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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte BRIAN A. KORGEL, MATTHEW G. PANTHANI, BRIAN W. GOODFELLOW, VAHID A. AKHAVAN, and BONIL KOO

Appeal 2018-009174
Application 12/991,518
Technology Center 1700

Before CATHERINE Q. TIMM, JAMES C. HOUSEL, and JEFFREY R. SNAY, *Administrative Patent Judges*.

SNAY, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision rejecting claims 1, 2, 6–20, 22, 24, 99, and 100. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

[1] We use the word Appellant to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the Board of Regents, the University of Texas System, as the real party in interest. Appeal Br. 3.

BACKGROUND

The invention relates to nanoparticle materials. Spec. ¶ 1. According to the Specification, copper indium gallium selenide (CIGS) material is useful as an absorber layer in photovoltaic devices, such as solar cells. *Id.* ¶ 2. Formation of a CIGS layer by reacting a deposited copper-indium-gallium layer with selenium vapor is said to be expensive and difficult to control. *Id.* Appellant describes quaternary CIGS nanoparticles suitable for use in photovoltaic devices. *Id.* ¶ 5. Nanoparticles comprising a copper zinc tin selenide (or sulphide) compound also are described. *Id.* ¶ 57. Claim 1—the sole independent claim on appeal—reads as follows:

> 1. A nanoparticle comprising a compound comprising copper, zinc, tin, and either selenide or sulphide, wherein the nanoparticle has a uniform or substantially uniform composition, and wherein the nanoparticle is at least partially crystalline.

Appeal Br. 12 (Claims Appendix).

REFERENCES

Name	Reference	Date
Probst et al. "Probst"	US 5,626,688	May 6, 1997
Hubert et al. "Hubert"	US 2004/0026007 A1	Feb. 12, 2004
Yu et al. "Yu"	US 2005/0183767 A1	Aug. 25, 2005
Whiteford et al. "Whiteford"	US 2006/0040103 Al	Feb. 23, 2006
Kazuo Jimbo et al., *Cu2ZnSnS4-type thin film solar cells using abundant materials*, 515 Thin Solid Films 5997–5999 (2007).		

REJECTIONS

I. Claims 1, 2, 6, 7, 9, 22, 24, 99, and 100 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Yu and Jimbo.

II. Claim 8 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Yu, Jimbo, and Hubert.

III. Claim 10 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Yu, Jimbo, and Probst.

IV. Claims 11–20 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Yu, Jimbo, and Whiteford.

OPINION

Appellant argues only the rejection of claim 1 over Yu and Jimbo, and does not present separate arguments addressing any other rejection on appeal. *See* Appeal Br. 7–11. Accordingly, all issues subject to this appeal are resolved with our determination as to the rejection of claim 1.

In rejecting claim 1, the Examiner finds that Yu discloses a quaternary CIGS nanoparticle for use in photovoltaic cells. Final Act. 2. The Examiner also finds that Jimbo teaches that a copper zinc tin sulfide (CZTS) material is advantageous over CIGS. *Id.* at 3. *See also* Jimbo 5997 ("CIGS, however, [is] compose[d] of rare Indium and toxic Selenium so that the problems of rare resources and environmental pollutions become troublesome. This paper is emphasized to introduce environment harmless type CZTS absorption layer composed of naturally abundant materials."). In light of these teachings, the Examiner finds one of ordinary skill would have had a reason to substitute zinc and tin for indium and gallium in Yu's nanoparticle. Final Act. 3.

Appellant argues that neither Yu nor Jimbo discloses a quaternary compound, and that Yu at best discloses a ternary compound. Appeal Br. 8 (citing Yu ¶ 19). For that reason, Appellant contends that substituting materials taught by Jimbo for those of Yu would not have resulted in the claimed quaternary compound material. *Id.*

The Examiner responds that Yu discloses a quaternary compound—namely, copper indium gallium selenium (or sulphide) in stoichiometric amounts. Ans. 7.

Yu discloses a nanoparticle-based CIGS ink which includes elemental metal or metallic nanoparticles. Yu ¶ 15. The disclosed nanoparticles may be provided in different categories, which "include but are not limited to" ternary, binary, or elemental metal nanoparticles. *Id.* ¶19. In one example, Yu identifies so-called "Ternary IB-IIIA-VIA Non-Oxide Quantum Nanoparticles (e.g., $Cu(In, Ga)Se(S)_2$)." *Id.* ¶ 21. Yu explains the nomenclature "(In, Ga)" as including Indium in combination with Gallium. *Id.* ¶ 18. *See also id.* ¶ 13 ("The liquid ink includes particles containing elements of groups IB, IIIA and (optionally) VIA, e.g., copper and indium (*with or without gallium*) and selenium or sulfur.") (emphasis added). Thus, we read, and one of ordinary skill in the art would have understood, Yu's compound identified in paragraph 21 as encompassing both a ternary compound in which gallium is not present and a quaternary compound in which the indium is combined with gallium. The latter embodiment corresponds to a quaternary CIGS nanoparticle. In light of our reading of Yu, we are persuaded the Examiner's finding that Yu discloses a quaternary CIGS nanoparticle is supported by a preponderance of the evidence. Appellant's argument to the contrary is not persuasive of reversible error.

Appellant also argues that Yu discloses a preferred embodiment in which different nanoparticles are provided as elemental metals, rather than compounds. Appeal Br. 9. However, the fact that Yu characterizes a particular embodiment as preferred does not negate Yu's disclosure of other embodiments characterized as suitable for the intended purpose in photovoltaic cells.

Appellant further argues that the Korgel Declaration provides evidence that "it was not known prior to Appellant's work that one could actually make nanoparticles of [CZTS]," such that "one would not have had a reasonable expectation of success that such nanoparticles could in fact be prepared." Appeal Br. 9 (emphasis and internal quotes omitted). In the Declaration, the inventor states that the only known route to obtaining either CIGS or CZTS materials was "to deposit a thin film of a combination of copper-indium-gallium (or copper-zinc-tin) and then anneal these mixtures in the presence of selenium or sulfur vapor at temperatures exceeding 500^{o}C." Decl. ¶ 4. The inventor continues, "[i]n the Application, my research group demonstrated for the first time that a colloidal route can be used to prepare these compounds directly at significantly lower temperature (<350^{o}C) than existing methods." *Id.* ¶ 5. However, the Declaration does not address the teachings of Yu, which also discusses formation of CIGS materials without high temperature selenization. *See* Yu Abstract. Moreover, Appellant's contention that it was not known that nanoparticles could be made from the claimed elements is undermined by Appellant's contradicting statement in the Specification. *See* Spec. ¶ 4 ("Synthetic procedures for colloidal $CuInS_2$ and CIGS nanocrystals have been reported in the literature."). Appellant does not point to any evidence of a material

distinction between production of CIGS and CZTS nanoparticles. *See* Spec. ¶ 57.

For the foregoing reasons, Appellant does not persuade us of reversible error in the Examiner's rejection of claim 1. Accordingly, the Examiner's rejection of that and each remaining claim subject to this appeal is sustained.

CONCLUSION

The Examiner's decision rejecting claims 1, 2, 6–20, 22, 24, 99, and 100 is affirmed.

DECISION SUMMARY

Claim(s) Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 2, 6, 7, 9, 22, 24, 99, and 100	103(a)	Yu, Jimbo	1, 2, 6, 7, 9, 22, 24, 99, and 100	
8	103(a)	Yu, Jimbo, Hubert	8	
10	103(a)	Yu, Jimbo, Probst	10	
11–20	103(a)	Yu, Jimbo, Whiteford	11–20	
Overall Outcome			1, 2, 6–20, 22, 24, 99, 100	

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