

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HUI WANG

Appeal 2007-2657
Application 09/837,911
Technology Center 1700

Decided: July 14, 2008

Before CHARLES F. WARREN, THOMAS A. WALTZ, and
JEFFREY T. SMITH, *Administrative Patent Judges*.

SMITH, *Administrative Patent Judge*.

DECISION ON APPEAL

Statement of the Case

This is an appeal under 35 U.S.C. § 134 from a final rejection of claims 110-129, 133-152, and 156-159. We have jurisdiction under 35 U.S.C. § 6.

Appellant's invention relates to a method and apparatus for plating a film to a desired thickness on a surface on a substrate. An understanding of Appellant's invention can be gleaned from independent claims 110 and 113 which appear below:

110. A method for plating a film to a desired thickness on a surface of a substrate, comprising:

providing a plurality of stacked plating modules and a substrate transferring mechanism;

picking up a substrate from a substrate holder with the substrate transferring mechanism;

loading the substrate into a first one of the stacked plating modules with the substrate transferring mechanism;

positioning the substrate within a bath in the first one of the stacked plating modules, the bath divided by a first wall and at least a second wall, wherein the first wall is adjacent to a first portion of the substrate and the at least second wall is adjacent to at least a second portion of the substrate when the substrate is positioned within the bath, wherein the first portion and the second portion are portions of the same surface on the substrate;

plating the film to the desired thickness on the first portion of the substrate in the first one of the stacked plating modules; and

after plating the film on the first portion of the substrate, plating the film to the desired thickness on the at least second portion of the substrate in the first one of the stacked plating modules, wherein, the second portion is at a different radial location than the first portion.

113. An automated tool for plating a film on a substrate, the substrate being a semiconductor wafer, comprising:

at least two plating baths positioned in a stacked relationship, wherein each of the at least two plating baths is divided by a first wall and at least a second wall, wherein each of the at least two plating baths includes a first anode adjacent to the first wall and a second anode adjacent to the at least second wall, wherein

the first and second anode are connected to a first power supply and a second power supply, respectively, and wherein the first and second power supplies are configured to alternate in providing power to the first and second anodes, respectively;
at least one substrate holder;
a substrate transferring mechanism;
a frame supporting said plating baths, said substrate holder and said substrate transferring mechanism; and
a control system in communication with said substrate transferring mechanism, substrate holder and said plating baths configured to continuously perform uniform film deposition on the substrate.

The Examiner relies on the following references in rejecting the appealed subject matter:

Hirohiko, as translated	JP 04-311591	Nov. 4, 1992
Van Raalte	3,880,725	Apr. 29, 1975
Kubo	5,326,455	Jul. 5, 1994
Andricacos	5,522,975	Jun. 4, 1996
Dubin	5,882,498	Mar. 16, 1999
Kobayashi	5,925,227	Jul. 20, 1999
Fairbairn	6,176,667 B1	Jan. 23, 2001
Davis	6,477,440 B1	Nov. 5, 2002

A. Kenneth Graham and H. L. Pinkerton, *Heating and Cooling Equipment*, Electroplating Engineering Handbook, second edition”, Reinhold Publishing Corporation, New York, 534-535 (1962).

The Examiner finally rejected the appealed claims 110-129, 133-152, and 156-159 as follows:

- A. Claims 110, 119, 122, 123,127, and 129 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko.¹
- B. Claims 111, 112, 124-126 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and Dubin;
- C. Claims 120 and 121 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and Andricacos.
- D. Claim 128 stands rejected under 35 U.S.C. § 103(a) over Fairbairn view of Hirohiko and Kobayashi.
- E. Claims 113, 115-116, 118,137, and 141-143 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or Kubo.
- F. Claims 114, 138, 139, 144-150 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or Kubo and Dubin.
- G. Claim 117 stands rejected under 35 U.S .C. § 103(a) over Fairbairn view of Hirohiko and further in view of Van Raalte or Kubo and Davis.
- H. Claim 140 stands rejected under 35 U.S .C. § 103(a) over Fairbairn in view of the Hirohiko and further in view of Van Raalte or Kubo and Kobayashi.
- I. Claims 151 and 152 stand rejected under 35 U.S .C. § 103(a) over Fairbairn in view of the Hirohiko and further in view of Van Raalte or Kubo and Dubin and Kobayashi.

¹ An English-language translation of the Hirohiko document has been provided in the present record.

J. Claims 133-135 and 156-158 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Kimhiko and further in view of Van Raalte or Kubo and Andricacos.

K. Claims 136 and 159 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or Kubo and Andricacos and the Electroplating Engineering Handbook.

We have thoroughly reviewed each of Appellant's arguments for patentability. However, we are in complete agreement with the Examiner that the claimed subject matter would have been obvious to one of ordinary skill in the art within the meaning of § 103 in view of the applied prior art. Accordingly, we affirm the Examiner's rejections for substantially the reasons set forth by the Examiner in the Answer, which we adopt and incorporate herein.

Under 35 U.S.C. § 103, the factual inquiry into obviousness requires a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) secondary considerations, if any. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). “[A]nalysis [of whether the subject matter of a claim would have been obvious] 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.” *KSR Int’l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740-41 (2007) quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969) (“Having established that this knowledge was in the art, the examiner could then properly rely, as put forth by the solicitor, on a conclusion of obviousness ‘from common knowledge and common sense of the person of

ordinary skill in the art without any specific hint or suggestion in a particular reference.”); *In re Hoeschele*, 406 F.2d 1403, 1406-07 (CCPA 1969) (“[I]t is proper to take into account not only specific teachings of the references but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. . .”).

*Method claims 110-112 and 119-129.*²

- A. Claims 110, 119, 122, 123,127, and 129 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko.³
- B. Claims 111, 112, 124-126 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and Dubin;
- C. Claims 120 and 121 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and Andricacos.
- D. Claim 128 stands rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and Kobayashi.

Appellants have not contested the Examiner's prima facie case for combining the teachings of Fairbairn and Hirohiko. Rather, Appellants contend that Hirohiko discloses plating across the entire surface of the wafer at one time and therefore does not teach the use of different plating rates for different portions of the metal film. (App. Br. 8). Appellants also contend that the Examiner has failed to cite explicit disclosure from Hirohiko to support the Examiner's assertion that different plating rates are used to plate different portions of the metal film. (App. Br. 7).

² For these rejected claims Appellants have limited their arguments to claim 110. We will do likewise.

³ An English-language translation of the Hirohiko document has been provided in the present record.

The issue before us is whether Appellants have shown that the Examiner reversibly erred in rejecting the claims under 35 U.S.C. § 103. Based on the contentions of Appellants, the issue turns on whether Hirohiko discloses or suggests different plating rates are used to plate different portions of the metal film.

The language of the claimed invention specifies “plating a film to a desired thickness on a first portion of the substrate and after plating the film on the first portion of a substrate, plating the film to the desired thickness on at least a second portion of the same substrate.” We agree with the Examiner (Ans. 5) that this language does not require the plating that's occurring on the first portion of the substrate to cease prior to plating initiating on the second portion of the substrate. Appellants have not directed us to evidence on this record that establishes that the plating of the first portion must be complete prior to initiation of plating on the second portion.

Regarding the plating rate, Hirohiko discloses that as the plating solution flows a plating reaction occurs, and as the plating solution keeps flowing from the center part towards the outer peripheral area and new plating solution from the cylindrical spaces (123) joins the flow. (Hirohiko [0023]). Thus, Hirohiko discloses that when the plating solution reaches the substrate the plating reaction is initiated and this initiation of the plating reaction is equivalent to the first portion specified by the claimed invention. The subsequent application of plating solution including the addition from the cylindrical spaces is equivalent to the claimed second portion of the substrate. Hirohiko recognizes that precisely uniform films are not obtainable. Hirohiko observes that when using a conventional plating device

and a device of the disclosed invention there is variation in film distribution across the wafer. (Hirohiko [0028]). Consequently we agree with the Examiner (Ans. 6) that the control of the plating reaction in Hirohiko “is not sufficiently precise to obtain perfectly uniform deposition at all radial positions, and a second portion is plated at a slightly slower rate than a first portion. As deposition across the entire substrate continues, the second portion reached the desired thickness at some time after the first portion as now recited in claim 110.”

Appellant contends that the Examiner's definition of the phrase “desired thickness” as any thickness is unreasonable and contrary to its ordinary meaning. Appellant further contends “that the ordinary meaning of ‘desired thickness’ is any thickness that is wanted. (App. Br. 7).

We do not find Appellants’ position persuasive. Appellant’s description of desired thickness as any thickness that is wanted does not exclude the Examiner's definition of the phrase. The Appellant has not identified a particular thickness that is suitable for the claimed invention. Appellant has not indicated how a person of ordinary skill in the art determines when the thickness is appropriate from the initial deposition thickness to the final deposition thickness. Thus, the Examiner's definition of "desired thickness" as any thickness is not patentably differentiated from Appellant’s definition and this construction or meaning is reasonable absent any contrary definition or guidelines in the Specification. *See In re Morris*, 127 F.3d 1048, 1054-55 (Fed. Cir. 1997);.

Regarding the rejections of claims 111-112 and 119-129 under 35 U.S.C. § 103(a), we affirm these rejections advanced by the Examiner. Appellant’s arguments repeat those presented for independent claim 110

(rejection discussed above) and have not otherwise presented separate arguments on the merits for the rejections of claims 111-112 and 119-129. In this regard, Appellant does not assert non-obviousness based on the additional limitations set forth in claims 111-112 and 119-129 subject to these rejections by explaining how the additional references (identified in the statement of the rejection) applied thereto by the Examiner fail to establish the obviousness of the additional features recited in this separately rejected claims. Because we do not find Appellant's arguments persuasive as to independent claim 110, it follows that these arguments are unpersuasive as to claims 111-112 and 119-129.

Apparatus Claims 113-118, 133-152, and 156-159

E. Claims 113, 115-116, 118, 137, and 141-143 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or Kubo.

F. Claims 114, 138, 139, 144-150 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or Kubo and Dubin.

G. Claim 117 stands rejected under 35 U.S.C. § 103(a) over Fairbairn in view of the Hirohiko and further in view of Van Raalte or Kubo and Davis.

H. Claim 140 stands rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Hirohiko and further in view of Van Raalte or the Kubo and Kobayashi.

I. Claims 151 and 152 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of the Hirohiko and further in view of Van Raalte or Kubo and Dubin and Kobayashi.

J. Claims 133-135 and 156-158 stand rejected under 35 U.S.C. § 103(a) over Fairbairn in view of Kimhiko and further in view of Van Raalte or the Kubo and Andricacos.

K. Claims 136 and 159 stand rejected under 35 U.S.C. § 103(a) over the Fairbairn in view of the Hirohiko and further in view of Van Raalte or Kubo and Andricacos and the Electroplating Engineering Handbook.

The subject matter of independent claims 113 and 142 is directed to an automated tool for plating a film on a semiconductor wafer substrate. The Examiner contends that the invention of claims 113 and 142 differ from the combined teachings of Fairbairn and Hirohiko in that the claims require that first and second anodes are connected to the first and second power supplies. The Examiner recognizes that Hirohiko discloses a plurality of anodes. However, Hirohiko does not disclose that these anodes are connected to a plurality of power supplies. The Examiner cites the Van Raalte and Kubo references as evidence that independent control of a plurality of counter electrodes in an electroplating process was known by persons of ordinary skill in the art. (Ans. 10-11).

Appellant contends that Van Raalte does not disclose a second anode as recited in the claims. Appellant contends that the Van Raalte and Kubo references do not disclose the requisite motivation to configure the power supplies to alternate in providing power to the first and second anodes, as recited in claims 113 and 142, because modifying the Van Raalte and Kubo references in such a manner would change their principle of operation. (App. Br. 10-11).

Correspondingly, the issue presented is: Did Appellants identify reversible error in the Examiner's rejection of claims 113 and 142 under § 103? We answer this question in the negative. The issue turns on whether a person of ordinary skill in the art would have reasonably expected that the plurality of anodes disclose by Hirohiko could have been connected to a plurality of power supplies

A claimed invention is unpatentable if the differences between it and the prior art "are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art." 35 U.S.C. § 103. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR*, 127 S. Ct. at 1739. The question to be asked is "whether the improvement is more than the predictable use of prior art elements according to their established functions." *KSR*, 127 S. Ct. at 1740.

The Examiner has determined that the combined teachings of Fairbairn and Hirohiko differed from the claimed invention in that the first and second anodes are connected to the first and second power supplies. The Examiner recognizes that Hirohiko discloses a plurality of anodes. However; Hirohiko does not disclose these anodes are connected to a plurality of power supplies. The Examiner cites the Van Raalte and Kubo references as evidence that independent control of a plurality of counter electrodes in an electroplating process was known by persons of ordinary skill in the art. (Ans. 10-11).

Under these circumstances, we concur with the Examiner that a person of ordinary skill in the art would have had sufficient skill and

creativity to utilize independent control of a plurality of counter electrodes in the electroplating process of Hirohiko. A person of ordinary skill in the art who desired independent control and operation of the electrodes would have been led to the claimed subject matter, motivated by a reasonable expectation that the utilization of independent power supplies would have been appropriate for this purpose. *Cf. In re Ludwig*, 353 F.2d 241, 243-244 (CCPA 1965). (Patentability does not convey to an invention where only simple observation is required to ascertain a problem). A person of ordinary skill in the art would have sufficient skill to select the appropriate independent power supplies for the electrodes of type of Hirohiko.

Appellants' separate arguments directed towards the modification of Van Raalte and Kubo references do not address the basis upon which the Examiner cited these references. Specifically, Appellants have not addressed the evidence that independent control of a plurality of counter electrodes in an electroplating process was known by persons of ordinary skill in the art and would have been suitable for operation of the electrodes of type of Hirohiko.

Regarding the rejections of claims 114-118, 133-141, 143-152, and 156-159 under 35 U.S.C. § 103(a), we affirm these rejections advanced by the Examiner. Appellants' arguments repeat those presented for independent claim 113 and 142 (rejection discussed above) and has not otherwise presented separate arguments on the merits for the rejections of claims 114-118, 133-141, 143-152, and 156-159. In this regard, Appellants do not assert non-obviousness based on the additional limitations set forth claims 114-118, 133-141, 143-152, and 156-159 subject to these rejections by explaining how the additional references (identified in the statement of the

Appeal 2007-2657
Application 09/837,911

rejection above) applied thereto by the Examiner fail to establish the obviousness of the additional features recited in this separately rejected claims. Because we do not find Appellants' arguments persuasive as to independent claims 113 and 142, it follows that these arguments are unpersuasive as to claims 114-118, 133-141, 143-152, and 156-159.

For the foregoing reasons and those presented in the Answer, the rejection of claims 110-129, 133-152, and 156-159 under 35 U.S.C. § 103(a) is affirmed. As a final point with respect to the § 103 rejection, we note that Appellants base no argument upon objective evidence of nonobviousness, such as unexpected results.

ORDER

The rejections of claims 110-129, 133-152, and 156-159 under 35 U.S.C. § 103(a) are 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)(1)(iv).

AFFIRMED

tc

HUI "DAVID" WANG, PRESIDENT
ACM RESEARCH, INC.
4378 ENTERPRISE STREET
FREMONT, CA 94538