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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MIAOXIN YANG, GUANGWEI WANG,
and JIANYU JIN

Appeal 2019-003609
Application 14/655,547
Technology Center 1700

Before LINDA M. GAUDETTE, ELIZABETH M. ROESEL, and
JANE E. INGLESE, *Administrative Patent Judges*.

INGLESE, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant¹ requests our review under 35 U.S.C. § 134(a) of the Examiner’s decision to finally reject claims 11, 12, and 16–24.² We have jurisdiction over this appeal 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 Koninklijke Philips N.V. as the real party in interest. Appeal Brief filed December 17, 2018 (“Appeal Br.”). Appeal Br. 3.

² Final Office Action mailed July 19, 2018 (“Final Act.”).

CLAIMED SUBJECT MATTER

Appellant claims a device for preparing a pH-adjusted electrolyte aqueous solution. Appeal Br. 7–8. Claim 11, the sole pending independent claim, illustrates the subject matter on appeal, and is reproduced below with contested subject matter italicized:

11. A device for preparing a pH adjusted electrolyte aqueous solution, the device comprising:

a pH adjustor configured to prepare the pH-adjusted electrolyte aqueous solution;

a second unit in liquid connection with the pH adjustor and configured to dispense the pH-adjusted electrolyte aqueous solution,

wherein the pH adjustor comprises:

an electrolysis cell including an anode and a cathode:

said cathode comprising pseudocapacitance material and said anode comprising a metal oxide, in operation of the pH adjustor, the pseudocapacitance material gets electrons from the anode and adsorbs cations from the electrolyte aqueous solution by electrochemically reacting with said cations, OH^- in the electrolyte aqueous solution are consumed at the anode by losing electrons and a consumption of H^+ in the electrolyte aqueous solution at the cathode is inhibited, leaving H^+ in the electrolyte aqueous solution; or

said anode comprises pseudocapacitance material and said cathode comprising a metal oxide, and in operation of the pH adjustor, the pseudocapacitance material loses electrons and adsorbs anions from the electrolyte aqueous solution by electrochemically reacting with said anions, H^+ in the electrolyte aqueous solution are consumed at the cathode by getting electrons and a consumption of OH^- in the electrolyte aqueous solution at the anode is inhibited, leaving OH^- in the electrolyte aqueous solution; and

a controller configured to control the electrolysis process in the electrolysis cell.

Appeal Br. 23–24 (Claims Appendix) (emphasis added).

REFERENCES

Nakamura et al. ("Nakamura")	US 6,113,853	Sept. 5, 2000
Rosenblum et al. ("Rosenblum")	US 2002/0027068 A1	Mar. 7, 2002
Tanahashi et al. ("Tanahashi")	US 2011/0042206 A1	Feb. 24, 2011

Kuo et al., *Investigation of Pseudocapacitive Charge-Storage Reaction of $MnO_2 \cdot nH_2O$ Supercapacitors in Aqueous Electrolytes*, 153 *Journal of the Electrochemical Society*, The Electrochemical Society, A1317–A1324 (2006), ("Kuo").

Chang, et al., *Electrochemically synthesized graphene/polypyrrole composites and their use in supercapacitor*, 50 *Carbon*, 2331–2336 (2012), www.sciencedirect.com, last visited Feb. 2020, ("Chang").

Xie et al., *Supercapacitance of ruthenium oxide deposited on titania and titanium substrates*, 122 *Materials Chemistry and Physics*, 23–29 (2010), ("Xie").

REJECTIONS

The Examiner maintains the following rejections in the Examiner's Answer entered February 7, 2019 ("Ans."):

- I. Claims 11 and 16–19 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum;
- II. Claim 12 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum and Nakamura;
- III. Claims 20–22 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum and Kuo; and
- IV. Claims 23 and 24 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum, Chang, and Xie.

FACTUAL FINDINGS AND ANALYSIS

Upon consideration of the evidence relied upon in this appeal and each of Appellant's contentions, we affirm the Examiner's rejections of claims 11, 12, and 16–24 under 35 U.S.C. § 103(a) for the reasons set forth in the Final Action, the Answer, and below.

We review appealed rejections for reversible error based on the arguments and evidence the appellant provides for each issue the appellant identifies. 37 C.F.R. § 41.37(c)(1)(iv); *Ex parte Frye*, 94 USPQ2d 1072, 1075 (BPAI 2010) (precedential) (cited with approval in *In re Jung*, 637 F.3d 1356, 1365 (Fed. Cir. 2011) (explaining that even if the Examiner had failed to make a prima facie case, “it has long been the Board’s practice to require an applicant to identify the alleged error in the [E]xaminer’s rejections”)).

Rejection I

We turn first to the Examiner's rejection of claims 11 and 16–19 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum. To address this rejection, Appellant presents arguments directed to claim 11 only, and asserts that claims 16–19 are allowable for the same reasons as claim 11. Appeal Br. 11–17. We, therefore, select claim 11 as representative, and decide the appeal as to claims 11 and 16–19 based on claim 11 alone. 37 C.F.R. § 41.37(c)(1)(iv).

We point out initially that claim 11 recites that the claimed device comprises a pH adjustor “configured to” prepare a pH-adjusted electrolyte aqueous solution. As discussed more fully below, Appellant's Specification discloses that the recited pH adjustor is designed and constructed to perform this recited function of adjusting the pH of an aqueous solution.

Consequently, claim 11 requires the recited pH adjustor to be “made to” or “designed to” perform the function of adjusting the pH of an aqueous solution. *In re Giannelli*, 739 F.3d 1375, 1379 (Fed. Cir. 2014) (explaining that recitation in a claim that an apparatus or structure is “configured to” perform a particular function requires more than “mere capability” of performing the recited function, and is synonymous with “made to” or “designed to” perform the function, when the description makes clear that the claimed apparatus or structure is “designed to” or “constructed to” perform the recited function).

We also point out that claim 11 sets forth two alternative compositions for the anode and cathode of the recited pH adjustor, and two consequent alternative operations of the pH adjustor, one of which is optional, by virtue of the claim’s recitation of “or” between the two relevant paragraphs in the claim. We, therefore, limit our discussion to the first alternative recited in claim 11, in which the cathode comprises a pseudocapacitance material and the anode comprises a metal oxide. *Fresenius USA, Inc. v. Baxter Int’l, Inc.*, 582 F.3d 1288, 1298 (Fed. Cir. 2009).

Tanahashi discloses a device for regulating the pH of drinking water that comprises an ion-adsorbing electrode, a metal electrode paired with the ion-adsorbing electrode that functions as a counter electrode, and a controller that controls a power supply to apply a voltage between the electrodes, which electrolyzes water at the surface of the metal electrode. Tanahashi ¶¶ 21, 28 48, 51, 75. Tanahashi discloses that the ion-adsorbing electrode can serve as a cathode, while the metal electrode serves as an anode. Tanahashi ¶ 52. Appellant does not dispute the Examiner’s finding

that the ion-adsorbing cathode disclosed in Tanahashi corresponds to a cathode comprising pseudocapacitance material as recited in claim 11.

Compare Final Act. 3–4, *with* Appeal Br. 11–17.

Tanahashi discloses lowering the pH of drinking water by applying a direct current voltage between the ion-adsorbing cathode and the metal anode, which, Tanahashi explains, causes cations in the drinking water to be adsorbed on the electrically conductive material of the ion-adsorbing electrode, and causes hydrogen ions (H⁺) and oxygen gas to be generated at the surface of the metal electrode, resulting in the drinking water becoming acidic. Tanahashi ¶ 52.

The Examiner finds that although Tanahashi discloses that suitable anodes for Tanahashi’s device include electrodes whose surface is coated with a metal that facilitates water electrolysis, such as platinum, Tanahashi does not disclose an anode comprising a metal oxide, as recited in claim 11. Final Act. 6 (citing Tanahashi ¶ 48).

Rosenblum, however, discloses that suitable materials for forming electrodes used for the electrolysis of water include platinum, ruthenium dioxide, and conductive oxides. Rosenblum ¶¶ 9, 73 (Table 1). Rosenblum further discloses that ruthenium oxides yield “[a] very good anode.” Rosenblum ¶ 73 (Table 1).

In view of these disclosures in Rosenblum, the Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time of Appellant’s invention to use a metal oxide, such as ruthenium dioxide, as disclosed in Rosenblum, to form Tanahashi’s metal anode, because Tanahashi “discloses that any electrode suitable for water electrolysis is enabled,” and Rosenblum discloses that ruthenium oxides yield “[a] very

good anode.” Final Act. 7 (citing Tanahashi ¶ 48; Rosenblum Table 1); *see also* Ans. 24. The Examiner determines that such a modification of Tanahashi’s metal electrode would constitute nothing more than selection of a known material based upon its suitability for an intended use. *Id.*

Appellant argues that the operating principle of Tanahashi’s device for regulating pH differs fundamentally from the operating principle of the pH adjuster recited in claim 11. Appeal Br. 12–15. Appellant argues that “the ion-adsorbing electrode (cathode)/metal electrode (anode) embodiment of Tanahashi may be characterized as an acidic regulation technique for drinking water” that generates “additional hydrogen ions (H^+) in the drinking water leading to a pH decrease,” but in contrast, “the pseudocapacitance material (cathode)/metal oxide (anode)” of Appellant’s invention “may be characterized as an acidic regulation technique for drinking water” that consumes hydroxide ions (OH^-) in the drinking water leading to a pH decrease. Appeal Br. 13–14.

Appellant’s arguments do not identify reversible error in the Examiner’s rejection, for reasons well-expressed by the Examiner in the Answer, and discussed below.

Claim 11 recites a pH adjuster comprising, in part, an electrolysis cell including a cathode comprising a pseudocapacitance material and an anode comprising a metal oxide. Claim 11 recites that, in operation, “the pseudocapacitance material gets electrons from the anode and adsorbs cations from the electrolyte aqueous solution by electrochemically reacting with said cations, OH^- in the electrolyte aqueous solution are consumed at the anode by losing electrons and a consumption of H^+ in the electrolyte aqueous solution at the cathode is inhibited, leaving H^+ in the electrolyte

aqueous solution.”

As the Examiner explains in the Answer (Ans. 17–22), contrary to Appellant’s arguments, Tanahashi’s device for regulating pH uses the same mechanism of operation (or operating principle) as the pH adjustor recited in claim 11, in view of the plain language of claim 11, and the description of the recited pH adjustor provided in Appellant’s Specification and drawings.

The Specification discloses that Appellant’s device for preparing a pH-adjusted aqueous solution operates according to an asymmetric electrolysis mechanism in which the formation of hydrogen gas at the cathode, which occurs during typical symmetrical electrolysis of water, is inhibited, while formation of oxygen gas at an anode, which occurs during typical symmetrical electrolysis of water, is not inhibited. Spec. pg. 1, ll. 11–15; pg. 5, ll. 6–25. The Specification discloses that the result of this asymmetrical electrolysis process is accumulation of hydrogen ions in the electrolysis solution, which lowers the pH of the solution. Spec. pg. 5, ll. 6–25; pg. 15, l. 22–pg. 16, l. 11; Fig. 9B.

More Specifically, the Specification discloses that Appellant’s device comprises an electrolysis cell that includes an anode comprising a metal oxide and a cathode comprising a pseudocapacitance material (such as a transition metal oxide), both of which are immersed in an aqueous solution, such as water, and a controller that controls the flow of current from a power supply to the electrodes. Spec. pg. 5, l. 6–pg. 6, l. 19; pg. 14, ll. 1–24; Fig. 9B. The Specification explains, as recited in claim 11, that the cathode pseudocapacitance material gets electrons from the anode, and absorbs cations from the water by electrochemically reacting with the cations, which inhibits the formation of hydrogen gas at the cathode (that normally occurs

during symmetric electrolysis). Spec. pg. 2, ll. 10–20; pg. 5, ll. 6–25; pg. 14, l. 26–pg. 16, l. 11; pg. 22, l. 23–pg. 23, l. 2; Fig. 9B. The Specification further explains—as also recited in claim 11—that hydroxide ions (OH^-) in the water are consumed at the anode by losing electrons, which generates oxygen gas and hydrogen ions (H^+). *Id.* Due to inhibition of the formation of hydrogen gas at the cathode, hydrogen ions (H^+) accumulate in the water, which lowers the pH of the water, and “result[s] in production of acidic water.” *Id.*

As the Examiner points out (Ans. 19), the Specification also discloses that during operation of Appellant’s device, the longer the water is in contact with the electrodes while current is being supplied, the more H^+ ions are generated. Spec. 16, ll. 13–24; Fig. 9B. Similarly, the higher the current/voltage supplied to the electrodes, the greater the electron transfer speed between the electrodes and the water, and the higher the generation rate of H^+ ions in the water. Spec. 16, ll. 13–24; Fig. 9B.

Consistent with the plain language of claim 11, the Specification thus explicitly indicates that the mechanism of operation of the pH adjuster recited in claim 11 involves the generation of hydrogen ions (H^+) at the anode and inhibition of the formation of hydrogen gas at the cathode, which lowers the pH of the water in the electrolysis cell due to the accumulation of hydrogen ions (H^+) in the water. As discussed above, Tanahashi discloses lowering the pH of drinking water by applying a direct current voltage between an ion-adsorbing cathode and a metal anode, which Tanahashi indicates causes cations in the drinking water to be adsorbed on the electrically conductive material of the ion-adsorbing cathode, and causes hydrogen ions (H^+) and oxygen gas to be generated at the surface of the

metal anode, resulting in the drinking water becoming acidic. Tanahashi ¶ 52.

As indicated above, Appellant argues that the mechanism of operation of Tanahashi's device differs from that of the device of claim 11 because Tanahashi's mechanism of operation "may be characterized as an acidic regulation technique for drinking water" that generates "additional hydrogen ions (H^+) in the drinking water leading to a pH decrease." As discussed above, however, the mechanism of operation of the device of claim 11 as explicitly recited in the claim and described in Appellant's Specification also generates additional hydrogen ions (H^+) in water being treated, leading to a decrease in the pH of the water. Thus, rather than distinguishing the mechanism of operation of Tanahashi's device from the mechanism of operation of the device of claim 11, Appellant's arguments show that the two devices both operate according to the same mechanism. Appellant's arguments, consequently, do not identify error in the Examiner's finding that Tanahashi's device modified as suggested by Rosenblum to include a ruthenium dioxide anode (as discussed more fully below) is configured to prepare a pH-adjusted aqueous solution as recited in claim 11.

Next, Appellant argues that Rosenblum "fails to describe, teach or suggest an electrode pairing of a pseudocapacitance material and a metal oxide [and] Rosenblum teaches away from the use of metal oxide by . . . stating a metal oxide capable of absorbing hydrogen should not be used as a cathode in an electrolytic cell." Appeal Br. 15 (citing Rosenblum ¶ 72) (emphasis omitted).

As discussed above, however, it is undisputed on this appeal record that Tanahashi—rather than Rosenblum—discloses a device for regulating

the pH of drinking water that includes a cathode formed of an ion-adsorbing material, which corresponds to a cathode comprising a pseudocapacitance material as recited in claim 11. As also discussed above, Tanahashi discloses that Tanahashi's device includes a metal anode, and Tanahashi indicates that suitable materials for forming the anode include metals that facilitate the electrolysis of water, such as platinum.

Rosenblum's disclosure that platinum and ruthenium dioxide are both suitable materials for forming anodes for the electrolysis of water would have indicated to one of ordinary skill in the art that both materials could be used interchangeably to form such anodes. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (An obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for [an examiner] can take account of the inferences and creative steps that a person of ordinary skill in the art would employ."); *see also In re Preda*, 401 F.2d 825, 826 (CCPA 1968) (In assessing the content of the applied prior art, "it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom."). This understanding in the art, coupled with Rosenblum's disclosure that ruthenium oxides yield "very good" anodes for the electrolysis of water, would have led one of ordinary skill in the art to substitute a ruthenium oxide, such as ruthenium dioxide as disclosed in Rosenblum, for the platinum disclosed in Tanahashi for forming Tanahashi's metal anode, resulting in a device including a cathode comprising an ion-adsorbing material (pseudocapacitance material) and an anode comprising ruthenium oxide (metal oxide), as recited in claim 11. *In re Fout*, 675 F.2d 297, 301 (CCPA 1982) ("Express suggestion to substitute

one equivalent for another need not be present to render such substitution obvious.”); *see also KSR*, 550 U.S. at 416 (“[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.”).

Although, as discussed above, Appellant argues that Rosenblum “teaches away from the use of metal oxide” by disclosing that a metal oxide capable of absorbing hydrogen should not be used as a cathode in an electrolytic cell, the paragraph of Rosenblum cited by Appellant for this disclosure explicitly mentions numerous metals and metal oxides that should be avoided as *cathode* materials, but makes no mention of ruthenium oxides, and does not describe any disadvantages associated with the use of ruthenium oxides as *anode* materials. Rosenblum ¶ 72. Thus, the cited paragraph of Rosenblum does not negate Rosenblum’s explicit disclosure that ruthenium oxides yield “very good” anodes for the electrolysis of water. Contrary to Appellant’s arguments, Rosenblum, therefore, does not teach away from using ruthenium oxides as an anode material for the electrolysis of water.

Finally, Appellant argues that any modification of Tanahashi’s operating principle in view of Rosenblum to that of the operating principle of the pH adjustor of claim 11 would improperly change the operating principle of Tanahashi’s device. Appeal Br. 15.

As discussed above, however, Tanahashi’s device for regulating pH uses the same mechanism of operation (or operating principle) as the pH adjustor recited in claim 11. As also discussed above, the Examiner’s proposed modification of Tanahashi in view of the relied-upon disclosures in

Rosenblum does not involve modifying the operating principle of Tanahashi's device. Rather, the proposed modification involves using ruthenium dioxide as disclosed in Rosenblum to form Tanahashi's metal anode. Appellant's conclusory argument does not identify any error in the Examiner's factual findings, reasoning, or conclusion of obviousness.

We, accordingly, sustain the Examiner's rejection of claims 11 and 16–19 under 35 U.S.C. § 103(a) as unpatentable over Tanahashi in view of Rosenblum.

Rejections II–IV

Appellant argues that the claims subject to these rejections (claims 12 and 20–24) under 35 U.S.C. § 103(a) are patentable over the applied prior art references for the same reasons Appellant presents for claim 11 (discussed above) because, Appellant argues, the additional references applied in these rejections (Nakamura, Kuo, Chang, and Xie) fail to cure the deficiencies of Tanahashi and Roenblum. Appeal Br. 16–20. Appellant also repeats the argument that Appellant presents for claim 11 that any modification of Tanahashi's operating principle in view of the additional prior art references to that of the operating principle of Appellant's claimed device would improperly change the operating principle of Tanahashi's device. Appeal Br. 18, 20.

Because Appellant's arguments do not identify reversible error in the Examiner's rejection of claim 11 for the reasons discussed above, Appellant's arguments also do not identify reversible error in Examiner's rejections of claims 12 and 20–24 under 35 U.S.C. § 103(a), which we accordingly sustain.

CONCLUSION

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
11, 16–19	103(a)	Tanahashi, Rosenblum	11, 16–19	
12	103(a)	Tanahashi, Rosenblum, Nakamura	12	
20–22	103(a)	Tanahashi, Rosenblum, Kuo	20–22	
23, 24	103(a)	Tanahashi, Rosenblum, Chang, Xie	23, 24	
Overall Outcome			11, 12, 16–24	

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