UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte FERDINAND BELL,
DIRK KNOBLOCH, KNUT VOIGTLANDER, AND JAN ZIMPEL,
APPELLANTS

Appeal 2008-2937
Application 10/205,080[1]
Technology Center 1700

Decided: June 11, 2008

Before TEDDY S. GRON, CATHERINE Q. TIMM, and
MARK NAGUMO, *Administrative Patent Judges*.

NAGUMO, *Administrative Patent Judge*.

DECISION ON APPEAL

---

[1] Application 10/205,080 ("080 Application," cited as "Spec.") was filed 25 July 2002 as a continuation of PCT/DE00/00249, which was filed 25 January 2000, titled *Method of Monitoring a Production Process*. The real party in interest is listed as Infineon Technologies AG (Substitute Appeal Brief, filed 5 August 2006 ("Br."), at 2.

A. Introduction

Ferdinand Bell, Dirk Knobloch, Knut Voigtlander, and Jan Zimpel ("Bell") appeal from the final rejection of claims 1 and 3-21, which are all of the pending claims. We have jurisdiction under 35 U.S.C. § 6. We REVERSE.

The subject matter on appeal relates to methods of monitoring processes by analyzing emission spectra. Claim 1, which is representative of the issues necessary to resolve this appeal, reads:

> Claim 1:
>
> a method of monitoring a production process, which comprises:
>
> > determining intensities of various wavelengths in an emission spectrum at predefined times;
> >
> > forming at least one linear combination from the intensities of various wavelengths, and selecting weights of the linear combination such that a predefined curve shape is approximated; and
> >
> > determining at least one characteristic variable from the linear combination.

(Br. Claims App. 1; emphasis added.)

The Examiner has maintained the following rejection:

> Claims 1 and 3-21 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Le[2], Saito[3], and White.[4]

---

[2] Minh Le *et al.*, *Monitor of Plasma Processes with Multivariate Statistical Analysis of Plasma Emission Spectra*, U.S. Patent 6,153,115 (28 November 2000, based on application 08/956,575, filed 23 October 1997).

[3] Susumu Saito and Shinji Sakano, *Etching End-Point Detecting Method*, U.S. Patent 6,586,262 B1 (1 July 2003, based on 09/926,544, which is the

B. Findings of Fact (FF)

Findings of fact throughout this Decision are supported by a preponderance of the evidence of record.

The 080 Application

1. The 080 application is said to have been filed as a continuation of copending International Application PCT/DE00/00249, which was filed 25 January 2000, designating the United States. (Spec. 1:6-8.)

2. According to the 080 application, production processes, particularly semiconductor fabrication processes, are advantageously monitored closely to identify, e.g., various endpoints in the process. (Spec. 1-2.)

3. An example of an endpoint in an etching process is when the substrate underlying a superficial layer is exposed. (Spec. 2-3.)

4. Such processes are said to be commonly monitored and analyzed via optical emission spectra. (Spec. 2:22-25.)

5. A prior art monitoring and analysis process is said to rely on principal component analysis ("PCA") of the development of an entire emission spectrum from 240 to 600 nm through a processing time. (Spec. 4:6-25.)

6. A disadvantage of the prior art method is said to be the requirement of reference values to identify the correct endpoint. (Spec. 4:13-20.)

National Stage of PCT/JP00/03167, filed 17 May 2000, which has been accorded the § 371(c)(1), (2), and (4) date 16 November 2001.

[4] David A. White *et al.*, *Spatial Characterization of Wafer State Using Principal Component Analysis of Optical Emission Spectra in Plasma Etch*, 10 IEEE Transactions Semiconductor Manuf. 52 (1997).

7. Neural networks are said to have been used to determine endpoints without corresponding reference values, but are said to lead to misinterpretation due to false signals and patterns. (Spec. 5:1-11.)

8. According to the specification, the inventive process seeks to avoid these problems by providing a method that:

> (a) measures a large number of variables at predetermined times (i.e., gathers optical emission spectra over a period of interest);
>
> (b) approximates a "predefined curve shape" by weighting at least one linear combination formed from the large number of measured variables (e.g., fits the data to some predefined function);
>
> (c) determines at least one characteristic variable from the linear combination (e.g., identifies an etching endpoint).

(Spec. 6:6-19.)

9. In the words of the specification, "the term linear combination should be understood not only as the procedure of linearly combining measured variables, but also the signal obtained in this way." (Spec. 7:1-4.)

10. The specification defines a linear combination $y_0(t)$, which can also be written $y_0(t, c_i)$ (Spec. 20:15), in which the dependence on the processing time and c_i, the "weights of the linear combination" mentioned in the claims, is highlighted. (*Id.* at 18 & 19.)

11. According to Bell, the function $y_0(t, c_i)$ "can be matched to a predefined curve shape by using the coefficients c_i." (Spec. 19:17-19.)

12. The specification teaches that the predefined curve shape, which is designated by the symbol $y_{MO}(t)$ (Spec. 19:25) or, equivalently, as $y_{MO}(t, t_{EP})$ (*id.* at 20:15) to emphasize the dependence on the process time and the endpoint time, "is chosen such that the important characteristic variable, in this case the end point of the etching, can be extracted relatively easily from the linear combination." (Spec. 19:19-22.)

13. In a preferred embodiment, the predefined curve shape $y_{MO}(t, t_{EP})$ is a step-like function of processing time t and the endpoint time t_{EP}. Thus, in these preferred embodiments, the predefined curve shape changes rapidly at the endpoint from a low value to a high value. (Spec. 9:7-19; 19:19-25.)

14. The specification then defines a quality function Q, which involves the difference between the linear combination of the measured variables and the predefined curve shape function:

$$Q = Q(y_0(t, c_i) - y_{MO}(t, t_{EP})).$$

(*Cf.*, Spec. 20:15.)

15. According to the specification, by minimizing the quality function Q, the weights c_i can be determined and the endpoint time t_{EP} can be optimized. (Spec. 20:22-25.)

16. The specification indicates that the correct weights (coefficients) for the linear combination of the measured variables are determined for a trial etching. (Spec. 28:5-9.)

17. The specification indicates ways by which the effect on the weights of drift or changes during multiple trial etchings and actual production runs can also be taken into account. (Spec. 28:18-30:6.)

The Examiner's Rejection

18. The Examiner finds that Le describes a method of collecting emission spectra from a plasma process, producing correlations between intensities of the monitored wavelengths, comparing the produced correlation indications with pre-specified correlation indications, and determining at least one characteristic variable such as an etching endpoint. (Ans. 3.)

19. The Examiner appears to find that Le does not describe forming at least one linear combination from the intensities of various wavelengths and approximating a preselected curve by selecting weights of the linear combination. (Ans. 3)

20. However, the Examiner concludes that, with the available data, it would have been obvious to the ordinary skilled worker "to select weights of the linear combination using numerical analysis techniques and statistical methods . . . to generate a predefined curve shape approximately," and to find the characteristic variable. (Ans. 3)

21. In particular, the Examiner cites Saito and White "as evidence for the typical principle [sic] component analysis and linearization of nonlinear mathematic model[s]." (Ans. 3.)

Bell's Opposition

22. Bell reviews the teachings of Saito and White. (Br. 14-17).

23. Bell acknowledges that both references describe ways of conducting principal component analysis to a series of spectra to identify endpoints in plasma etch processes. (Br. 17.)

24. Bell, however, objects that the references relied on do not teach approximation of a predefined curve by selecting weights of the linear combination. (Br. paragraph bridging 17-18.)

25. Moreover, Bell objects that Saito is not prior art due to the effective filing date under 35 U.S.C. § 363 of the 080 application of 25 January 2000, which is the filing date of the parent PCT application. (Br. 18.)

26. The Examiner does not respond to Bell's objection.

C. Discussion

The recommended framework for establishing a prima facie case of obviousness is well known: "[u]nder § 103, 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." *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17 (1966). As our reviewing court has instructed repeatedly, "[t]he Board's findings must extend to all material facts and must be documented on the record, lest the 'haze of so-called expertise' acquire insulation from accountability. 'Common knowledge and common sense,' even if assumed to derive from the agency's expertise, do not substitute for authority when the law requires authority." *In re Lee*, 277 F.3d 1338, 1344-45 (Fed. Cir. 2002). The Supreme Court has emphasized recently that the obviousness analysis should be made explicit. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007).

The Examiner has not explained why the recited mode of analysis would have been obvious in view of the cited prior art.[5] The Examiner's arguments are conclusory. The Examiner has not, for example, come forward with evidence that the recited step of "forming at least one linear combination from the intensities of various wavelengths, and selecting weights of the linear combination such that a predefined curve shape is approximated" has been used in a process sufficiently related to the claimed process that the invention as a whole would have been obvious. The Examiner has not directed our attention to any credible evidence in the record that this step, which appears to read on fitting a linear combination of intensities to a predefined curve, is taught or suggested. In particular, the Examiner has not explained why it would have been obvious to substitute such a procedure for the use of the Hotelling's $T^2(t)$ statistic in the analysis of endpoints from plasma emission spectra obtained during the plasma etching process as taught by Le.

Indeed, it is not clear from the record whether the Examiner has construed the term "predetermined curve shape" as it is used in the claims. Accordingly, it is not clear precisely what the Examiner considers the

[5] As Bell correctly points out (Br. 18), 35 U.S.C. § 363(a) reads in relevant part, "[a]n international application designating the United States shall have the effect, from its international filing date under article 11 of the treaty, of a national application for patent regularly filed in the patent and Trademark Office . . . ". Thus, the effective filing date of the 080 application is 25 January 2000, the date on which the parent application, PCT/DE00/00249 was filed. Accordingly, Saito, which has a § 371(c) date of 16 November 2001, is not prior art; nor would it be prior art if it were accorded [improperly] benefit of the PCT filing date of 17 May 2000. In any event, as explained in the main text, the Examiner has failed to show that the teachings of Saito help to establish a prima facie case of obviousness.

differences between the claimed process and the prior art processes to be. Whatever the Examiner considers those differences to be, the Examiner has not directed our attention to specific disclosures or otherwise specifically explained why the invention as a whole would have been obvious to persons having ordinary skill in the relevant arts. Although we do not doubt that the level of skill is high, a high level of skill is no substitute for evidence that something was known in the prior art; nor is a high level of skill evidence that those skilled in the art would have considered it obvious to use that something in a newly claimed process. In short, the Examiner's rejection appears to rely impermissibly on hindsight reconstruction based on Bell's disclosure and claims to make a case for obviousness.

Accordingly, we REVERSE the rejection.

E. Summary

In view of the record and the foregoing considerations, it is:

ORDERED that the rejection of claims 1 and 3-21 under 35 U.S.C. § 103(a) in view of the combined teachings of Le, Saito, and White is REVERSED.

REVERSED

MAT

LERNER GREENBERG STEMER LLP
FOR INFINEON TECHNOLOGIES AG
P.O. BOX 2480
HOLLYWOOD FL 33022-2480