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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte QINGSONG YU, HAO LI, and MENG CHEN

Appeal 2017-003397
Application 12/766,602¹
Technology Center 3700

Before STEFAN STAICOVICI, LYNNE H. BROWNE, and
ANNETTE R. REIMERS, *Administrative Patent Judges*.

STAICOVICI, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Qingsong Yu et al. (“Appellants”) appeal under 35 U.S.C. § 134(a) from the Examiner’s decision in the Non-Final Office Action (dated June 4, 2015, hereinafter “Non-Final Act.”) rejecting claims 1–5, 7, 8, 11–13, 15, 16, 20, 23, 25, and 29–32.²

Appellants’ representative presented oral argument on November 6, 2018. We have jurisdiction over this appeal under 35 U.S.C. § 6(b).

¹ The real party in interest is identified as The Curators of the University of Missouri in Appellants’ Appeal Brief 4 (filed June 2, 2016, hereinafter “Appeal Br.”).

² Claims 6, 9, 10, 14, 17–19, 21, 22, 24, and 26–28 are cancelled. Appeal Br. 51–54 (Claims App.).

SUMMARY OF DECISION

We REVERSE.

INVENTION

Appellants' invention is directed to a surface treatment method for dentin using a cold plasma technique. Spec., para. 3.

Claims 1, 12, and 23 are independent. Claim 1 is illustrative of the claimed invention and reads as follows:

1. A method of increasing bonding strength on a dental restoration site in the mouth of a patient comprising:
 - removing material from the dental restoration site to expose a surface comprising dentin;
 - generating a cold atmospheric plasma inside the mouth of the patient, said plasma having a brush-like shape;
 - after the step of removing material to expose the dentin, applying the cold atmospheric plasma onto the dental restoration site for a period of time between about 30 seconds and 60 seconds to chemically activate the dentin to increase penetration of a dental adhesive into collagen fibrils of the dentin and increase chemical bonding between the collagen fibrils and the dental adhesive;
 - wherein said dental adhesive is a composite material and wherein said cold atmospheric plasma comprises argon;
 - after the step of applying the plasma, applying the adhesive to the surface; and
 - installing a dental restoration on the adhesive-coated surface.

REJECTIONS

- I. The Examiner rejects claims 1–5, 8, 11–13, 16, 20, 25, and 29–32 under 35 U.S.C. § 103(a) as being unpatentable over Allred et al. (US 2003/0186197 A1, published Oct. 2, 2003, hereinafter “Allred”), Laroussi (WO 2006/096716 A2, published Sept. 14, 2006), as evidenced by Karmaker et al.

- (US 2004/0202985 A1, published Oct. 14, 2004, hereinafter “Karmaker”), and R.E.J. Sladek et al. (*Treatment of Streptococcus Mutans Biofilms with a Nonthermal Atmospheric Plasma*, 45 LETTERS IN APPLIED MICROBIOLOGY, 318–323 (2007), hereinafter “Sladek”).³
- II. The Examiner rejects claims 7, 15, and 23 under 35 U.S.C. § 103(a) as being unpatentable over Allred, Laroussi, as evidenced by Karmaker, Sladek, and Watson (US 2009/0012589 A1, published Jan. 8, 2009).⁴

ANALYSIS

Rejection I

As noted above, independent claim 1 recites, *inter alia*, “applying the cold atmospheric plasma . . . for a period of time between about 30 seconds and 60 seconds to *chemically activate* the dentin to . . . increase chemical bonding between the collagen fibrils and the dental adhesive.” Appeal Br. 50 (Claims App.) (emphasis added). Similarly, independent claim 12 recites, *inter alia*, “*chemically activating* the dentin by applying the cold atmospheric plasma . . . for a period of time between about 30 seconds and 60 seconds to . . . increase chemical bonding between the collagen fibrils and the dental adhesive.” *Id.* at 51–52 (emphasis added).

The Examiner finds that Allred discloses a method for adhering amalgam or composite restoratives to dental structures including, *inter alia*, removing material from the tooth to expose the dentin layer, treating the surface with a dental acid,

³ We note that claims 31 and 32 depend from independent claim 23, which is not part of this rejection.

⁴ We view the Examiner’s omission of Karmaker from the heading of this rejection as a mere typographical error.

subsequently removing the dental acid, coating the acid treated surface with a dental composite adhesive, and installing a dental restoration structure. *See* Non-Final Act. 2 (citing Allred, paras. 24- 6, 104, 124); *see also* Allred, Figs. 1–4. However, the Examiner finds that Allred fails to disclose applying cold plasma to the acid treated surface for a time range of between 30 and 60 seconds. *See id.* at 3, 4. Thus, the Examiner relies on Laroussi to disclose the application of cold plasma for cleaning of dental caries and on Sladek to disclose application of cold plasma for 60 seconds for sterilization of dental bacteria. *Id.* at 3–4 (citing Laroussi, paras. 4, 7, and 9; Sladek, p. 319, col. 2, ll. 27–29). Hence, the Examiner concludes that it would have been obvious to a person of ordinary skill in the art to apply cold plasma, as taught by Laroussi, for a time of 60 seconds, as taught by Sladek, to the acid treated dental surface of Allred. *Id.* The Examiner’s reasoning for such a modification is to “ensur[e] sterilization before placement of dental adhesive” and to “destroy[] biofilms from contaminating a fissure or crack in a dental carie being treated.” *Id.* (citing Laroussi, para. 4; Sladek, p. 319, col. 1, ll. 1–12).

The Examiner further relies on the disclosure of Karmaker to show that “the application of . . . [cold] plasma caus[ing] chemical modification . . . [of a surface] . . . is a known effect.” *Id.* at 3 (citing Karmaker, paras. 33–37). According to the Examiner, because both Laroussi and Karmaker disclose the use of cold plasma to affect surface modification of polymers and “dentin . . . is generally made . . . [from] hydroxyapatite and collagen[,] which is a polymer,” a skilled artisan would readily understand that dentin “would [likewise] be affected by the plasma during the sanitation treatment” of Allred, as modified by Laroussi and Sladek. *Id.* at 3–4.

Appellants argue that although Karmaker discloses the application of cold plasma to affect surface treatments, Karmaker “does not refer to restoration sites that are in the mouth of a patient.” Appeal Br. 19. Furthermore, Appellants contend that because Karmaker’s application time of cold plasma of about 10 minutes is contradictory to the application time of Sladek of 60 seconds, a skilled artisan “would not have incorporated the time period set forth in Sladek into the teachings of Allred, Laroussi, and Karmak[er].” Reply Brief 9 (filed Dec. 20, 2016, hereinafter “Reply Br.”).

The Examiner responds that because the combined teachings of Allred and Laroussi disclose the application of cold plasma to a dental carie for sterilization and cleaning, “Karmaker was relied upon to show that . . . Allred and Laroussi would *inherently* cause the [chemical] activation,” as called for by each of independent claims 1 and 12. Examiner’s Answer 4 (dated Oct. 20, 2016, hereinafter “Ans.”) (emphasis added). According to the Examiner, because the combined teachings of Allred, Laroussi, and Sladek disclose applying cold plasma “to a dental restoration site for the same [amount of] time” as claimed, i.e., 60 seconds, “the same *inherent* effect of activating the dental tissue” would result. *Id.* at 9 (emphasis added).

The Examiner is relying on a theory of inherency to establish that in light of Karmaker, using cold plasma, as taught by Laroussi, in the process of Allred, as modified by Sladek, would necessarily chemically activate the dentin to increase chemical bonding. “Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.” *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). In this case, the Examiner is correct in that both Laroussi and Karmaker

disclose the use of cold plasma to treat the surface of polymers, and Karmaker further discloses that such a treatment improves bonding properties of the surface. *See* Non-Final Act. 3–4; *see also* Laroussi, para. 4; Karmaker, paras. 23, 33. However, this in no way demonstrates that cold plasma can also chemically activate *dentin* to increase chemical bonding, as the Examiner contends. Just because Karmaker discloses that cold plasma treatment of a dental post or obturator made from a metal, plastic, ceramic, polymeric, or composite material improves the material’s bonding properties (*see* Karmaker, paras. 23, 33, 34), it does not necessarily mean that it can also chemically activate dentin to increase its chemical bonding properties.

In other words, just because cold plasma can treat general classes of inorganic materials, such as, metal, plastic, ceramic, polymeric, or composite materials, to improve their respective bonding properties, it does not mean that the same will necessarily occur when treating a specific inorganic-organic composite material, such as dentin. The Examiner’s reliance on Karmaker’s general disclosure of classes of inorganic materials does not take into account the distinct structure of dentin, which is an inorganic-organic composite material made from a “matrix of hydroxyapatite” (an inorganic mineral) and “fibrils of collagen” (organic). *Spec.*, para. 33. We, thus, do not agree with the Examiner’s finding that dentin constitutes a “polymer.” *See* Non-Final Act. 3–4.⁵

Furthermore, we note the Examiner’s reliance on Sladek to disclose a cold plasma application time of 60 seconds for sterilization (*in vivo* disinfection) of

⁵ Hydroxyapatite is “a complex phosphate of calcium $\text{Ca}_5(\text{PO}_4)_3\text{OH}$ that occurs as a *mineral* and is the chief structural element of vertebrate bone.” *See* Merriam-Webster.com, <https://www.merriam-webster.com/dictionary/hydroxyapatite> (emphasis added) (last visited Nov. 8, 2018).

dental bacteria. *See* Non-Final Act. 4. However, because chemical activation of dentin to increase chemical bonding is a different process than sterilization of dental bacteria, it does not mean that applying Laroussi's cold plasma for 60 seconds, as taught by Sladek, to Allred's dentin for sterilizing dental bacteria, necessarily would chemically activate the dentin to increase chemical bonding. As discussed *supra*, the Examiner's position does not take into account the distinct structure of dentin, which as an inorganic-organic composite material is structurally different from the general classes of inorganic materials discussed in Karmaker.

Accordingly, the Examiner's determination that applying Laroussi's cold plasma for 60 seconds, as taught by Sladek, to Allred's conditioning process necessarily would chemically activate the dentin to increase chemical bonding is mere speculation on the Examiner's part. Stated differently, just because cold plasma can treat inorganic materials, in general, to improve their bonding characteristics, and can sterilize dental bacteria when applied for 60 seconds, it does not mean that applying cold plasma for 60 seconds necessarily would chemically activate dentin to increase its chemical bonding properties.

In conclusion, as speculation cannot form the basis for concluding obviousness, we do not sustain the rejection of independent claims 1 and 12, and their respective dependent claims 2–5, 8, 11, 13, 16, 20, 25, and 29–32, under 35 U.S.C. § 103(a) as unpatentable over Allred, Laroussi, Sladek, and as evidenced by Karmaker.

Rejection II

Similar to independent claims 1 and 12, independent claim 23 recites, *inter alia*, “*chemically activating the dentin . . . to expose amino acids and increase the exposed surface area of amino acids available for adhesion.*” Appeal Br. 53 (Claims App.) (emphasis added). The Examiner’s reliance on Watson does not remedy the deficiency of the Examiner’s combination of Allred, Laroussi, and Sladek, as evidenced by Karmaker, discussed *supra*. See Non-Final Act. 5–6.

Accordingly, for the same reasons discussed above, we also do not sustain the rejection of claims 7, 15, and 23 as unpatentable over the combined teachings of Allred, Laroussi, Sladek, as evidenced by Karmaker, and Watson.

SUMMARY

The Examiner’s decision to reject claims 1–5, 7, 8, 11–13, 15, 16, 20, 23, 25, and 29–32 under 35 U.S.C. § 103(a) is reversed.

REVERSED