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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte BOGUSLAW A. SWEDEK, DOMINIC J. BENVEGNU, and JEFFREY DRUE DAVID

Appeal 2019-000009
Application 14/322,686
Technology Center 1700

Before JEFFREY T. SMITH, MICHAEL P. COLAIANNI, and N. WHITNEY WILSON, *Administrative Patent Judges*.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 27 to 46. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Applied Materials, Inc. Appeal Br. 1.

Appellant's invention is directed to a computer implemented method that includes selecting two or more reference spectra to determine an endpoint of a chemical mechanical polishing process (Spec. 1:14–15; 2:17–18; Claims 27, 35).

Claim 35 is representative of the subject matter on appeal:

> 35. A computer program product encoded in a non-transitory machine-readable medium, the product comprising instructions operable to cause a processor to:
>
> store a reference spectrum, the reference spectrum representing a spectrum resulting from reflection of white light from a reference substrate;
>
> receive a plurality of measured spectra from an optical sensor for each sweep of a plurality of sweeps of the optical sensor across a substrate undergoing polishing, each measured spectrum of the plurality of measured spectra for each sweep being a spectrum resulting from reflection of white light from the substrate undergoing polishing;
>
> for each sweep of the plurality of sweeps, determine a difference between each measured spectrum of the plurality of measured spectra obtained in the sweep and the reference spectrum to generate a plurality of differences for each sweep;
>
> for each sweep of the plurality of sweeps, select a difference from the plurality of differences for the sweep based on a comparison of magnitudes of the plurality of differences, thus generating a sequence of selected differences; determine a polishing endpoint based on the sequence of selected differences;
>
> and cause polishing of the substrate to halt at the polishing endpoint.

App. Br. 19–20 (Claims Appendix).

Appellant appeals the following rejections:

1. Claims 27–46 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

2. Claims 35, 38, 41, and 44 are rejected under 35 U.S.C. § 102(b) as unpatentable over Bibby, Jr. (US 2002/0155789 Al, published October 24, 2002).
3. Claims 27, 31–33, 36, 37, 40, 42, 43, 45, and 46 are rejected under 35 U.S.C. § 103(a) as unpatentable over Bibby Jr. in view of Chen (US 2003/0053042 Al, published March 20, 2003).
4. Claims 28 and 29 are rejected under 35 U.S.C. § 103(a) as unpatentable over Bibby Jr. in view of Chen, and Yang (6,153,116, issued November 28, 2000).
5. Claims 30, 39, and 45 are rejected under 35 U.S.C. § 103(a) as unpatentable over Bibby Jr. in view of Chen, and Du-Nour (US 6,885,467 B2, issued April 26, 2005).

FINDINGS OF FACT & ANALYSIS

35 U.S.C. §112, ¶ 2

The Examiner determines that the independent claims 27, 35, and 41 recite "cause polishing of the substrate to halt at the polishing endpoint" is indefinite because the claims do not require any sort of polishing operation/process so as to provide a particular halting thereof coincident with a polishing endpoint (Ans. 3–4). The Examiner finds that to "receive a plurality of current spectra . . . for each sweep of a plurality of sweeps . . ." renders the claim indefinite because "such reception of current spectra is undefined with respect to "each sweep of a plurality of sweeps" as the claims do not necessitate any such sweeps by an optical sensor and thereby such "determin[ation] of a polishing endpoint" is indefinitely defined at

present as such step relies on the indefinitely defined sweeps." (Ans. 4). The Examiner finds that the claims do not provide a link which gives basis to the step of "cause polishing of the substrate to halt at the polishing endpoint" because there is no polishing of a substrate being monitored in accordance with receiving and comparing the spectra to the reference spectra (Ans. 4).

Regarding claim 34, the Examiner finds that it is unclear how the particular processor instructions relate to zones of a substrate and sweeps thereof (or sweeps relating beyond such zones). (Ans. 4). The Examiner finds that the claims are indefinitely defined in providing particular processor instructions that allow assessment of particular zones of the substrate because the claims do not require a substrate undergoing polishing that being swept and assessed (Ans. 4–5).

In assessing whether a claim is indefinite, we determine whether those skilled in the art would understand what is claimed when the claim is read in light of the specification. *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576 (Fed. Cir. 1986). In the present case, claims 27, 34, 35, and 41 are directed to a computer program encoded in non-transitory machine-readable medium, not a polishing process. Claim 27 recites "receiv[ing] a plurality of current spectra from an optical sensor for each sweep of a plurality of sweeps of the optical sensor across a substrate undergoing polishing." Claim 35 recites to "receive a plurality of measured spectra from an optical sensor for each sweep of a plurality of sweeps of the optical sensor across a substrate undergoing polishing." Claim 41 recites to "receive a measured spectrum from an optical sensor for each sweep of a plurality of sweeps of the optical sensor across a substrate undergoing polishing." Contrary to the Examiner's findings, each of the independent

claims requires an optical sensor to receive the current spectrum or spectra for each pass of the optical sensor across a substrate undergoing polishing. *See*, claims 27, 35, and 41. The Specification describes that the optical head 53 receives light reflected from the substrate to create a spectrum that is used in the computing device to determine an endpoint of the polishing process (Spec. 12:12–30). Figure 5 shows that a series of light flashes 501 to 510 moves across the substrate 10 via optical head 53 (Spec. 12:1–10). The series of light flashes 501 to 510 can be used to determine a spectrum for the reflected light which is received via the optical head 53 (Spec. 12:12-20). The Specification describes that the optical sensor acquires spectrum data from the light flashes that are applied during the sweep of the substrate by the optical sensor. The Specification further describes the intensity of the spectrum data is subtracted from the intensity of a reference spectrum and the difference is used to determine a trace which used in determining an endpoint for the polishing (Spec. 17). In our view, one of ordinary skill in the art would understand what is claimed when the claim is read in light of the Specification.

We reverse the Examiner's § 112, second paragraph, rejection.

35 U.S.C. §102

The Examiner finds that Bibby Jr. anticipates the subject matter of independent claims 35 and 41. The Examiner finds that Bibby Jr.'s use of a least squares fit for the spectrum data in paragraphs 26 and 27 would meet the following claim limitations: "for each sweep of the plurality of sweeps, select a difference from the plurality of differences for the sweep based on a comparison of magnitudes of the plurality of differences, thus generating a

sequence of selected differences" (claim 35), and "for each sweep of the plurality of sweeps, select a difference from the plurality of differences for the sweep based on a comparison of magnitudes of the plurality of differences, thus generating a sequence of selected differences" (claim 41) (Ans. 5–6, 15).

Appellant argues that Bibby Jr. does not teach determining a difference for each sweep and selecting a difference from the plurality of differences for the sweep (App. Br. 8, 9, 11). Appellant argues that Bibby Jr.'s least squares fit uses a line fit to the data points to determine an endpoint trigger, but the trigger time is not a selected difference value (Reply Br. 2). Appellant contends that the least squares regression line is not used to find the best one among the current data (Reply Br. 3). Appellant argues that the least squares regression analysis is not used to select a difference from the plurality of differences as required by the claims (Reply Br. 3). We agree.

The Examiner has not established within the meaning of 35 U.S.C. § 102 that Bibby Jr.'s least squares fit analysis includes selecting difference from a plurality of differences to generate a sequence of selected differences as recited in claims 35 and 41. The least squares fit analysis may involve taking a difference and squaring it, but that is done for each data point in the analysis. The Examiner has not shown where Bibby Jr. teaches to select a difference from among the plurality of differences and generate a sequence of selected differences.

On this record, we reverse the Examiner's § 102(b) rejection of claims 35, 38, 41, and 45 over Bibby Jr.

35 U.S.C. § 103

The Examiner rejects independent claim 27 under § 103(a) as obvious over Bibby Jr. in view of Chen. The Examiner relies on Bibby Jr.'s paragraphs 26, and 27 to teach "determining the smallest difference between the current spectrum and reference spectrum of a plurality of reference spectra to generate a plurality of differences as represented by Equation 1" (Ans 7-8). The Examiner finds that Bibby Jr. does not teach generating a sequence of smallest differences (or additionally next to smallest or median as in claims 36 and 42) and determining a polishing endpoint based on the sequence of smallest differences (Ans. 8). The Examiner finds that Chen generates a spectrum difference value for each scan cycle according to an equation in paragraph 21 and therefore generates a sequence of smallest difference to calculate endpoint parameter calculation as disclosed in Chen's paragraph 22 (Ans. 8). The Examiner concludes that it would have been obvious to generate a sequence of smallest differences to determine a polishing endpoint because Chen illustrates that the process of generating a sequence of smallest differences repeated several times in order for a computer to monitor the planarization process (Ans. 8).

Appellant argues that the Examiner has not shown where Bibby Jr. or Chen disclose selecting the best-matching reference spectrum from the plurality of reference spectra where the best-matching reference spectrum has a smallest difference of the plurality of differences (App. Br. 12-13). Appellant contends that the Examiner has not even addressed the claim limitation that requires selecting the best-matching reference spectrum from the plurality of reference spectra and thus fails to establish a prima facie case of obviousness (App. Br. 12).

The Examiner finds that Bibby Jr. teaches selecting the best-matching selection and Chen further teaches generating a sequence of smallest differences is utilized in a repeated fashion to monitor the polishing endpoint and planarization process in a sensitive and accurate manner (Ans. 17).

We have reviewed the portions of Chen and Bibby Jr. cited by the Examiner and we cannot find where either reference teaches "select[ing] a best-matching reference spectrum from the plurality of reference spectra, the best-matching reference spectrum having a smallest difference of the plurality of differences, thus generating a sequence of best matching reference spectra" as required by claim 27. Bibby Jr. teaches preforming a least squares regression on the totality of the data and fitting a regression line to the data (Bibby Jr. ¶¶ 26, 27). Chen calculates the difference in the absolute value of a detected spectrum and a reference spectrum for each wavelength reflected back from a point on the workpiece (¶ 18). Chen sums the absolute values of the spectrum differences over a selected range of wavelengths and calculates a time-based endpoint parameter therefrom (¶ 18). Chen's paragraphs 21 and 22 exemplify the paragraph 18 disclosure of the Chen's general process.

We do not find and the Examiner has not explained how or where Chen teaches to select a best-matching reference spectrum having the smallest differences from the calculated differences in a sweep and then generate a sequence of best matching reference spectra using the selected reference spectrum. Bibby Jr. and Chen appear to teach simply calculating differences for all the data points acquired and then assessing the data to determine an endpoint. The Examiner has not met the initial burden of showing where Bibby Jr. and Chen teach or would have suggested

"select[ing] a best-matching reference spectrum from the plurality of reference spectra, the best-matching reference spectrum having a smallest difference of the plurality of differences, thus generating a sequence of best matching reference spectra" as required by claim 27.

On this record, we are constrained to reverse the Examiner's § 103 rejection over Bibby Jr. in view of Chen.

The Examiner's § 103 rejections of dependent claims 28 and 29 over Bibby Jr. in view of Chen and Yang and the § 103 rejection of claims 30, 39, and 45 over Bibby Jr. in view of Chen and Du-Nour do not rely on Yang or Du-Nour to cure any of the above noted deficiencies. Therefore, we reverse the § 103 rejections over Bibby Jr. in view of Chen and Yang and Bibby Jr. in view of Chen, and Du-Nour for similar reasons.

CONCLUSION

In summary:

Claims Rejected	Basis	Prior Art	Affirmed	Reversed
27–46	§ 112, ¶ 2			27–46
35, 38, 41, 44	§102(b)	Bibby Jr.		35, 38, 41, 44
27, 31–33, 36, 37, 40, 42, 43, 45, 46	§ 103(a)	Bibby Jr., Chen		27, 31–33, 36, 37, 40, 42, 43, 45, 46
28, 29	§ 103(a)	Bibby Jr., Chen, Yang		28, 29
30, 39, 45	§ 103(a)	Bibby Jr., Chen, Du-Nour		30, 39, 45
Overall Outcome				27–46

REVERSED