

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TED KO and MING-HSING TSAI

Appeal 2008-1014
Application 10/407,129
Technology Center 1700

Decided : May 20, 2008

Before RICHARD E. SCHAFER, RICHARD TORCZON, and SALLY
GARDNER LANE, *Administrative Patent Judges*.
LANE, *Administrative Patent Judge*.

DECISION ON APPEAL

I. STATEMENT OF THE CASE

Appellants appeal from the Final Rejection of claims 1-3, 6-10, and 12-14. 35 U.S.C. § 134. We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

The application was filed on April 3, 2003. The real party in interest is said to be Taiwan Semiconductor Manufacturing Company, Ltd. (App. Br. at 2).

The following U.S. patents were relied upon by the Examiner:

<u>Name</u>	<u>Patent/Publication No.</u>	<u>Issue/Publication Date</u>
Jones	5,778,554	Jul. 14, 1998
Dubin	6,491,806	Dec. 10, 2002
Wen	US 2004/0118697	Jun. 24, 2004

Appellants did not dispute the prior art status of any of these references.

The Examiner rejected claims 1, 3, and 6-7 under 35 U.S.C. § 103(a), over the combination of the teachings of Wen and Dubin. (Ans. at 3-5).

The Examiner also rejected claims 2, 8-10, and 12-14 under 35 U.S.C. § 103(a), over the combination of the teachings of Wen, Dubin, and Jones. (Ans. at 5-7).¹

We review each ground of rejection for a selected, representative claim because Appellants did not separately argue the rejection of any of the claims. *See* App. Br. at 11, 12, and 14; *see* Bd. R. § 41.37(c)(1)(vii).

II. Findings of Fact

Claims

1. Claim 1 recites:

A method of improving surface mobility of a metal seed layer in an integrated circuit before electroplating, comprising:
applying an organic solvent to a surface of said metal seed layer, the organic solvent including compounds contained in an electrolytic solution; and
immersing said metal seed layer in said electrolytic solution for electroplating.

¹ The Examiner rejected the group of claims 1 and 8 separately from the group of claims 9-10 and 12-14, but both groups are rejected under 35 U.S.C. § 103(a) over the combination of the teachings of Wen, Dubin, and Jones. (Ans. at 5-7).

2. Claim 2 recites:

The method of claim 1 further comprising:
removing superfluous organic solvent from the surface of
said metal seed layer.

3. Claim 9 recites:

A method of improving surface mobility of a metal seed
layer in an integrated circuit, comprising:
applying a solvent to a surface of said metal seed layer;
removing superfluous solvent from the surface of said
metal seed layer;
immersing said metal seed layer in an appropriate
electrolyte solution containing organic compounds as additives;
and
electroplating;
wherein said solvent includes said organic compounds.

Specification

4. Appellants' specification notes that "it is important to have a
high quality of electroplating to ensure proper electrical connections."
(Spec. at 2).

5. Appellants' specification discloses: "A thin film of the solvent
. . . is formed on the surface of the metal seed layer . . . to improve surface
mobility." (Spec. at 3, ll. 11-12).

6. Appellants' specification provides for adding "de-ionized water
or an organic solvent, for example polyethylene glycol," (*id.* at 3, ll. 3-4), to
an "electrolyte solution," (*id.* at 3, l. 16).

7. The only other components of the "electrolyte solution"
provided in Appellants' specification are "metal ions such as copper ions
. . . ." (*id.* at 3, l. 13).

Wen

8. The disclosure of Wen relates to pre-cleaning a metal seed layer prior to forming an electrochemically deposited metal fill layer. (Wen at abstract).

9. The problem that Wen addresses is providing “inexpensive and efficient techniques for eliminating oxide layers, contaminants and the like from a metal seed layer prior to fill layer deposition, as well as to provide inexpensive and efficient techniques for generally limiting the potential for air bubbles to be formed on a seed layer” (*Id.* at, ¶ [0010]).

10. In one solution of this problem, Wen discloses “providing a substrate having a metal seed layer, and exposing the metal seed layer to an organic solvent” (*id.* at ¶ [0014]), as a “liquid pre-clean” (*id.* at [0018]).

11. Wen teaches that the method “further includes depositing a metal fill layer on the metal seed layer by electrochemical deposition.” (*Id.*).

12. Figure 4 of Wen discloses the sequence of pre-cleaning and “ECD,” (*id.* at ¶ [0024]), wherein “ECD” is defined as “electrochemical deposition” in paragraph [0004].

13. Wen provides for a metal seed layer that is copper. (*Id.* at ¶ [0028]).

14. Wen discloses that the “pre-cleaning liquid . . . may include an additive suppressor solution for electrochemical plating such as polyethylene glycol.)” (*Id.* at [0040]; *see also id.* at [0041]).

15. Wen also discloses that the pre-cleaning liquid can be applied as an agitated rinse, wherein the semiconductor substrate is sprayed with the pre-cleaning liquid and then rotated on a “rotatable substrate support or other similar mechanism.” (*Id.* at ¶ [0037]).

16. Wen does not disclose use of an “organic solvent including compounds contained in an electrolytic solution.”

Dubin

17. Dubin relates generally to electroplating (Dubin at col. 1, l. 7) and more specifically to copper electroplating bath compositions. (*Id.* at col. 2, ll. 17-18¶).

18. A problem recognized by Dubin is “the formation of defects such as voids in metallization.” (*Id.* at col. 1, ll. 22-23).

19. Dubin provides “an electroplating bath composition and process that overcomes the problems of the prior art.” (*Id.* at col. 1, ll. 49-50).

20. The “plating bath composition” of Dubin “is preferably an aqueous electroplating composition” and comprises copper, among other components. (Dubin at col. 2, ll. 31-38).

21. The “inventive plating bath composition” of Dubin includes at least one additive, including a “suppressing agent.” (*Id.* at col. 2, ll. 32-38).

22. The “suppressing agents” of Dubin include polyethylene glycol. (*Id.* at col. 4, ll. 33-37).

23. We understand, and Appellants have not argued otherwise, that a “suppressing agent” is the same as an “additive suppressor.”²

24. Dubin also discloses that “pretreatment may include organic and inorganic solvents . . . ,” referring to a pre-cleaning step performed before the semiconductor structure is placed into the “inventive plating bath composition.” (*Id.* at col. 6, ll. 56-65).

² Both Wen and Dubin specifically identify polyethylene glycol as an “additive suppressor” or “suppressing agent”, respectively.

25. Dubin discloses pre-cleaning with an organic solvent and electroplating in a bath composition that includes polyethylene glycol.

Jones

26. Jones is directed to a mechanism that “reliably yields a clean, dry wafer suitable for further processing.” (Jones at col. 1, ll. 46-49).

27. Jones provides a system of applying a “rinse liquid” to the wafer and rotating the wafer “to create a centrifugal force which removes the liquid from the good side of the wafer.” (Jones at col. 1, ll. 55-60).

III. Issues

The issues are:

(1) Whether the Examiner erred in rejecting claims 1, 3, and 6-7 as being obvious under 35 U.S.C. § 103(a), over Wen and Dubin.

(2) Whether the Examiner erred in rejecting claims 2 and 8 as being obvious under 35 U.S.C. § 103(a), over Wen, Dubin, and Jones.

(3) Whether the Examiner erred in rejecting claims 9-10 and 12-14 as being obvious under 35 U.S.C. § 103(a), over Wen, Dubin, and Jones.

IV. Legal Principles

To determine whether subject matter would have been obviousness, “the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. . . . Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.” *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17-18 (1966).

When elements of an invention are found in multiple references,

[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

KSR Int'l Co. v. Teleflex Inc., 127 S.Ct. 1727, 1740-41 (2007).

An “[obviousness] analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *Id.* at 1741. Indeed, “[u]nder the correct analysis, any need or problem known in the filed of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* at 1742.

V. Analysis

While we do not read limitations from the specification into the claims, we give claims their broadest reasonable construction in view of the specification. *See Elektra Instr. S.A. v. O.U.R. Sci. Int'l, Inc.* 214 F.3d 1302, 1307 (Fed. Cir. 2000). The only mention of a method where the organic solvent and the electrolytic solution contain the “same compounds” in Appellants’ specification is at page 3, ll. 23-25, which states: “Moreover, the electrolyte solution contains some additives which are organic compounds in most cases. Thus, applying organic solvents with the same compounds as that of electrolyte solution has less of an adverse effect in the composition of electrolyte solution.” We note further that the specification recites only one

organic solvent, polyethylene glycol (FF³ 6), and that beyond metal ions, the specification does not disclose specifically what “same compounds” are in both the claimed organic solvent and electrolyte solutions (FF 7).

Claims 1, 3, 6, and 7

Claim 1, which is representative, recites:

A method of improving surface mobility of a metal seed layer in an integrated circuit before electroplating, comprising:
applying an organic solvent to a surface of said metal seed layer, the organic solvent including compounds contained in an electrolytic solution; and
immersing said metal seed layer in said electrolytic solution for electroplating.

(FF 1).

Wen teaches a method of improving a metal seed layer during electrochemical plating by pre-cleaning it with an organic solvent. (FF 8-10). Wen further teaches that the metal seed layer will then be used in electrochemical deposition, such as electrochemical plating with copper. (FF 11-13). Wen teaches including an additive suppressor, such as polyethylene glycol, to a pre-cleaning solution (FF 14). Wen differs from the claimed invention in that Wen does not teach an “organic solvent including compounds contained in an electrolytic solution.” (FF 16),

Like Wen, the specification of Dubin addresses problems of semiconductor fabrication electroplating. (FF 17-19). Dubin teaches a plating bath composition that is an aqueous electroplating composition (FF 20) and can include suppressing agents, such as polyethylene glycol. (FF 21-22).

Wen and Dubin both teach the steps of:

³ Finding of Fact.

- (1) pre-cleaning with an organic solvent,
- (2) followed by electroplating using an electrolytic solution

Neither Wen nor Dubin teaches that “the organic solvent includ[es] compounds contained in an electrolytic solution.” However, if one were to use the pre-cleaning liquid of Wen, which contains an “additive suppressor” such as polyethylene glycol (FF 14), and the electroplating bath composition of Dubin, which also contains a “suppressing agent,” such as polyethylene glycol (FF 21-22), then “the organic solvent includ[es] compounds contained in an electrolytic solution.” (Claim 1).

Wen teaches that pre-cleaning with its solution gives the advantage of removing contaminants from metal seed layers to avoid introducing air bubbles on the seed layer (FF 9), while Dubin teaches that electroplating with its solution gives the advantage of avoiding the formation of defects, such as voids (FF 18). Thus, one skilled in the art would have had a good reason to combined the two solutions, i.e., for the purpose of achieving an improved electroplating process.

We note that combining known components for their known purposes is likely to be obvious where only a predictable result is achieved. *KSR*, 127 S.Ct. at 1740 (“when a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious” (citing *Sakraida v. Ag Pro, Inc.* 425 U.S. 273, 282 (1976))). In addition, “when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element of another known in the field, the combination must do more than yield a predictable result.” *Id.* (citing *United States v. Adams*, 383 U.S. 39, 50-51 (1966)). Appellants have

not directed us to evidence showing that any unexpected result is achieved by the claimed invention compared to the combined Wen and Dubin teachings.

The claimed invention recites the preamble language a “method of improving surface mobility” of a metal seed layer (FF 1). Appellants acknowledge that the improvement in surface mobility results from application of the organic solvent to the semiconductor surface. (See FF 5; Spec. at 3, ll. 11-12 (“[a] thin film of the solvent . . . is formed on the surface of the metal seed layer . . . to improve surface mobility.”)). Wen and Dubin each teach applying an organic solvent to the semiconductor surface. The recited preamble language, even though not found expressly in the references, only recognizes the result of the taught process and does not serve to distinguish the claims. See *In re Tomlinson*, 363 F.2d 928, 934 (C.C.P.A. 1966) (“As to the introductory language, ‘a process of inhibiting degradation of polypropylene caused by exposure to light,’ again we do not think these words can serve to patentably distinguish the claimed process from the prior art. That language in effect, states the *result* of admixing the two materials. While the references do not show a specific recognition of that result, its discovery by appellants is tantamount only to finding a property in the *old composition*, not in the nickel compound for which, it is argued, a new use has been found.”).

Appellants argued that Wen taken with Dubin does not render claim 1 obvious because Wen is “directed to the pre-cleaning operation that takes place prior to electrochemical deposition (i.e. electroplating) and NOT the electrochemical deposition itself.” (App. Br. at 6). Appellants also asserted that “Wen does not apparently contemplate or address the concerns or

shortcomings thereof, much less any techniques or practices associated with improving the electroplating process.” (*Id.* at 7).

We disagree that Wen does not contemplate the electrochemical process. In contrast to Appellants’ assertion, Wen expressly teaches “depositing a metal fill layer onto the metal seed layer by electrochemical deposition” after first exposing the metal seed layer to an organic solvent, as provided in Appellants’ claim 1. (FF 10).

Appellants also argued that “[n]othing in Wen suggests a common organic or other compound among the wet or dry pre-cleaning solutions and the electrolytic solution used for electrochemical plating.” (App. Br. at 7; FF 16). As noted above, Wen discloses adding an additive suppressor, e.g., polyethylene glycol to a pre-cleaning solution (FF 14) and Dubin discloses adding a suppressing agent, e.g., polyethylene glycol to an electroplating bath solution (FF 21 and 22). As explained above, one skilled in the art would have had reason to combine the pre-cleaning solution of Wen with the electroplating bath solution of Dubin. Thus, the combination of Wen and Dubin teaches the claimed method. Appellants’ arguments that Wen itself does not disclose each feature of the claimed invention are not persuasive since the Examiner’s rejection was based upon a combination of references. *See In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (“Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.”).

Appellants also argued that “Dubin does not mention, much less discuss, any pre-treatments and his invention is directed to, by itself, preventing anomalies and voids in the interconnect structures using his

electroplating bath composition and waveform potential.” (App. Br. at 8). We disagree that Dubin does not contemplate pretreatments because it expressly provides that “pretreatment may include organic and inorganic solvents” (FF 24). At any rate, one skilled in the art would have had reason to use the pre-treatment described in Wen, i.e., to obtain the benefits disclosed by pre-cleaning as disclosed by Wen. As with Wen, Appellants’ arguments that Dubin itself does not disclose each feature of the claimed invention are not persuasive since the Examiner’s rejection was based upon a combination of references.

Appellants argue that “the Examiner has impermissibly combined the references using hindsight reconstruction,” (App. Br. at 9), and that “[t]he references provide no suggestion and do not address, or even identify, the problem solved by the claimed invention,” (*id.* at 11). As stated above, we determine that the common goal of optimizing electroplating surfaces and a desire to achieve the advantages taught in Wen and Dubin is a sufficient reason why those in the art would have combined the teachings of Wen and Dubin (*see* FF 8-10, and 17-19). Appellants have not directed us to evidence showing that any unexpected result was achieved by combining the known pre-cleaning solution of Wen with the known electroplating bath of Dubin.

In the Reply Brief, Appellants proposed that the claimed subject matter presents the “advantage of both increased surface mobility due to the pre-treatment solution and uniformity in the electroplating solution which provides the advantages of uniform electroplating and obviates the need to adjust the composition of the electroplating solution.” (Reply Br. at 3). Appellants did not direct us to any evidence or testimony establishing that such advantages were achieved or that such advantages would have been

unexpected by those skilled in the art. Unexpected results must be established with factual evidence, not attorney arguments or conclusory statements *In re Geisler*, 116 F.3d 1465, 1469-70 (Fed. Cir. 1997). Therefore, Appellants have not demonstrated any purported results to be unexpected.

In addition, Appellants referred to a “long-standing problem and need that persisted in the art and the inventor’s solution,” (*id.*), but again fail to direct us to any evidence to support the existence of this problem or need. Actual evidence of secondary considerations is necessary to rebut a prima facie case for obviousness, *see In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006) (“our precedent requires that the applicant submit actual evidence of long-felt need, as opposed to argument.”). “Argument of counsel cannot take the place of evidence lacking in the record.” *Meitzner v. Mindick*, 549 F.2d 775, 782 (CCPA 1977).

Finally, Appellants argued that “the Examiner could *only* have arrived at the particular combination of references to yield the claimed ‘common components’ . . . after having used Applicants’ claimed invention as roadmap” (Reply Br. at 4), and cited the different options for the components of the pre-cleaning liquid and plating bath composition provided by Wen and Dubin, respectively. However, Wen teaches that an “additive suppressor” (.e.g, polyethylene glycol) is a part of the pre-cleaning liquid of its invention and Dubin teaches that a “suppressing agent” (which we understand to be the same as an additive suppressor” (FF 23)(e.g., polyethylene glycol) may be added to the plating bath composition of its invention. Thus, Wen requires and Dubin allows for an additive suppressor (i.e., suppressing agent). Given the limited number of options allowed for

by the references and the failure of Appellants to direct us to evidence showing any criticality to the selection of a common component for use in each step of the claimed process, the claimed process would have been obvious. *See Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989).

Because the Examiner has presented a prima facie case of obviousness, which is not rebutted by Appellants, we conclude that the Examiner did not err in rejecting claim 1 as being unpatentable under 35 U.S.C. § 103(a) over Wen and Dubin.

Claims 2 and 8

Claim 2, as the representative claim for this rejection, depends from claim 1 and requires “removing superfluous organic solvent from the surface of said metal seed layer.” (FF 2).

Wen and Dubin teach a two part process for electroplating. Neither Wen nor Dubin expressly teaches “removing superfluous organic solvent from the surface of said metal seed layer.”

Jones is directed to a mechanism for providing “clean, dry wafers⁴ suitable for further processing.” (FF 26). To accomplish this goal, Jones proposes a spin drying system, wherein a “rinse liquid” is applied to the wafer and the wafer is rotated “to create a centrifugal force which removes the liquid from the good side of the wafer.” (FF 27). This mechanism is similar to the rotating mechanism proposed by Wen for an agitated rinse during pre-cleaning (FF 15), but is described by Jones as a drying system. Thus it appears that Wen uses a system which would result in the removal of

⁴ We understand the term “wafer” to mean the substrate on which an integrated circuit is formed, for example by electroplating.

superfluous organic solvent from the surface of the metal seed layer. At any rate, it would have been obvious to use the drying system as taught in Jones and achieve the limitation of “removing superfluous organic solvent from the surface of said metal seed layer” since Jones teaches that removing the fluid results in wafers that are clean, dry and suitable for further processing.

Appellants argued that “Jones does not teach electroplating or any other electro- or chemical deposition process but is directed solely to a Spin Dryer apparatus and method for rinsing wafers with water and drying them.” (App. Br. at 12). Jones is not relied upon for the teaching of electroplating. Instead, Jones would have informed one skilled in the art of a method for obtaining clean and dry wafers that are suitable for further processing.

The Examiner has presented a prima facie case of obviousness. Appellants have not directed us to any evidence of unexpected results or other secondary considerations. We determine that the Examiner did not err in rejecting claims 2 and 8.

Claims 9-10 and 12-14

Representative claim 9 recites:

A method of improving surface mobility of a metal seed layer in an integrated circuit, comprising:
applying a solvent to a surface of said metal seed layer;
removing superfluous solvent from the surface of said metal seed layer;
immersing said metal seed layer in an appropriate electrolyte solution containing organic compounds as additives; and
electroplating;
wherein said solvent includes said organic compounds.

(FF 3).

For the reasons stated above in regard to the rejection of claim 1, the combination of Wen and Dubin would have rendered obvious a method of applying a solvent containing an organic compound to the surface of a metal seed layer and immersing the metal seed layer in an electrolytic compound that contains the same organic compound. In addition, as explained above in regard to the rejection of claim 2, the combination of Wen, Dubin, and Jones teach removal of the superfluous solvent from the surface of the metal seed layer obvious. Appellants' arguments against the rejection of claim 9-10 and 12-14 are the same as its arguments against the rejection of claims 2 and 8, (*see* App. Br. at 13-14). For the same reasons stated above as to claim 2 and 8, we determine that the Examiner did not err in rejecting claims 9-10 and 12-14.

VI. Order

Upon consideration of the record and for the reasons given, it is

ORDERED that the Examiner's rejection of claims 1-3, 6-10, and 12 under 35 U.S.C. § 103(a) is AFFIRMED.

AFFIRMED

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