UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ALAA A. ELMOURSI, FRANS P. LAUTZENHISER,
ALBERT B. CAMPBELL, and JOHN R. SMITH

Appeal 2008-1411
Application 10/154,342
Technology Center 1700

Decided: March 12, 2008

Before PETER F. KRATZ, CATHERINE Q. TIMM, and
ROMULO H. DELMENDO, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of all pending claims (claims 1-5, 8-10, and 13-16[1]). (Final Office Action

[1] Claims 6, 7, 11, 12, and 17-21 have been canceled. (*See* Amendments filed July 15, 2003, November 17, 2003, and August 5, 2004).

entered November 17, 2006). We have jurisdiction under 35 U.S.C. § 6(b) (2002).

Appellants' claimed process provides a copper-based circuit. According to Appellants, in a first aspect of the invention, the circuit is constructed with an electrically insulative substrate, a bond layer formed over select portions of the substrate, and plastically deformed copper particles deposited on the bond layer. (Spec. 3). In a second aspect of the invention the circuit is formed without a bond layer, having copper particles directly deposited on the electrically insulative substrate. (*Id*. 3).

Representative claims 1 and 13 read as follows:

> 1. A process for forming a copper-based circuit, said process comprising the steps of:
>
> providing an electrically insulative substrate;
>
> forming a bond layer comprising silver over select portions of said substrate according to a desired shape of a circuit; and
>
> depositing copper on said bond layer by the steps of:
>
> introducing copper particles having a particle size of about 45 microns to about 150 microns into a pressurized carrier gas;
>
> forming said pressurized carrier gas and said copper particles into a supersonic jet; and
>
> directing said jet toward said bond layer formed over said substrate without use of a mask and from a standoff distance of from 5 to 19 millimeters such that said jet has a velocity sufficient to cause plastic deformation of said copper particles onto said bond layer, thereby forming an electrically conductive layer only on said bond layer in the desired shape of the circuit by selective adherence of said copper particles to said bond layer.
>
> 13. A process for forming a copper-based circuit, said process comprising the steps of:
>
> providing an electrically insulative substrate;

providing particles of copper each having a particle size of less than about 45 micrometers;

depositing said copper particles on said substrate by the steps of:

introducing said copper particles into a pressurized carrier gas;

forming said pressurized carrier gas and said copper particles into a supersonic jet; and

directing said jet toward said substrate from a standoff distance of from 5 to 19 millimeters such that said jet has a velocity sufficient to cause plastic deformation of said copper particles onto said substrate, thereby forming an electrically conductive layer on said electrically insulative substrate.

The prior art references relied upon by the Examiner to reject the claims on appeal are:

Alkhimov	5,302,414	Apr. 12, 1994
Komorita	5,328,751	Jul. 12, 1994
Van Steenkiste	6,139,913	Oct. 31, 2000
Sasaki	6,261,703 B1	Jul. 17, 2001
Miyasaka	6,291,012 B1	Sep. 18, 2001
Rao	6,924,004 B2	Aug. 2, 2005

VAN STEENKISTE ET AL., *Kinetic Spray Coatings*, 111 SURFACE AND COATINGS TECHNOLOGY 62 (1999).

The Examiner rejected claims 1-5 and 8-10 under 35 U.S.C. § 103(a) as unpatentable over Komorita or Sasaki in combination with Miyasaka, Van Steenkiste (*Kinetic Spray Coatings*), and Rao. (Ans. 3).

The Examiner rejected claims 13-16[2] as unpatentable over the combination of: (i) Miyasaka; (ii) Rao; and (iii) Alkhimov or Van Steenkiste ('913). (Ans. 6).

We affirm-in-part.

ISSUES

Has the Examiner made out a prima facie case of obviousness with respect to the subject matter of claims 1-5 and 8-10, taking into account all claim limitations?

Have Appellants shown error in the Examiner's determination that the combined disclosures of: (i) Miyasaka; (ii) Rao; and (iii) Alkhimov or Van Steenkiste '913 would have led one of ordinary skill in the art to obtain a process within the scope of appealed claim 13?

PRINCIPLES OF LAW

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 to which the subject matter pertains." 35 U.S.C. § 103(a) (2007).

The factual inquiry into whether claimed subject matter would have been obvious includes a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior

[2] Although not explicitly stated (Ans. 6), it is clear from context that claims 13-16, like claims 1-5 and 8-10, have been rejected under 35 U.S.C. § 103(a). The Examiner's error, however, was harmless because Appellants have understood that claims 13-16 stand rejected under 35 U.S.C. § 103(a). (App. Br. 14-17).

art; (3) the level of ordinary skill in the art; and (4) secondary consideration (e.g., the problem solved) that may be indicia of (non)obviousness. *KSR Int'l Co. v. Teleflex*, 127 S. Ct. 1727, 1734 (2007) (citing *Graham v. John Deere Co., Inc.*, 383 U.S. 1, 17-18 (1966)).

ANALYSIS

Claims 1-5 and 8-10

The Examiner rejected claims 1-5 and 8-10 under 35 U.S.C. § 103(a) as unpatentable over Komorita or Sasaki in combination with Miyasaka, Van Steenkiste (*Kinetic Spray Coatings*), and Rao.

Komorita teaches a process for forming ceramic circuit boards by bonding a copper circuit plate onto a ceramic base board. (Col. 1, ll. 17-21). The circuit is described as formed either by bonding the metal plate directly onto the ceramic base board by a eutectic phase or by bonding the metal plate to the base board through a bonding material containing an active metal selected from Ti, Zr, Hf, V, Nb, and Ta. (Col. 7, ll. 39-50). The metal plate can have a predetermined circuit pattern before bonding to the substrate or the circuit pattern can be formed after bonding. (Col. 1, ll. 44-51).

Komorita also describes a conventional process for forming ceramic circuit boards that integrally bonds a copper circuit plate to a ceramic base board through a bonding layer containing silver, copper, and an active metal like titanium. (Col. 2, ll. 40-45).

Sasaki teaches a method of making a copper circuit-joined board of one or more joining units; where a joining unit comprises a conductor layer, containing copper, bonded to a ceramic substrate through an interposing

layer. (Col. 10, ll. 58-65). The conductor layer is a conventional sheet sized layer so its length and width dimensions are at least 0.05 mm smaller than the adjacent interposing layer in order to relax thermal stress concentrations between the substrate and conductor layers, as well as to prevent damage to the substrate when making and using the circuit board. (Col. 23, ll. 18-33). Etching the conductor layer, after joining, forms the circuit pattern. (Col. 23, ll. 37-38).

Miyasaka teaches a method of forming a metallic coat on a workpiece by ejecting metallic powders, with sufficient velocity or ejection pressure, onto the workpiece surface; causing the particles to adhere to the surface. (Col. 5, ll. 18-24). A mask is used to cover the workpiece in a predetermined coat pattern so that metallic powders, impinging onto the workpiece, will adhere to the surface portion of the workpiece not covered by the mask. (Col. 7, ll. 56-63).

Van Steenkiste (*Kinetic Spray Coatings*) teaches depositing metallic low porosity coatings onto substrates by using a carrier gas to accelerate particles and to impact them onto substrates, where particulate kinetic energy causes mechanical and thermal deformation of the particles when they strike the substrate. (P. 62).

Rao discloses a method of forming patterned films or coatings onto a substrate by generating gas-borne nanoparticles, aerodynamically focusing the particles into a narrow high speed particle beam, and impacting the nanoparticles onto substrates in a vacuum deposition chamber. (Col. 4, ll. 49-58). Patterned films are formed by moving the substrate relative to a nozzle at the chamber inlet. (Col. 5, ll. 1-3). The disclosed method achieves collimated particles of specified size ranges. (Col. 6, ll. 35-36). Rao states

the prior art uses collimated beams of nanoparticles to deposit metal patterns for printed circuit boards in maskless processes. (Col. 3, ll. 11-18).

Thus, Komorita and Sasaki differ from the subject matter of appealed claim 1 in that they do not teach spraying copper particles unto a substrate so the particles plastically deform upon a silver bonding layer to make a copper circuit and forming circuit patterns using maskless methods. The Examiner appears to admit as much. (Ans. 4-5).

The Examiner maintains that Miyasaka teaches an impacting process which, combined with Komorita or Sasaki, would successfully result in a process for obtaining high adhesion strength without deficiencies of using heat and solvents. (Ans. 4). Additionally, the Examiner asserts that Rao teaches creating patterns with collimated nanoparticles without masking which, combined with Komorita or Sasaki, and Miyasaka and Van Steenkiste (*Kinetic Spray Coatings*), would result in a successful process for forming circuit patterns. (Ans. 5). The Examiner also contends that copper circuitry selective adherence is taught in the prior art because Komorita or Sasaki supplies the teachings for a copper plate and Rao forms circuitry using a stream of particles. (Ans. 8).

After consideration of the record we agree with Appellants that the references do not teach "forming an electrically conductive layer only on said bond layer in the desired shape of the circuit by selective adherence of said copper particles to said bond layer." (App. Br. 18).

The Examiner has not pointed to any disclosure in the prior art applying a jet of particles selectively to a bond layer deposited on a substrate in a desired shape of a circuit. Nor has the Examiner provided any acceptable reasoning that makes up for the lack of an explicit teaching,

suggestion, or motivation in the prior art itself. Furthermore, there is no support in the record that a method of applying a jet of particles to a substrate can replace a method of applying a plate or sheet to a bond layer on a substrate to meet the requirements of the claimed invention. The Examiner has not shown any evidence, or provided sufficient reasoning, that would have suggested substituting a supersonic jet of copper particles for the copper plate or sheet of Komorita or Sasaki for selective adherence only on the bond layer, as further discussed below.

The Examiner has not established that the combination of teachings of the prior art references would have resulted in the claimed invention, let alone shown that a person having ordinary skill in the art would have had a reasonable expectation of success. Komorita or Sasaki disclose processes using copper plates or sheets that adhere onto a bond layer. (Komorita col. 16, ll. 12-25; Sasaki col. 10, ll. 58-65). While these references teach adherence to a bond layer, they do not disclose "forming an electrically conductive layer only on said bond layer in the desired shape of the circuit by selective adherence of said copper particles to said bond layer," (App. Br. 18) as recited in claim 1. Miyasaka, Van Steenkiste, and Rao teach processes applying particles onto a substrate, but without a bond layer. (Miyasaka col. 5, ll. 17-24; Van Steenkiste 62; Rao col. 4, line 49 – col. 5, line 3). The Examiner has failed to demonstrate that one of ordinary skill in the art would have read these references to teach selectively applying copper particles to a bond layer formed on a substrate.

At best, the combination of references would have resulted in a method of applying a jet of copper particles without the use of a bonding layer. Such a process, however, does not satisfy all the limitations recited in

claim 1. Therefore, the subject matter of claim 1 has not been shown to be obvious (as well as the subject matter of claims 2-5 and 8-10 dependent thereon). *In re Fine*, 837 F.2d 1071, 1076 (Fed. Cir. 1988) ("Dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious.").

Claims 13-16

The Examiner rejected claims 13-16 as unpatentable over the combination of: (i) Miyasaka; (ii) Rao; and (iii) Alkhimov or Van Steenkiste ('913).

Appellants have not provided separate arguments in support of claims 14-16. Accordingly, claims 13-16 stand or fall together. 37 C.F.R. § 41.37(c)(vii) (2006).

Appellants argue that the Examiner cannot combine Alkhimov or Van Steenkiste to provide the missing particle size limitation in the combined references of Miyasaka and Rao. (App. Br. 14-16). On review of the record, this argument is unpersuasive.

Rao discloses a method of forming patterned films or coatings on a substrate using nanoparticles less than 100 nm. (Col. 5, ll. 4-7). The teaching of particle sizes less than 100 nm meets the claimed limitation of "a particle size less than about 45 micrometers . . . ." (App. Br. 19). Therefore, the combined teachings of Miyasaka and Rao disclose the claimed particle size, and Appellants' arguments against combining Alkhimov or Van Steenkiste with Miyasaka and Rao are ineffective to rebut the Examiner's prima facie case of obviousness.

Appellants state "the Examiner failed to articulate any reason for the combination of Miyasaka with Rao et al. further with Alkhimov et al. or Van Steenkiste et al. '913." (Reply Br. 10). Additionally, Appellants argue "the Examiner has failed to provide any teaching, suggestion, or motivation to combine these references to make claim 13." (App. Br. 15). By failing to state a reason for combining the references, Appellants argue, "a *prima facie* case of obviousness cannot be established for any of the claims." (Reply Br. 10).

These arguments are not persuasive. In the rejection of claims 13-16, the Examiner incorporated the features discussed in the rejection of claims 1-5 and 8-10 (Ans. 6). In that discussion, the Examiner describes the disclosure of Rao as teaching a method of "creating patterns without the use of masking through the collimated beams of nanoparticles." (Ans. 5). The Examiner discussed combining this teaching with the prior art of record:

> Therefore it would have been obvious for one skilled in the art at the time the invention was made to have modified Komorita et al. (5,328,751) or Sasaki et al. (6,261,703 Bl) in combination with Miyasaka (6,291,012) further in combination with Van Steenkiste et al., "Kinetic Spray Coating" process by using a maskless process as evidenced by Rao et al. (6,924,004) with the expectation of achieving similar success.

(Ans. 5).

The Examiner continued his reasoning for combining Rao with the prior art:

> Finally, regarding the Rao et al. (6,924,004) reference, the use of a maskless system would avoid the disadvantages associated with using masks (extra process step) and the removal thereof (etchants) and this advantage would be achieved regardless of

> the particle size as long as the collimated beams of particles was utilized.

(Ans. 7).

The teachings of Rao would have led one of ordinary skill in the art to use the disclosed maskless method and particle sizes with a reasonable expectation of achieving a successful method of applying particles, thereby obtaining a method encompassed by claim 13. Appellants have not supplied any evidence that the combination would be beyond the skill of a person of ordinary skill in the art. *KSR Int'l v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740 (2007) ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.").

Appellants have not pointed out any reversible error in the Examiner's reasoning to rebut the prima facie case of obviousness, and therefore fail in satisfying their burden to show the rejections are incorrect. *In re Mayne*, 104 F.3d 1339, 1342 (Fed. Cir. 1997) ("When the PTO shows prima facie obviousness, the burden then shifts to the applicant[s] to rebut.").

Based on evidence in the record, Appellants have not shown the Examiner erred in rejecting claims 13-16.

CONCLUSION

In view of the above discussion, we do not sustain the rejection under 35 U.S.C. § 103(a) of claims 1-5 and 8-10.

With respect to claims 13-16, Appellants have failed to show that the Examiner erred in concluding that one of ordinary skill in the art would have found the subject matter of these appealed claims obvious over the prior art. Therefore, we sustain the rejection of claims 13-16.

Accordingly, the decision of the Examiner is affirmed-in-part.

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-IN-PART

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