2003/0003492 A1.

on Roscheisen and Scher, and not on the other references or the limitations of the claims other than common limitations of the independent claims, we will limit our consideration accordingly, with all of the claims standing or falling together.

GEC argues that Roscheisen is not proper prior art for purposes of an obviousness rejection. GEC argues that Scher does not teach a limitation, teaches away from the limitation or otherwise is not properly combinable to produce the limitation.

ROSCHEISEN

GEC contends that it has successfully antedated Roscheisen as provided under agency rules.[10] As an initial matter, GEC has not presented the affidavits to the board on appeal.[11] We nevertheless exercise our discretion to take official notice of the paper in the examination record entitled "RULE 131 DECLARATION", filed 17 March 2010.

Facts and Findings

[1] GEC's application was filed on 16 March 2005.[12]

[2] The application that resulted in the Roscheisen patent was filed on 21 April 2004.

We find that the Roscheisen patent is facially available as prior art for an obviousness rejection because the application for the Roscheisen patent was pending when GEC's application was filed.[13]

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[10] 37 C.F.R. § 1.131 (Affidavit or declaration of prior invention).
[11] Br. 23 (Evidence Appendix): "None." See 37 C.F.R. § 41.37(c)(1)(ix) (2010) (requiring an evidence appendix when GEC's brief was filed).
[12] Br. 1, caption.
[13] 35 U.S.C. 102(e)(2); *see also Hazeltine Res., Inc. v. Brenner*, 382 U.S. 252, 255 (1965), *citing Alexander Milburn Co. v. Davis-Bournonville Co.*, 270 U.S. 390, 401 (1926).

[3] The examiner relies on Roscheisen to teach:[14]

a photovoltaic device (photovoltaic cell 200, fig. 3, col. 8, lines 23 to col. 10, line 13) comprising:

• a substrate (202);

• a first region (window layer 206) made up of semiconductor such as CdS, ZnS, ZnSe or the like positioned on the substrate (202) in a monolayer (layer of 209) (see fig. 3) and in a substantially vertical orientation (see fig. 3), wherein a majority of the semiconductor are electrically isolated from each other (via template 209) (col. 9, lines 29-35);

• a second region (active layer 208) made up of semiconductor such as CdTe or CdSe or the like and residing on top of the first region (206) such that contact of the first (206) and second (208) regions forms at least one charge separating junction (photovoltaic cell inherently forms p-n junction or heterojunction between semiconductors of window layer and active layer);

• a third region (210) comprising a conductive transparent material (col. 10, lines 3-13) residing as a layer on top of the second region (208); and

  ○ wherein the first (206), second (208), and third (210) regions are comprised exclusively of inorganic components (col. 9, lines 15-18; col. 8, lines 45-48; and col. 10, lines 3-13).

[4] All of the named inventors subscribed the Rule 131 declaration.[15]

[5] The inventors state that they filed "an invention record with the General Electric Legal Department describing the elements [of the invention] on a date prior to April 24, 2004."[16]

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[14] Ans. 4-5 (explaining the rejection of claim 1).
[15] 131 Decl. 1 & signature pages.
[16] *Id.* ¶ 4.

The declaration in the agency record does not include a copy of the invention record and the declaration itself does not say that a copy of the invention record is included. GEC has not indicated where in the agency record a copy of the invention record might be found. The absence of the invention record is not explained. In any case, the alleged invention record date is a few days after Roscheisen's effective date, but the declaration does not account for this difference.

[6] The inventors state that:[17]

> From at least April 2004 to November 2004, lead inventor Loucas Tsakalakos directed at least about 50% of his time/responsibilities to this particular project. In other words, on a weekly basis, he spent an average of 20 hours per week on the project that led to the present patent application. This effort was supplemented by the efforts of other project contributors during this time period.

The declaration provides a starting month, but not date, for the start of the inventors' diligence to a reduction to practice.[18] At most, we can only acknowledge diligence from the last date of the month: Friday, April 30, 2004, a date more than a week after the Roscheisen effective date.

[7] As corroboration, the inventors provide:[19]

> a. A slide showing a preliminary summary of project progress showing the growth of substantially vertical nanowires from a substrate and the optical properties thereof presented on April 4, 2004 (Appendix A);
>
> b. A slide showing summary of progress made on the project showing the electrical isolation of a majority of the nanowires and their ability to photoconduct presented on September 9, 2004 (Appendix B); and

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[17] *Id.* ¶ 5.
[18] The board appreciates that the reduction to practice could be either actual or constructive.
[19] *Id.* ¶ 6.

c. A slide showing a complete photoconductor, including second and third regions wherein all of the regions comprise inorganic components, and properties thereof presented on November 8, 2004.

[8] The slide in appendix A of the declaration purports to show "Initial Results", "Si[licon] Nanowires", their optical properties, "Aligned Nanorods in AAO" and "Electrical Properties – Single Nanowire FETS".

The copy of the slide in the record is blurry, with most of the text and image detail illegible. Assuming the truth of the labels in the slide in the declaration, the slide does not indicate what project the initial results are for or how they relate to the claimed invention. The declaration summarizes the slide ("a preliminary summary of project progress showing the growth of substantially vertical nanowires from a substrate and the optical properties thereof") but does not correlate these results to a complete conception of the invention now claimed, such as by explaining how the details of the slide were necessarily intended for the photovoltaic device now claimed. The evidence does not indicate that prior to April 21, 2004, the inventors had a complete conception.

Analysis

While the requirements of antedating under Rule 131 are not as stringent as those of priority in an interference, a complete conception of the invention before the critical date must be shown.[20] Mere citation to evidence is not proof.[21] In this case, the best evidence corroborating evidence of an antedating conception—the

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[20] *In re Borkowski*, 505 F.2d 713, 719 (CCPA 1974).
[21] *Borkowski*, 505 F.2d at 718 (explaining that general statements in Rule 131 affidavits amounted to little more than pleading); *see also Creative Compounds, LLC v. Starmark Labs.*, 651 F.3d 1303, 1313 (Fed. Cir. 2011) (explaining that the trial court is not obligated to make out a party's case from an incomplete record).

invention record—does not appear to have been placed in the agency record and certainly has not been placed before the board. The inventors have not explained why the invention record was not available for submission. Similarly, the inventors have not explained the gap between Roscheisen's effective date and the later alleged date of the invention record. The inventors' reference to the invention record is facially inadequate to establish a complete conception of the invention presently claimed.

The only corroborating document from before Roscheisen's effective date is the slide in appendix A of the declaration. As the examiner notes,[22] at most the slide shows properties for silicon nanowires. Neither the slide nor the declaration tie the results shown to the photovoltaic device now claimed. For example, there is no indication (or explanation) that the presently claimed use for the nanowires necessarily preceded their development. An antedating effort relying on conception with diligence must show a complete conception.[23] In the case of an apparatus claim, as here, it is not enough to show conception of a subcomponent unless the subcomponent necessarily implies the resulting apparatus; otherwise, any conception of a subcomponent would provide an antedating basis for every use of that subcomponent. GEC has not provided the obligatory implication for the nanowire evidence.

While the inventors allege diligence from "at least April 2004", they must show diligence from before the critical date, April 21, 2004. Where a declarant testifies to a period rather than a date, the testimony is taken as proof only for the last date of the period,[24] in this case, the last day of April 2004, which is more than

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[22] Ans. 25.
[23] *Supra*, n.20.
[24] *E.g.*, *Oka v. Youssefyeh*, 849 F.2d 581, 584 (Fed. Cir. 1988) (explaining that "the last week of October" only proves October 31).

a week after the critical date. GEC has not established diligence from before the critical date.

Holding

GEC has not shown complete conception before the critical date or diligence commencing before the critical date. Consequently, GEC has not shown that Roscheisen was improperly applied as prior art.

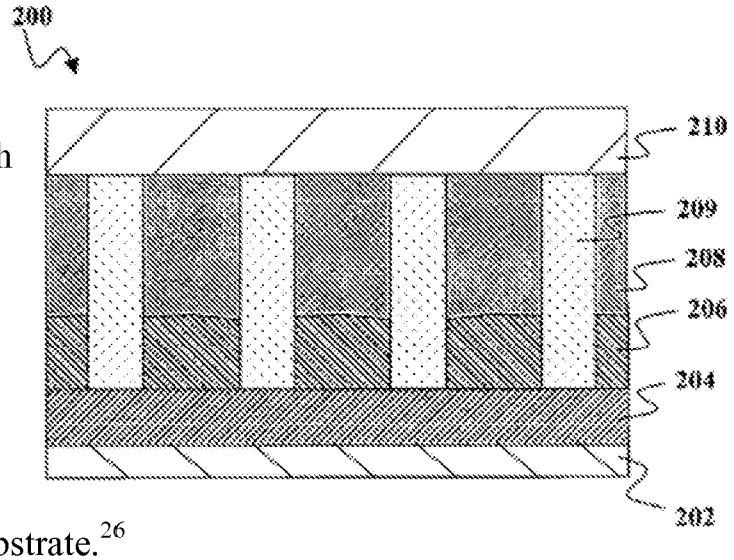
SCHER

GEC contends that Scher teaches a bilayer of nanostructures such that it either teaches away from a monolayer or the examiner has applied Scher's teachings out of context.

Facts and Findings

[9] The examiner found that Roscheisen taught a substantially vertical monolayer.[25]

[10] Roscheisen Figure **3** (right) illustrates a photovoltaic cell **200** with a substrate **202**, a base electrode **204**, a window layer material **206**, an active layer material **208**, a nanotube template **209** and a transparent electrode **210**, where the nanotubes are substantially orthogonal to the substrate.[26]



Roscheisen appears to disclose a monolayer of columnar nanotubes.

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[25] Ans. 28.
[26] Roscheisen 8:23-10:13.

[11] Scher repeatedly and preferentially discloses an active layer formed of two populations of nanostructures or more than one active layer.[27]

[12] Scher notes a trade-off in the use of a monolayer for one class of nanostructures:[28]

> In order to minimize hopping, therefore, it is desirable to provide as direct a conductive path through the active layer, as possible, e.g., a path with fewer required crystal to crystal hops. In the case of spherical or near spherical nanocrystals, this is best accomplished by providing the nanocrystal component as substantially a monolayer disposed on one electrode. While this provides an advantage in charge conduction, it carries the disadvantage of substantially reduced light absorption from a single thin layer of nanocrystals.

One skilled in the art would have known that, at least for spherical nanocrystals, there were known advantages and disadvantages to using a monolayer. Scher does not address a monolayer of nano*tubes*. Scher's preference for a bilayer of nanostructures does not, by itself, teach away from using a monolayer of nanotubes.

Analysis

The examiner relies principally on Roscheisen to teach the monolayer.[29] The examiner contends that Scher is used to show the advantages of a nanostructure array in a photovoltaic cell.[30] Consequently, GEC's argument that Scher does not teach a monolayer is misplaced.[31]

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[27] Scher, e.g., ¶¶ 0016, 0033, 0135 and 0137.
[28] *Id.* ¶ 100.
[29] Ans. 28.
[30] *Id.*
[31] *Nat'l Steel Car, Ltd. v. Canadian Pac. Rwy., Ltd.*, 357 F.3d 1319, 1336-37 (Fed. Cir. 2004) (rejecting argument attacking wrong reference).

Scher expresses a preference for a bilayer, but a preference does not exclude or teach away from the alternative. Scher only expressly addresses a nanostructure monolayer for nanospheres, which are not directly relevant because they are not 1-dimensional. Even so, Scher indicates that those skilled in the art would appreciate the use of a monolayer to address a problem in using nanostructures.

Holding

GEC's argument appears to stem from a misapprehension of the examiner's reasoning. GEC has not shown a reversible error in the examiner's use of Scher in combination with Roscheisen.

HOLDING

GEC has not shown reversible error. Accordingly, the examiner's rejection of claims 1-24 and 43-54 is—

AFFIRMED

For the appellant: KIMBERLY S. JORDAHL,[32] KSJLaw, LLC, of Willernie, Minnesota.

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[32] 37 C.F.R. § 1.34 (Acting in a representative capacity).