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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte TAKASHI SAKURADA and TOMOHIRO KAWASE

Appeal 2017-004671
Application 13/953,421
Technology Center 1700

Before LINDA M. GAUDETTE, RAE LYNN P. GUEST, and CHRISTOPHER L. OGDEN, *Administrative Patent Judges*.

OGDEN, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] appeals under 35 U.S.C. § 134(a) from the Examiner's final decision rejecting claims 7–12, 14, and 15 in the above-identified application.[2] We have authority pursuant to 35 U.S.C. § 6(b). We affirm.

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[1] Appellant is the Applicant, Sumitomo Electric Industries, Ltd., which according to the Appeal Brief is the real party in interest. Appeal Brief 1, May 12, 2016 [hereinafter Appeal Br.].

[2] Final Office Action, Dec. 31, 2015 [hereinafter Final Action]; Examiner's Answer, Nov. 3, 2016 [hereinafter Answer]. Appellant's arguments are found in the Appeal Brief. Appellant did not submit a Reply Brief.

BACKGROUND

Appellant's invention "relates to a crystal and a substrate of electrically conductive GaAs, and more particularly to reduction in size and density of precipitates contained in the crystal and substrate of conductive GaAs." Spec. 1.[3]

Representative claim 7 is the sole independent claim:

> 7. A conductive GaAs bulk crystal having an atomic concentration of Si more than 1×10^{17} cm^{-3}, *wherein a density of precipitates having sizes of at least 30 nm contained in the crystal is at most 400 cm^{-2}.*

Appeal Br. A-1 (emphasis of key limitation added).

The Examiner maintains the following grounds of rejection:

1. Claims 7–9, 14, and 15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Inoue[4] in view of Suezawa[5] and Dutta.[6] *See id.* at 2–4.

2. Claims 7–10, 14, and 15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsumoto[7] in view of Suezawa and Dutta. *See id.* at 5–7.

3. Claims 11 and 12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsumoto in view of Suezawa, Dutta, and Iwasaki.[8] *See id.* at 7–8.

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[3] Specification, July 29, 2013 [hereinafter Spec.].
[4] Inoue et al., US 5,612,014 (issued Mar. 18, 1997).
[5] M. Suezawa et al., *Optical Studies of Heat-Treated Si-Doped GaAs Bulk Crystals*, 89 J. APPL. PHYS. 1618 (1991).
[6] Dutta, US 2007/0034250 A1 (published Feb. 15, 2007).
[7] Matsumoto, US 2007/0079751 A1 (published Apr. 12, 2007).
[8] Iwasaki, US 5,599,389 (issued Feb. 4, 1997).

In the Appeal Brief, Appellant argues claim 7 separately with respect to the first two rejections, and these arguments regarding each rejection are substantially the same. *Compare* Appeal Br. 5–13, *with id.* at 14–22. Appellant presents no substantially different argument with respect to dependent claims 8–12, 14, and 15. *See id.* at 13, 22–24. Therefore, consistent with 37 C.F.R. § 41.37(c)(1)(iv), we limit our discussion to independent claim 7. Claims 8–12, 14, and 15 fall with claim 7.

DISCUSSION

The Examiner finds that Inoue and Matsumoto, separately, teach Si-doped GaAs crystals having an atomic concentration of Si more than 1×10^{17} cm^{-3} as recited in claim 7. Final Action 2, 5 (citing Inoue 2:1–4, 4:40–51; Matsumoto ¶ 50). Neither Inoue nor Matsumoto, however, discloses that "a density of precipitates having sizes of at least 30 nm contained in the crystal is at most 400 cm^{-2}" as recited in claim 7. *Id.*

Nevertheless, the Examiner finds that Suezawa teaches that the particle size, spatial distribution, and density of Si precipitates affect the electrical and optical characteristics of a GaAs material. *See id.* at 2–3, 5 (citing Suezawa 1618, 1620–23). The Examiner also finds that Dutter teaches making bulk semiconductor crystals, such as GaAs, "substantially free of crystal defects" by reducing the number of defects, including precipitates, to fewer than 1000 or 100 defects per cm^2. *Id.* at 3–4, 6.

Therefore, the Examiner determines that a person of ordinary skill in the art at the time of invention would have been motivated to optimize the density and size of Si precipitates in the GaAs bulk crystal of Inoue or Matsumoto to achieve the material recited in claim 7 and, in particular, to

optimize in the direction of making the crystals "substantially free of defects." *Id.*; *see also* Answer 9–11.

Appellant argues that the Examiner has not established a prima facie case of unpatentability because "the Examiner does not explain anywhere the standard(s) by which one skilled in the art would have considered any particular density and size combination to be more optimal than another." Appeal Br. 7, 16.

This argument is not persuasive of reversible error in the Examiner's rejection. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012) (quoting *In re Aller*, 220 F.2d 454, 456 (Fed. Cir. 1955)). This rule applies when the optimized variable is a "result-effective variable." *Id.* "[T]he prior art need not provide the exact method of optimization for the variable to be result-effective. A recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective." *Id.* at 1297.

The Examiner has shown that a person of ordinary skill in the art would have understood that the size and the density of Si precipitates affects the electrical and optical properties of a GaAs bulk crystal, and that the size and density are therefore result-effective variables. *See* Answer 9–11. Moreover, the Examiner has identified additional guidance in Dutta that would have given a skilled artisan a reason to reduce precipitates of all kinds (including precipitates larger than 30 nm) to a density as low as 100 cm^{-2}, so that the material is "substantially free of defects." The Examiner has thus established a prima facie case of unpatentability. *Cf. In re Swentzel*, 219

F.2d 216, 219 (1955) (where the prior art suggested that smaller particles have an advantage over larger ones, finding the desired particle size "involves nothing more than routine experimentation and exercise of the judgment of one skilled in the art.").

Appellant also argues that the teachings in Suezawa constitute "vague prior art," of the type criticized in *Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341 (Fed. Cir. 2009)." Appeal Br. 9, 18. This argument is not persuasive of reversible error. In *Bayer*, the court stated that "an invention is not obvious to try where vague prior art does not guide an inventor toward a particular solution." *Bayer*, 575 F.3d at 1347. This is inapplicable to the Examiner's rejections, which show that the prior art would have guided a skilled artisan to optimize the size and density of Si precipitates in a GaAs bulk crystal, as discussed above. Moreover, the Examiner has persuasively shown that Suezawa teaches that particle size and density affect specific electrical and/or optical properties of crystals, and that these teachings are not vague. *See* Answer 12, 18.

Appellant next argues that Suezawa teaches away from the proposed combination with Inoue or Matsumoto because Suezawa discloses annealing after cooling to room temperature. *See* Appeal Br. 10–11, 19–20 (citing Suezawa 1618). By contrast, according to Appellant, the Specification "makes clear that it is critical to anneal the grown crystal before cooling to room temperature." *Id.* at 11, 20 (citing Spec. 6). We find this argument unpersuasive. First, the Examiner does not cite Suezawa for its method of forming a GaAs bulk crystal, but for its teachings about how particle size and density affect electrical and optical properties of a GaAs bulk crystal. *See* Answer 13, 19. Second, while Suezawa teaches a particular annealing

method, Appellant has not directed our attention to anything in Suezawa or elsewhere to "criticize, discredit, or otherwise discourage" the composition of matter recited in claim 7. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). Claim 7 does not require that the composition be made by any particular annealing method.

Appellant also argues that "the annealing process relied upon in Suezawa, even if followed, would not result in a density of precipitates having sizes of at least 30 nm contained in the crystal being at most 400 cm^{-2}." Appeal Br. 12, 21. This argument is not persuasive of reversible error, because the Examiner's rejection, as discussed above, does not rely on any specific process recited in Suezawa, but rather on what Suezawa teaches a person of ordinary skill in the art. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981) ("The test for obviousness . . . is what the combined teachings of the references would have suggested to those of ordinary skill in the art.")

For the above reasons, Appellant has not shown reversible error in the Examiner's rejections of claims 7–12, 14, and 15.

DECISION

The Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended. *See* 37 C.F.R. § 1.136(a)(1)(iv) (2016).

AFFIRMED