UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TOMOKO TAKAGI
and MASASHI UEDA

Appeal 2008-3843
Application 10/276,371
Technology Center 1700

Decided: December 8, 2008

Before EDWARD C. KIMLIN, LINDA M. GAUDETTE, and
KAREN M. HASTINGS, *Administrative Patent Judges*.

HASTINGS, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF CASE

Appellants appeal under 35 U.S.C. § 134 from a final rejection of claims 26-32, 34, 35, 37-44 and 46-51, the only claims pending in the above-identified application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

The invention relates to a plasma CVD (i.e., chemical vapor deposition) apparatus and method. Claims 26 and 38 are representative:

26. A plasma CVD apparatus comprising, in a reaction chamber, an electrode array with a plurality of inductively coupled electrodes which are arranged in a parallel in a common plane, each electrode being folded back at the center and having a feeding portion at a first end and a grounded portion at a second end, said electrode having at least a portion with a diameter of 10 mm or less, and a means for controlling a phase of high frequency power,

whereby high frequency power is fed to said feeding portions so as to establish a standing wave of a half wavelength or natural number multiple of a half wavelength between said feeding portion and said folded back portion and between said grounded portion and said folded back portion, and is controlled to have a phase difference between adjacent two feeding portions.

38. A plasma CVD method comprising, arranging, in a reaction chamber, a plurality of inductively coupled electrodes in parallel in a common plane to construct an electrode array, each electrode being folded back at the center and having a feeding portion at a first end and a grounded portion at a second end, said electrode having at least a portion with a diameter of 10 mm or less;

feeding high frequency power so as to establish a standing wave of a half wavelength or natural number multiple of a half wavelength between said feeding portion and said folded back portion and between said grounded portion and said folded back portion to generate a plasma of reactive gas introduced in said reaction chamber to form a thin film including at least one element constituting the reactive gas, and

setting a phase difference between adjacent two feeding portions of said electrodes to a prescribed value.

The Examiner relies upon the following prior art in rejecting the claims:

Hama	5,525,159	Jun. 11, 1996
Ishii	5,571,366	Nov. 5, 1996
Kinoshita	5,795,452	Aug. 18, 1998
Takeuchi	5,824,158	Oct. 20, 1998
Nakagawa	6,030,667	Feb. 29, 2000
Collins	6,068,784	May 30, 2000
Tontani	6,181,069 B1	Jan. 30, 2001
Suzuki[1]	JP 11-317299	Nov. 16, 1999

The Examiner rejected the claims under 35 U.S.C. § 103(a) as follows:

1) claims 26-27, 29-30, 32, 35, 48-51 over Suzuki, or Tonotani, in view of Takeuchi with Hama or Ishii,

2) claims 28, 31, 34, 37 over Suzuki, or Tonotani, in view of Takeuchi with Hama or Ishii, and further in view Kinoshita,

3) claims 38, 39, 41, 42, 44 over Suzuki, or Tonotani, in view of Takeuchi with Hama or Ishii, and further in view of Nakagawa,

4) claims 40, 43, 46 over Suzuki, or Tonotani, in view of Takeuchi with Hama or Ishii, and further in view of Nakagawa and Kinoshita,

5) claim 47 over Suzuki, or Tonotani, in view of Takeuchi with Hama or Ishii, and further in view of Nakagawa and Collins,

6) claims 26, 27, 29, 30, 32, 35, 38, 39, 41, 42, 44, 47-51 over Suzuki, or Tonotani, in view of Takeuchi and Nakagawa, and further in view Hama or Ishii.

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[1] It is undisputed that Tonotani is the U.S. equivalent of Suzuki. For convenience, citations in the findings of fact are made only to Tonotani, and we refer to these references collectively as Tonotani in the analysis.

7) claims 28, 31, 34, 37, 40, 43, and 46 over Suzuki, or Tonotani, in view of Takeuchi and Nakagawa, further in view Hama or Ishii, and further in view of Kinoshita.

Although there are a number of alternative rejections, Appellants traverse each of the first five grounds of rejection on the basis of the same or similar limitations found in each of independent claims 26 (apparatus) and 38 (method). (App. Br 5-6.) With respect to the sixth and seventh grounds of rejection, Appellants rely on the same arguments presented in connection with rejection numbers 3) and 5) listed above (App. Br. 22; Reply Br. 11-12.). Furthermore, Appellants separately argue dependent claims 27, 30, 39, 42, 49, and 51 (e.g., App. Br. 14, 15, 29; Reply Br. 5-7). Our decision will therefore focus on independent apparatus claim 26, independent method claim 38, and those dependent claims separately argued.

ISSUE

Appellants contend that the Examiner did not provide adequate suggestion or motivation to modify or combine the applied references (see, e.g., App. Br. 6, 10, 12).

Appellants also contend "criticality" (i.e., unexpected results) has been shown in Fig. 8 of their Specification for "the phase difference" of "180 degrees" as recited in dependent claims 27, 30, 39 and 42, and for the limitation requiring that "the distance between the feeding portion and folded back portion of every other electrode is elongated by the half wavelength," as recited in dependent claims 49 and 51 (e.g., Appeal Br. 14, 15; Reply Br. 12-15).

Thus, the issue is: have Appellants shown reversible error in the Examiner's determination that a person having ordinary skill in the art

would have found it obvious to arrive at the claimed invention in view of the applied prior art? And, if not, then: have Appellants overcome any prima facie case of obviousness with evidence of unexpected results in Fig. 8 of their Specification?

We answer both of these questions in the negative.

FINDINGS OF FACT

The following findings of fact are supported by a preponderance of the evidence. Additional findings of fact as necessary appear in the Analysis portion of the opinion.

1. There is no dispute that Tonotani describes a plasma CVD apparatus and a CVD method comprising, arranging, in a reaction chamber 1, a plurality of inductively coupled electrodes (16, 17), each electrode arranged parallel in a common plane, having a feeding portion at a first end and a grounded portion at a second end, having a diameter of 10 mm or less partially or entirely between the feeding portion and the grounded portion, and partially or entirely covered with a dielectric (11), wherein the thickness of the dielectric can be varied in the longitudinal direction of the electrode, and a high frequency power source (13) feeds power to the electrodes (see, for example, Figs. 1-4, 22-24, 26-30B, and their descriptions).

2. Tonotani does not expressly disclose that 1) the inductively coupled electrodes are "folded back at the center", nor that 2) there is "a means for controlling a phase of high frequency power" whereby high frequency power is fed "so as to establish a standing wave of a half wavelength or natural number multiple" thereof and "is controlled so as to have a phase difference between the adjacent two feeding portions" as set out in

independent apparatus claim 26. Tonotani likewise does not disclose similar features set out in method claim 38.

3. Appellants' Specification describes the alternative use of either straight line or folded back at the center electrodes (e.g., Spec. ¶ [0015]).[2]

4. A person of ordinary skill in the CVD art would have known that a folded back inductive electrode was a known alternative to a straight line electrode and used in the art as a suitable inductive electrode for generating plasma in an inductive plasma apparatus (Takeuchi Fig. 9, antenna 203; col. 1, ll. 10-28; col. 18, ll. 13-21; Fig. 11A versus Fig. 11D).

5. Structure that corresponds to Appellants' claimed "means for controlling a phase of high frequency power" is a phase shifter (Spec. ¶ [0063]; App. Br. 3).

6. A person of ordinary skill in the CVD art would have known that the use of phase shifter for adjusting the phase in adjacent coils to allow for control of the plasma density and a uniform plasma density within the apparatus was known (Ishii, e.g., Figs. 27-31, phase shifter 174 for RF coils 116, 117; col. 20, ll. 20-64; Hama e.g., Fig. 1; phase shifter 114; col. 9, ll. 5-32).[3]

7. The Examiner found that the generation of the standing wave depends on the length of the electrode and the frequency of the high frequency power.

8. Once a RF power source capable of supplying high-frequency power is provided, the apparatus is capable of generating a standing wave as

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[2] All references are to the Specification as published (US 2004/0020432 A1).

[3] The teachings of Ishii are cumulative of the teachings of Hama.

claimed (e.g., of one half wavelength or a multiple thereof as recited in apparatus claim 26) as found by the Examiner (e.g., Ans. 15).

9. The Examiner concluded that it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the desired degree of phase shift (e.g. 180 degrees as recited in dependent claims 27, 30, 39, and 42) based upon a variety of factors including the desired plasma distribution (e.g., Ans. 15).

10. None of the prior art applied to claims 49 and 51 (which respectively depend from claims 27 and 30) explicitly describes that the distance between the feeding portion and the folded back portion of every other electrode is elongated by the half wavelength outside the reaction chamber as recited in these claims.[4]

11. One of ordinary skill in the CVD art would appreciate that substrates may be arranged on both sides of an inductive electrode (as recited in dependent apparatus claims 28, 31, 34 and 37) in order to increase the throughput of the apparatus, e.g., to allow a large number of substrates to be processed simultaneously (see, Takeuchi Fig. 10, substrates 209a and 209b on both sides of electrode 203; Kinoshita Fig. 4, substrates 3 arranged on both sides of electrodes 21, 22).[5]

12. Independent method claim 38 recites a CVD reaction chamber with similar structural features as in independent apparatus claim 26 and also calls for "feeding high frequency power so as to establish a standing wave of a half wavelength or natural number multiple…". Apparatus claim 26

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[4] Appellants describe this as an alternative to a phase shifter (Spec. ¶ [0063]). This feature is not illustrated in any of the figures.
[5] The teachings of Kinoshiti are cumulative of the teachings of Takeuchi.

similarly recites "whereby high frequency power is fed . . . so as to establish a standing wave of a half wavelength . . ." .

13. Nakagawa teaches a plasma generating apparatus and method in which the standing wave of the radio frequency power applied to the coil is an integral multiple of a ¼ wavelength in order to efficiently and effectively provide an initial discharge to generate plasma (see, e.g., col. 3, ll. 60-65).

14. The Examiner concluded that it would have been obvious to one having ordinary skill in the art to modify the teachings of the combination of references previously applied to apparatus claim 26 (Tonotani, Takeuchi, with Hama or Ishii) so as to perform a depositing method in which the standing wave of the radio frequency power applied to the coil is an integral multiple of a ¼ wavelength in order to efficiently and effectively provide an initial discharge to generate plasma as taught in Nakagawa.

15. The Examiner concluded that it would have been obvious to one having ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum standing wave wavelength value (i.e., the standing wavelength of a half wavelength or multiple thereof as claimed in method claim 38 and apparatus claim 26), based upon, for example, the desired energy to be applied across the antenna coil (Ans. 12).

16. A frequency range of 30MHz to 300 MHz (as recited in dependent method claim 47) for the high frequency power source for the antenna of an inductive plasma apparatus was known to one of ordinary skill in the CVD art (see Nakagawa col. 4, ll. 43-53; Collins, col. 11, ll. 18-28).

PRINCIPLES OF LAW

Pending claims must be interpreted as broadly as their terms reasonably allow. *In re Zletz,* 893 F.2d 319, 321 (Fed. Cir. 1989). An applicant seeking a narrower construction must either show why the broader construction is unreasonable or amend the claim to state expressly the scope intended. *In re Morris*, 127 F.3d 1048, 1057 (Fed. Cir. 1997).

In analyzing obviousness, the scope and content of the prior art must be determined, the difference between the prior art and the claim ascertained, and the ordinary level of skill in the art resolved. *Graham v. John Deere Co. of Kansas City,* 383 U.S. 1, 17 (1966). The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1739-40 (2007). As stated in *KSR*, "any need or problem known in the field of endeavor at the time of the invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.* at 1742.

"[A] reasonable expectation of success, not absolute predictability" supports a conclusion of obviousness *In re Longi*, 759 F.2d 887, 897 (Fed. Cir. 1985).

Non-obviousness cannot be established by attacking references individually when the rejection is based upon the teachings of a combination of references. *In re Merck & Co. Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). A teaching, motivation, or suggestion may be implicit from the prior art as a whole, rather than expressly stated in the references. *In re Kahn*, 441 F.3d 977, 987-88 (Fed. Cir. 2006).

A prior art reference is not limited to what is preferred, but may be relied upon for all that it teaches. *See Merck & Co., Inc. v. Biocraft Laboratories, Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989). The disclosure of a reference is not limited what is disclosed in the examples. *In re Heck*, 699 F.2d 1331, 1332-33 (Fed. Cir. 1983).

As for objective evidence of non-obviousness, in order for a showing of "unexpected results" to be probative evidence of non-obviousness, it falls upon the Appellants to at least establish: (1) that there actually is a difference between the results obtained through the claimed invention and those of the prior art; and (2) that the difference actually obtained would **not** have been expected by one skilled in the art at the time of invention. *In re Freeman*, 474 F.2d 1318, 1324 (CCPA 1973).

In order to prove unexpected results, the invention must be compared with the closest prior art. *In re Payne*, 606 F.2d 303, 316 (CCPA 1979). Evidence of unexpected results must be reasonably commensurate in scope with the claimed invention. *In re Greenfield*, 571 F.2d 1185, 1189 (CCPA 1978).

ANALYSIS

Appellants contend that the fact that various features were known in the art does not provide motivation for modifying Tonotani to include those features (Appeal Br. 6-13; Reply Br. 1-11). We disagree. Appellants repeatedly attack the references individually when the Examiner uses a combination of references to reject the claims (e.g., Ans. 4-10). The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the

references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

The applied prior art recognizes the desirability of uniformity of the film deposition in the CVD art, thus, the Examiner's rationale that a person of ordinary skill in the art would have been motivated to use the prior art features to enhance or optimize the uniformity of the deposition process is reasonable (Findings 1-16). It appears that Appellants are merely combining known elements in the prior art to obtain predictable results of improved film uniformity. The combination of familiar elements according to known methods is likely to be obvious when it does not more than yield predictable results. *KSR Int'l Co.* 127 S. Ct. at 1739-40. Appellants have not provided any convincing line of reasoning or evidence that the apparatus or method claimed produces any unpredictable results. Thus, Appellants have not shown reversible error.

Appellants also contend that in Takeuchi, "none of these [antenna] shapes reflects the [claimed] folded back electrode configuration" (App. Br. 10). We disagree. We take the broadest reasonable interpretation of the contested limitation in view of the Specification. Appellants have not pointed us to any specific definition of "folded back" in their Specification. Examples illustrated in the Specification (e.g., "U-shaped") may not be read into the claimed language. The broadest reasonable interpretation of a "folded back" shape, as pointed out by the Examiner, encompasses the "folded back" electrode Fig. 11A of Takeuchi which is suitable for generating plasma in an inductive plasma apparatus.

Appellants argue that the Examiner did not identify any reason to modify the phase shifters in Hama or Ishii to control the high frequency power as claimed. As Appellants admit, the "means for controlling" may be a phase shifter (e.g., App. Br. 3). Hama or Ishii each demonstrates that a phase shifter is desirable to improve uniformity of the deposition in CVD apparatus. Thus, one of ordinary skill in the art would have appreciated that the use of a known feature of a phase shifter for its known advantage in a CVD apparatus of the combined Tonotani/Takeuchi prior art would have been the predictable use of a known prior art element for its intended purpose. The Examiner's interpretation of apparatus claim 26, that the apparatus need only be *capable of* generating a standing wave as claimed, is reasonable. It is well established that while the features of an apparatus claim may be recited functionally, the apparatus must be distinguished from the prior art in terms of structure, rather than function. *See In re Schreiber,* 128 F.3d 1473, 1477 (Fed. Cir. 1997). Thus, claim 26 is rendered obvious by the combined teachings of Tonotani, Takeuchi, with Ishii or Hama.

Furthermore, as necessary, the Examiner applies Nakagawa which explicitly describes a CVD method wherein the standing wave of the radio frequency power applied to the antenna coil is an integral multiple of a ¼ wavelength in order to efficiently and effectively provide an initial discharge to generate plasma in the CVD method. Assuming arguendo that the apparatus claim 26 is interpreted to require that the apparatus generates such a wave (as opposed to merely *being capable of* generating such a wave), we agree with the Examiner that optimizing the frequency of the wave would have been within the skill of the art in view of the combined teachings of the applied prior art, including Nakagawa.

Appellants further contend that the ¼ wavelength taught in Nakawaga is not the claimed correlation of the length of the folded back electrode to half the wavelength as claimed (Reply Br. 4). However, one of ordinary skill in the art following the teachings of the Nakagawa to use an integral multiple of ¼ wavelength would appreciate the *de facto* correspondence to the claimed correlation of "a half wavelength or natural number multiple" thereof. Furthermore, the prior art applied reflects that the frequency applied, the wavelength pattern applied, and the degree of phase shift are all known variables for generating a uniform plasma in the CVD art. Further, Appellants have not shown that the improvement was "uniquely challenging or difficult for one of ordinary skill in the art" or "represented an unobvious step over the prior art." *Leapfrog Enters., Inc. v. Fisher-Price, Inc.,* 485 F.3d 1157, 1162 (Fed. Cir. 2007). Thus, Appellants have not shown the Examiner erred in the § 103 rejections, of either apparatus claim 26 or method claim 38, which further rely on Nakagawa.

Dependent apparatus claims 49 and 51

Appellants contend that the feature claimed is not taught or suggested in the prior art (App. Br. 15, 16; Reply Br. 6, 7).

The Examiner concluded that it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum claimed distance based upon a variety of factors including the desired plasma distribution (e.g., Ans. 16).[6]

The Examiner's position seems reasonable since the prior art establishes that the phase difference between adjacent electrodes is a known

[6] Appellants' Specification describes the feature of dependent claims 49 and 51 as an alternative to the use of a phase shifter (Spec. ¶ [0063]).

result effective parameter for a uniform plasma distribution (see, e.g., Hama col. 9, ll. 5-30). The distance relationship claimed appears to be no more than an alternative mechanical arrangement to the known use of a "phase shifter" to obtain the desired 180 degree phase difference. The Appellants do not provide any convincing reasoning why the Examiner's position is in error.

Dependent Method Claim 47

Appellants argue in the Reply Brief that the high frequency power supply of Collins "would not function" in accordance with claim 47 (Reply Br. 11). This argument is unpersuasive since Collins exemplifies the use of frequencies in the claimed range of "60MHz or higher" (as recited in claim 47) for a plasma deposition process (Collins, col. 11, ll. 18-28). In any event, Nakagawa also provides evidence that a frequency of 60MHz or higher as claimed in dependent claim 47 was known in the CVD art (Finding 16).

Evidence of unexpected results

Dependent claims 27, 30, 39, 42, 49, and 51

Appellants argue that Fig. 8 of the Specification shows the criticality of the claimed phase difference of 180 degrees (as recited in claims 27, 30, 39 and 42), as well as the criticality of claims 49 and 51 (which respectively depend from claim 27 and claim 30) (e.g., App. Br. 14-16; Reply Br. 5-15[7]).

The burden rests with Appellants to establish that the results are unexpected, based on comparisons with the closest prior art, and

[7] Appellants' remarks in the Reply Brief regarding "Fig. A" have not been considered as this evidence was not timely presented to the Examiner (Reply Br. 14-16).

commensurate in scope with the claimed subject matter. *See, e.g., In re Kulling,* 897 F. 2d 1147, 1149 (Fed. Cir. 1990). We determine that Appellants have not met this burden. Specification Fig. 8 shows a comparison of the film thickness distributions on a substrate when using a dielectric covering on the electrodes of the CVD chamber versus the non-use of a dielectric coating on the electrodes (Spec. [0076]- [0077]). It is undisputed that the primary reference Tonotani teaches the use of a dielectric covering on the electrodes. To the extent that the Appellants are alleging that the claimed subject matter exhibits unexpected results, the Appellants have failed to establish that any benefits obtained with the claimed CVD apparatus and method would have been unexpected. *Freeman*, 474 F.2d at 1324.

Further, Appellants have not established unexpected results for an apparatus or method commensurate in scope with the subject matter sought to be patented. *Greenfield*, 571 F.2d at 1189; *see also In re Dill,* 604 F.2d 1356, 1361 (CCPA 1979). For example only, Appellants have not satisfactorily explained why the evidence provided by alleged inventive Specification Example 2 (whose results are shown in Fig. 8), which uses "film formation of a-Si film on glass substrates" in an apparatus with six electrodes of specified lengths and spacing, covered with 1mm thick TEFLON® as the dielectric material, is sufficient. None of the claims is limited to such a method or apparatus. For the foregoing reasons, Appellants have not shown reversible error.

Remaining arguments

We have considered Appellants' remaining arguments and find none that warrant reversal of the Examiner's rejection(s). *Cf. Hartman v. Nicholson*, 483 F.3d 1311, 1315 (Fed. Cir. 2007).

CONCLUSION

Appellants have not shown reversible error in the Examiner's determination that a person having ordinary skill in the art would have found it obvious to arrive at the invention of claims 26-32, 34, 35, 37-44 and 46-51 in view of the applied prior art.

Appellants have not overcome the prima facie case of obviousness with evidence of unexpected results via Fig. 8 of their Specification.

It follows that we sustain all of the § 103 rejections advanced by the Examiner in this appeal.

ORDER

The Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a) (2007).

AFFIRMED

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