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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte SAMARTH AGARWAL, ABHISEK DIXIT, and JEFFREY B. JOHNSON[1]

Appeal 2018-004930
Application 14/146,114
Technology Center 2100

Before ERIC B. CHEN, MICHAEL J. STRAUSS, and DAVID J. CUTITTA II, *Administrative Patent Judges*.

STRAUSS, *Administrative Patent Judge*.

DECISION ON APPEAL

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[1] According to Appellants, the real party in interest is GLOBALFOUNDARIES INC. *See* App. Br. 1.

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from a rejection of claims 1–7, 9–18, and 20, which constitute all the claims pending in this application. Claims 8 and 19 are canceled. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.[2]

THE INVENTION

According to Appellants, the claims are directed to modeling random dopant fluctuations in semiconductor devices. Spec., Title. Claim 1, reproduced below, is representative of the claimed subject matter:

> 1. A method of modeling random dopant fluctuations (RDF) in a semiconductor device, the method comprising:
>
> overlaying a finite element mesh atop a model of a layer of a semiconductor device;
>
> defining a first volume in the layer of the semiconductor device as a node of the finite element mesh;
>
> calculating a probability of finding at least one dopant atom in the first volume, based on a dopant distribution of the layer;
>
> in the case that the calculated probability is equal to or greater than a pre-determined threshold, defining at least one additional volume in the layer substantially equal to the first volume; and
>
> in the case that the calculated probability is less than the pre-determined threshold:

[2] We refer to the Specification, filed January 2, 2014 ("Spec."); Final Office Action, mailed February 10, 2017 ("Final Act."); Applicant-Initiated Interview Summary of telephonic interview of April 26, 2017, mailed May 2, 2017 ("Interview Summary"); Appeal Brief, filed August 15, 2017 ("App. Br."); Examiner's Answer, mailed February 6, 2018 ("Ans.") and Reply Brief, filed April 6, 2018 ("Reply Br.").

> aggregating the first volume with a second volume adjacent the first volume, the second volume being substantially equal to the first volume; and
>
> recalculating a probability of finding at least one dopant atom in the aggregated first and second volumes, based on the dopant distribution of the layer.

REJECTION

The Examiner rejected claims 1–7, 9–18, and 20 under 35 U.S.C. § 101 as directed to patent-ineligible subject matter. Final Act. 2–6.

ANALYSIS

Appellants' contentions are unpersuasive of reversible Examiner error. We adopt as our own (1) the findings and reasons set forth by the Examiner in the action from which this appeal is taken (Final Act. 2–11) and (2) the reasons set forth by the Examiner in the Examiner's Answer in response to Appellants' Appeal Brief (Ans. 3–13) and concur with the conclusions reached by the Examiner. We highlight the following for emphasis.

Section 101 defines patentable subject matter: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. The U.S. Supreme Court, however, has "long held that this provision contains an important implicit exception" that "laws of nature, natural phenomena, and abstract ideas are not patentable." *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 70 (2012) (quotation omitted). "Eligibility under 35 U.S.C. § 101 is a question of law,

based on underlying facts." *SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1166 (Fed. Cir. 2018).

To determine patentable subject matter, we undertake a two part test. "First, we determine whether the claims at issue are directed to one of those patent-ineligible concepts" of "laws of nature, natural phenomena, and abstract ideas." *Alice Corp. v. CLS Bank Int'l*, 573 U.S. 208, 217 (2014). "The inquiry often is whether the claims are directed to 'a specific means or method' for improving technology or whether they are simply directed to an abstract end-result." *RecogniCorp, LLC v. Nintendo Co.*, 855 F.3d 1322, 1326 (Fed. Cir. 2017). A court must be cognizant that "all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas" (*Mayo*, 566 U.S. at 71), and "describing the claims at . . . a high level of abstraction and untethered from the language of the claims all but ensures that the exceptions to § 101 swallow the rule." *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1337 (Fed. Cir. 2016). Instead, "the claims are considered in their entirety to ascertain whether their character as a whole is directed to excluded subject matter." *Internet Patents Corp. v. Active Network, Inc.*, 790 F.3d 1343, 1346 (Fed. Cir. 2015).

If the claims are directed to an abstract idea or other ineligible concept, then we continue to the second step and "consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Alice*, 573 U.S. at 217 (quoting *Mayo*, 566 U.S. at 79, 78). The Court describes the second step as a search for "an 'inventive concept'– *i.e.*, an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more

than a patent upon the [ineligible concept] itself.'" *Id.* (quoting *Mayo*, 566 U.S. at 72–73).

The Office recently published revised guidance on the application of § 101. *2019 Revised Patent Subject Matter Eligibility Guidance*, 84 Fed. Reg. 50 (Jan. 7, 2019) ("Guidance"). Under that guidance, we look to whether the claim recites

(1) a judicial exception, such as a law of nature or any of the following groupings of abstract ideas:
   (a) mathematical concepts, such as mathematical formulas;
   (b) certain methods of organizing human activity, such as a fundamental economic practice; or
   (c) mental processes, such as an observation or evaluation performed in the human mind;
(2) any additional limitations that integrate the judicial exception into a practical application (*see* MPEP § 2106.05(a)–(c), (e)–(h)); and
(3) any additional limitations beyond the judicial exception that, alone or in combination, were not "well-understood, routine, conventional" in the field (*see* MPEP § 2106.05(d)).

See Guidance 52, 55, and 56. Under the Guidance, if the claim does not recite a judicial exception, then it is eligible under § 101, and no further analysis is necessary. *Id.* at 54. Similarly, under the Guidance, "if the claim as a whole integrates the recited judicial exception into a practical application of that exception," then no further analysis is necessary. *Id.* at 53, 54.

Appellants contend the claims are sufficiently tied to a semiconductor device to render them patent-eligible, i.e., not abstract. *See generally* App. Br. 3–6. "While the mathematical calculation of a probability might be sufficiently devoid of concrete or tangible aspects to be considered 'abstract,' Appellant[s] assert[] that calculating a mathematical probability of finding a dopant in a volume of a semiconductor device is quite a particular calculation of a mathematical probability." *Id.* at 3. Appellants further contend error in rejecting the claims, arguing the Examiner failed to consider "whether the *claim as a whole* amounts to significantly more than the judicial exception." *Id.* Appellants also argue, as in BASCOM, "the claims do no preempt all methods for the 'mathematical calculation of probability.'" *Id.* at 4.

Appellants further contend the Examiner erred in finding the claimed combination of elements fails to provide a technological improvement, arguing the "claimed invention is directed to improvements in the manufacture of semiconductor devices by improving the modeling of random dopant fluctuation." *Id.* at 5. Appellants argue the claims are rendered patent-eligible because they "recite a direct action taken (overlaying) with respect to two distinct objects (a finite element mesh and a model of a layer of a semiconductor device)." *Id.* at 6. Finally, with respect to claim 12, Appellants contend, based on the Examiner's indication that the claims are allowable over the prior art, "the claims must . . . recite more than what is 'well-understood, routine and conventional'", thereby overcoming the rejection under 35 U.S.C. § 101. *Id.*

The Examiner determines the claims "are directed to the abstract idea of calculating a mathematical probability of finding a dopant in a volume." Final Act. 2–3. According to the Examiner:

> The claims recitation of overlaying a mesh, defining a volume, and calculating a probability all represent abstract ideas both independently and as a whole. Further the claimed recitation of aggregating or deaggregating volumes in calculating the probability also represents an abstract idea. Overlaying a mesh and defining a volume merely represent basic computer functions as is, specifically since the mesh and volume are standard elements in computer aided design of any type of hardware device. The calculation of a probability is merely a mathematical step to determine a value.

Ans. 3. The Examiner finds "the steps in combination and as a whole do not amount to more than an abstract idea since they entirely encompass only the calculation of a probability value which is clearly defined as an abstract idea." [3] *Id.* Responding to Appellants' preemption argument, the Examiner concludes "[a] specific abstract idea is still an abstract idea and is not eligible for patent protection without significantly more recited in the claim." *Id.* at 4. The Examiner also finds unpersuasive Appellants' reliance on BASCOM, contrasting Appellants' claims "which are merely limited to calculating the probability which is simply a mathematical/numerical value" over the filtering requirement constituting a technical improvement in BASCOM. *Id.* at 4–5.

We agree with the Examiner for the reasons discussed below.

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[3] We note the Examiner has indicated the rejection under 35 U.S.C. § 101 could be overcome by amending the claims "to recite an actual manufacturing step using the resultant dopant OR to incorporate language that indicates the claim has a physical or meaningful result using the final resulting aggregation or calculation." Interview Summary.

USPTO Step 2A, Prong 1

Claim 1 recites, in part, (I) overlaying a finite element mesh atop a model; (II) defining a first volume in the layer as a node of the finite element mesh; (III) calculating a probability of finding at least one dopant atom in the first volume, based on a dopant distribution of the layer; (IV)(A) in the case that the calculated probability is equal to or greater than a pre-determined threshold, defining at least one additional volume in the layer substantially equal to the first volume; and (IV)(B) in the case that the calculated probability is less than the pre-determined threshold: (IV)(B)(1) aggregating the first volume with a second volume adjacent the first volume, the second volume being substantially equal to the first volume; and (IV)(B)(2) recalculating a probability of finding at least one dopant atom in the aggregated first and second volumes, based on the dopant distribution of the layer.

Mesh overlaying step (I) defines a geometry for partitioning the model into regions so as to define regions (i.e., virtual spaces or volumes) to be processed according to the steps that follow but does not affect any physical operation or transformation. *See* Spec. ¶ 11. Defining divisions of a layer into smaller areas or volumes is a mathematical relationship (e.g., geometry, a branch of mathematics) and, therefore, an abstract idea.

Defining steps (II) and (IV)(A) involve mathematical concepts including relationships, formulas or equations, and calculations for designating locations, i.e., virtual spaces containing designated volumes for which calculations are to be defined. For example, the mathematical processes of summation and integration include defining a closed interval over which summations are performed. In a model of a three-dimensional

system, the corresponding intervals define a region or a virtual volume. Thus, steps (II) and (IV) are mathematical concepts that are abstract ideas.

Probability calculation step (III) is a mathematical calculation, i.e., a mathematical concept and, therefore, also an abstract idea. To the extent identification of the stated condition of step (IV)(B) is positively recited, it involves comparison of numeric values which is a mathematical relationship, formula, or calculation and, accordingly, an abstract idea. Aggregating step (IV)(B)(1) involves the mathematical calculation of a sum (i.e., summation), again, an abstract idea. Finally, recalculating step (IV)(B)(2) repeats the calculations of calculation step (III) with updated data and is also a mathematical calculation constituting an abstract idea.

In addition to steps individually reciting a mathematical concept and, therefore, an abstract idea, we agree with the Examiner that the steps in combination and as a whole constitute an abstract idea. *See* Ans. 3. This determination is consistent with Appellants' characterization of the invention as particularly relating to the modeling of random dopant fluctuations (RDFs) in semiconductor devices (Spec. ¶ 1), i.e., a mathematical model comprising mathematical relationships, formulas, equations and/or calculations and, therefore an abstract mathematical concept. Therefore, Appellants' argument that the Examiner failed to consider the claim as a whole is unpersuasive.

For the reasons discussed above, under Prong 1 of our analysis, we agree with the Examiner in determining claim 1 recites an abstract idea.

USPTO Step 2A, Prong 2

Appellants' contention that claim 1 is not abstract because it is directed to a particular calculation of a mathematical probability related to

semiconductor manufacturing (App. Br. 3–6) is unpersuasive because there is no recitation of a semiconductor manufacturing step or a semiconductor product manufactured using the model. *See* Ans. 3; *c.f.* Interview Summary. We contrast the present claims with those determined to be patent-eligible in *Diamond v. Diehr*, 450 U.S. 175, 192 (1981). In *Diehr*, the claim at issue was directed to "[a] method of operating a rubber-molding press" and, although reciting a mathematical formula, included a practical application by reciting the step of "opening the press automatically when a said comparison [according to the mathematical formula] indicates equivalence." *Diehr*, 450 U.S. at 179, fn. 5. The Court held that "[a] claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula." *Diehr*, 450 U.S. at 176; *see also id.* at 192 ("We view respondents' claims as nothing more than a process for molding rubber products and not as an attempt to patent a mathematical formula."). However, the Court also indicated that a claim "seeking patent protection for that formula in the abstract . . . is not accorded the protection of our patent laws, . . . and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment." *Id.* (citing *Gottschalk v. Benson*, 409 U.S. 63, 69 (1972) and *Parker v. Flook*, 437 U.S. 584 (1978)). We find no corresponding recitation by the claims of any physical action responsive to or product produced by the recited steps as was the case in *Diehr*. Contrary to Appellants' argument we disagree the recited overlying is a direct action with respect to two distinct objects (App. Br. 6) because the argued action is a mathematical or geometric partitioning of a virtual space, not a physical action. Likewise, the argued objects (the mesh and model) are mathematical constructs, not physical objects or particular

data structures.

Although possibly improving the modeling of random dopant fluctuation as argued by Appellants, claim 1 does not recite the manufacture of a semiconductor device and, therefore, does not encompass the argued "improvements in the manufacture of semiconductor devices." *See* App. Br. 5. Claim 1 merely limits the mathematical model to a particular technical environment, i.e., modeling of semiconductor devices, but does not include a particular machine, transform an article to a different state, or otherwise integrate the abstract mathematical concepts into a practical application. "[A]s we have said before, merely limiting the field of use of the abstract idea to a particular environment does not render the claims any less abstract." *Smart Sys. Innovations, LLC v. Chicago Transit Auth.*, 873 F.3d 1364, 1373 (Fed. Cir. 2017) (quotation omitted); *Bilski v. Kappos*, 561 U.S. 593, 612 (2010) ("limiting an abstract idea to one field of use . . . did not make the concept patentable"); *see also* MPEP § 2106.05(h).

In particular, we determine claim 1 does not recite:

(i) an improvement to the functioning of a computer;

(ii) an improvement to another technology or technical field;

(iii) an application of the abstract idea with, or by use of, a particular machine;

(iv) a transformation or reduction of a particular article to a different state or thing; or

(v) other meaningful limitations beyond generally linking the use of the abstract idea to a particular technological environment.

See MPEP §§ 2106.05(a)–(c), (e)–(h). Instead, any improvement is to calculating a mathematical probability of finding a dopant in a volume. Thus, claim 1 does not integrate the judicial exception into a practical application. *See* Guidance 54–56; MPEP § 2106.05(a)–(c), (e)–(h).

We are also not persuaded that the claims are patent-eligible based on any similarity with the subject matter determined to be patent-eligible in *BASCOM*. *See* App. Br. 11–13. In *BASCOM*, the court determined that "an inventive concept can be found in the non-conventional and non-generic arrangement of known, conventional pieces." *BASCOM*, 827 F.3d at 1350. In that case, the installation of a filtering tool at a specific location, remote from the end users, with customizable filtering features specific to each end user, provided an inventive concept in that it gave the filtering tool both the benefits of a filter on a local computer and the benefits of a filter on the ISP server. *Id.* We find no analogous technical improvement here. Absent recitation of a manufacturing step or resultant product, none of the claimed steps address a technological problem to which the claim is directed, i.e., calculation of a mathematical probability related to semiconductor manufacturing. That is, in contrast to the claims in *BASCOM*, Appellants' claims do not address a problem involving the use of a computer to perform the recited calculations, much less a problem specific to a computing device. Accordingly, Appellants' reliance on *BASCOM* is inapposite and, therefore, unpersuasive of Examiner error.

Appellants' preemption argument is also unpersuasive. *See* App. Br. 4. Although preemption "'might tend to impede innovation more than it would tend to promote it,' thereby thwarting the primary object of the patent

laws" (*Alice*, 573 U.S. at 216 (quoting *Mayo*, 566 U.S. at 71)), "the absence of complete preemption does not demonstrate patent eligibility" (*Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1379 (Fed. Cir. 2015)). *See also OIP Techs., Inc. v. Amazon.com, Inc.*, 788 F.3d 1359, 1362–63 (Fed. Cir. 2015) ("[T]hat the claims do not preempt all price optimization or may be limited to price optimization in the e-commerce setting do not make them any less abstract.").

USPTO Step 2B

Otherwise similar to claim 1, Beauregard-type claim 12 recites the additional limitations of a computer program product for storing a program executable by a processor for performing steps corresponding to the method of claim 1. We agree with the Examiner that the computer program product

> is recited at a high level of generality . . . as . . . generic computer functions routinely used in computer applications. Generic computer components recited as performing generic computer functions that are well-understood, routine and conventional activities amount to no more than implementing the abstract idea with a computerized system. The use of generic computer components to transmit information through an unspecified interface does not impose any meaningful limit on the computer implementation of the abstract idea. Thus, taken alone, the additional elements do not amount to significantly more than the above-identified judicial exception (the abstract idea).

Final Act. 3.

We are unpersuaded by Appellants' argument that, because "the Examiner concedes that the pending claims are allowable over the known art . . . the claims must . . . recite more than what is 'well-understood, routine and conventional.'" The Examiner does not find the entirety of the claim constitutes well-understood, routine and conventional activities, only the

computer program product and processor required to implement the abstract method. We agree with the Examiner that performing an otherwise abstract idea using only generic hardware is well-understood, routine and conventional. As the Federal Circuit has held, "the use of conventional computer components, such as a database and processors, operating in a conventional manner" "do[es] not confer patent eligibility." *Intellectual Ventures I LLC v. Capital One Bank (USA)*, 792 F.3d 1363, 1371 (Fed. Cir. 2015). This is because "mere automation of manual processes using generic computers does not constitute a patentable improvement in computer technology." *Credit Acceptance Corp. v. Westlake Servs.*, 859 F.3d 1044, 1055 (Fed. Cir. 2017).

Furthermore, whether the subject matter of claim 1 is novel is not dispositive with respect to the patent eligibility inquiry. *Mayo*, 566 U.S. at 78, 88 (even a truly groundbreaking abstract idea, like Einstein's theory of relativity, cannot make a claim patent-eligible); *Affinity Labs of Texas, LLC v. DirecTV, LLC*, 838 F.3d 1253, 1263 (Fed. Cir. 2016) (novelty "does not avoid the problem of abstractness"); *Genetic Techs. Ltd. v. Merial L.L.C.*, 818 F.3d 1369, 1376 (Fed. Cir. 2016) ("a claim directed to a newly discovered law of nature (or natural phenomenon or abstract idea) cannot rely on the novelty of that discovery for the inventive concept necessary for patent eligibility"); *buySAFE*, 765 F.3d 1350, 1352 (Fed. Cir. 2014) (abstract ideas are unpatentable "no matter how '[g]roundbreaking, innovative, or even brilliant'" they may be); *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 716 (Fed. Cir. 2014) (the fact that a method was "not previously employed in this art is not enough—standing alone—to confer patent eligibility upon the claims").

We, therefore, determine that neither the limitations of claim 1 nor those of claim 12 add significantly more to the patent-ineligible abstract idea.

Accordingly, we sustain the rejection of independent claims 1 and 12 under 35 U.S.C. § 101 together with dependent claims 2–7, 9–11, 13–18, and 20 which are not argued separately with particularity.

DECISION

We affirm the Examiner's decision to reject claims 1–7, 9–18, and 20 under 35 U.S.C. § 101.

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). *See* 37 C.F.R. § 41.50(f).

AFFIRMED