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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* LAWRENCE T. DRZAL and  
HIROYUKI FUKUSHIMA

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Appeal 2010-005104  
Application 11/435,471  
Technology Center 1700

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Before STEVEN J. BARTLETT, *Division 2 Support Manager*.

ORDER RE-MAILING BOARD DECISION

This appeal was originally decided on September 28, 2011 (see attached copy of the Decision). The Decision returned to the Patent and Trademark Office as undeliverable. Accordingly, the Decision is being re-mailed. Appellants' time for seeking rehearing under 37 CFR § 41.52(a)(1) expires two (2) months from the entry date of this Order.

Appeal 2010-005104  
Application 11/435,471

If there any questions pertaining to this Order, please contact the  
Board of Patent Appeals and Interferences at 571-272-9797.

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BEFORE THE BOARD OF PATENT APPEALS  
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*Ex parte* LAWRENCE T. DRZAL and HIROYUKI FUKUSHIMA

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Appeal 2010-005104  
Application 11/435,471  
Technology Center 1700

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Before LINDA M. GAUDETTE, MARK NAGUMO, and  
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

Opinion for the Board filed by *Administrative Patent Judge* GAUDETTE.

Opinion Concurring filed by *Administrative Patent Judge* NAGUMO.

GAUDETTE, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision<sup>1</sup> finally rejecting claims 1-26, the only claims pending in the Application.<sup>2</sup> We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

The invention relates to polymer-expanded graphite composites. (Spec.<sup>3</sup> [0004].) The expanded graphite used in the composites "is one which has been heated with radiofrequency waves and microwaves in a

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<sup>1</sup> Final Office Action mailed Sep. 11, 2007.

<sup>2</sup> Supplemental Appeal Brief filed Aug. 14, 2009 ("App. Br.").

<sup>3</sup> Specification filed May 17, 2006.

gaseous atmosphere to separate individual platelets of graphite.” (Spec. [0072].) “The use of microwave energy or RF induction heating” is said to “provide[] a fast and economical method to produce expanded graphite nanoflakes, graphite nanosheets, or graphite nanoparticles.” (Spec. [0073].)

Independent claim 1 is representative of the invention, and is reproduced below from the Claims Appendix to the Appeal Brief:

1. A composite composition which comprises in admixture:
  - (a) a polymer; and
  - (b) microwave or radiofrequency wave expanded graphite platelets, which were expanded from a graphite containing an intercalcant by boiling the intercalcant with radiofrequency or microwaves for up to five minutes and are optionally pulverized, in admixture in the polymer, wherein the platelets are present in an amount which provides electrical conductivity properties or provides barrier properties to gases or liquids or a combination of these properties.

Appellants request review of the following rejections (App. Br. 6):

1. Claims 1-26 under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement (Ans.<sup>4</sup> 3);
2. Claims 1-9, 11-16, 18-20 and 22-26 under 35 U.S.C. §102(b) as anticipated by Saito (US 6,024,900, issued Feb. 15, 2000) (Ans. 3-6);
3. Claims 1-9, 11-16, 18-20 and 22-26 under 35 U.S.C. §103(a) as unpatentable over Saito (Ans. 6-9); and
4. Claims 10 and 17 under 35 U.S.C. §103(a) as unpatentable over Saito in view of Krassowski (US 6,395,199 B1, issued May 28, 2002) (Ans. 9-10).

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<sup>4</sup> Examiner’s Answer mailed Jun. 6, 2008.

*Rejection under 35 U.S.C. §112, first paragraph,  
written description requirement*

The Examiner finds the Application, as originally filed, fails to provide support for “boiling the intercalcant” for time periods within the entire claim range of “for up to five minutes” as required by each of the independent claims, claims 1, 3, 7, 13, 14, 15, 16 and 23. (Final 2, Ans. 3.) Appellants have not argued the Examiner’s reasons are insufficient to meet the initial burden of establishing lack of support under 35 U.S.C. § 112, ¶ 1. (See App. Br. 7.) Thus, the sole issue raised for our consideration with respect to the first ground of rejection is:

Have Appellants identified disclosure in the originally filed Application which clearly allows one of ordinary skill in the art to recognize that Appellants invented a composite composition comprising “graphite platelets, which were expanded from a graphite containing an intercalcant by boiling the intercalcant with radiofrequency or microwaves for” time periods over the entire range of “up to five minutes” as recited in each of the independent claims?<sup>5</sup>

Appellants rely on Specification paragraphs [0075] and [0080] for written description support. (See Rep. Br.<sup>6</sup> 5.) Paragraph [0075] reads, in relevant part: “Heating for 3 to 5 minutes removes the expanding chemical.

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<sup>5</sup> “The test for sufficiency of a written description is ‘whether the disclosure clearly “allow[s] persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.”’” *Crown Packaging Technology, Inc. v. Ball Metal Beverage Container Corp.*, 635 F.3d 1373, 1380 (Fed. Cir. 2011) (quoting *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc) (quoting *Vas–Cath Inc. v. Mahurkar*, 935 F.2d 1355, 1562-63 (Fed. Cir. 1991))).

<sup>6</sup> Reply Brief filed Jul. 3, 2008.

The graphite absorbs the RF or microwave energy very quickly without being limited by convection and conduction heat transfer mechanisms. The intercalant heats up past the boiling point and causes the graphite to expand to many times its original volume.” Paragraph [0080] describes EXAMPLE 1, in which expanded graphite was prepared by exposing “[i]ntercalated graphite flakes . . . to microwave energy, typically at 2.45 GHz frequency, for a few seconds to a few minutes in an oven.”

The claims require “graphite platelets, which were expanded from a graphite containing an intercalant by *boiling* the intercalant with radio frequency or microwaves *for up to five minutes.*” (Claims 1, 3, 7, 13, 14, 15, 16 and 23 (emphasis added).) Appellants argue, and we agree, that the phrase “for up to five minutes” does not encompass 0 minutes, since the claims require “boiling,” which must necessarily take place for some period of time. (App. Br. 7.) However, we interpret the phrase “for up to five minutes” as encompassing a fraction of second. Appellants have not identified, nor do we find, any basis in the Specification or claims which supports a narrower interpretation of the claimed range.

The Specification provides support for *exposing* graphite flakes to microwave energy for a minimum time period of “a few seconds” and a maximum time period of five minutes. However, the Specification fails to indicate at what point during the *exposure* to radio frequency or microwaves, the intercalant begins to *boil*. Appellants have not directed us to any evidence which demonstrates that one of ordinary skill in the art would have understood from the originally filed Application that the inventors were in possession of a composite composition comprising “expanded graphite platelets, which were expanded from a graphite containing an intercalant by

*boiling* the intercalcant with radiofrequency or microwaves *for up to five minutes.*” (Claims 1, 3, 7, 13, 14, 15, 16 and 23 (emphasis added).) *See Carnegie Mellon Univ. v. Hoffmann-La Roche Inc.*, 541 F.3d 1115, 1122 (Fed. Cir. 2008) (explaining that to satisfy the written description requirement, an “applicant must ‘convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention,’ and demonstrate that by disclosure in the specification.” (quoting *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563-64 (Fed. Cir. 1991))).

Accordingly, we affirm the rejection of claims 1-26 under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement.

*Rejections under 35 U.S.C. §102(b) & §103(a)*

With respect to the prior art rejections, Appellants do not advance arguments in support of separate patentability of any particular claim or claim grouping. Rather, Appellants’ traversal of the prior art rejections is based on their contention that Saito fails to disclose graphite platelets “which were expanded from a graphite containing an intercalcant by boiling the intercalcant with radio frequency or microwaves for up to five minutes” as required by each of the independent claims. (*See* App. Br. 8.) Appellants concede that Saito does disclose graphite platelets expanded from a graphite by a conventional high temperature treatment. (*See* App. Br. 9.) The Examiner has correctly noted that the argued claim language is not a structural limitation, but describes the graphite platelets by the process used to obtain them. (*See* Final 3; Ans. 4; App. Br. 10 (“The graphite platelets in the claims of the present application have been described by a product-by-



process limitation.”.) Thus, the sole issue raised for our consideration with respect to the above-listed grounds of rejection 2-4 is:

Have Appellants met their burden to show that the claimed graphite platelets are structurally different from Saito’s graphite platelets?<sup>7</sup>

Saito discloses that production of expanded graphite can be conducted from a known process, such as by mixing concentrated sulfuric acid with hydrogen peroxide to form peroxomonosulfuric acid, adding raw material graphite with stirring to give rise to a reaction for about 1 hour to 1 day, and heating the reacted graphite at 500-1000 °C. (Col. 2, ll. 59-65.) According to Appellants, this is a conventional heating process to expand graphite. (App. Br. 9.)

As evidence of a difference between the claimed graphite platelets and those prepared by a conventional heating process, Appellants rely on evidence in the Specification and the Declaration of Lawrence T. Drzal<sup>8</sup>, a named inventor in the present application. Prof. Drzal relies on the

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<sup>7</sup> See *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985) (citations omitted) (“The patentability of a product does not depend on its method of production.”); *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977) (citations omitted) (“Where . . . the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the PTO can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of his claimed product. Whether the rejection is based on ‘inherency’ under 35 U.S.C. § 102, on ‘prima facie obviousness’ under 35 U.S.C. § 103, jointly or alternatively, the burden of proof is the same, and its fairness is evidenced by the PTO’s inability to manufacture products or to obtain and compare prior art products.”); *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990).

<sup>8</sup> Declaration under 37 C.F.R. § 1.132, executed Jun. 21, 2006 (“Dec.”), included in the Evidence Appendix to the Appeal Brief.

dissertation of Mr. Hiroyuki Fukushima (Dec. ¶ 4 (citing Exhibit A<sup>9</sup>)), also a named inventor in the present application. (See App. Br. 11-13.) Appellants contend the evidence shows that graphite expanded by a microwave or radiofrequency process for up to 5 minutes has a higher degree of expansion, less residual expander, and a cleaner surface than graphite expanded by a heat treatment. (App. Br. 11.)

The experiments described in the Specification were conducted using “a commercial microwave oven operating at 2.45 GHz.” (Spec. [0076].) FIG. 4 of the Specification reveals that the experiments included preparing expanded graphite by microwaving at 1040W for 3 minutes.

According to Mr. Fukushima,

[t]here are several methods to expand GICs [(graphite intercalated compounds)]. The most commonly used technique is the rapid heating in a furnace. This is widely used in the commercial stage. Other methods can include infrared laser, microwave, and electric current. Among these, *microwave systems are available in many sizes and power levels.*

(p. 71 (emphasis added).) Mr. Fukushima investigated the effects of “temperature, microwave power, and the size of graphite flakes on degree of expansion” and “the surface chemistry of the exfoliated graphite samples.” (p. 71.)

A comparison was made between expanded graphite prepared from various sizes of graphite flakes by heating at 900 °C for 5 minutes (p. 76) and by microwaving at 900W, 2.45 GHz for 5 seconds (p. 82<sup>10</sup>). With

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<sup>9</sup> The appeal record includes pages 70-98 of the Fukushima dissertation. The date of the dissertation is not identified in the appeal record.

<sup>10</sup> *Contra* p. 83, Figure 2.6, which identifies the samples as microwaved at 1300 W.

respect to the heating process, Mr. Fukushima “concluded that graphite flakes of 75  $\mu\text{m}$  or larger size show good expansion, and those of 180  $\mu\text{m}$  or larger show the maximum expansion.” (p. 76.) With respect to the microwave process, Mr. Fukushima concluded “the larger the size, the better the expansion.” (p. 82.) According to Mr. Fukushima, the comparison revealed “that microwave process could give *the same or better* degree of expansion for graphite flakes.” (p. 82 (emphasis added).)

A comparison was also made between expanded graphite prepared from graphite 160-50A<sup>11</sup> by heating for 3 minutes at temperatures of 300, 400, 500, 600, 700, 800, 900 and 1000 °C (p. 75), and by microwaving at powers of 650, 780, 910, 1040, 1170, and 1300 W for an undisclosed time period (p. 87, Figure. 2.10). According to Mr. Fukushima, the comparison “revealed that overall microwave treatment showed a better degree of expansion than conventional heating process.” (p. 84.)

“BET surface areas of heat or microwave treated samples were measured to estimate the degree of expansion.” (p. 84.) According to Mr. Fukushima, “[t]he surface areas of microwave exfoliated graphite samples were more than 4 times larger than those of the heat exfoliated samples.” (*Id.*) The copy of the dissertation in the appeal record does not include the details of the heat and microwave treatments used to prepare the samples on which the BET surface areas were measured.

On page 89 of the dissertation, Mr. Fukushima explains:

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<sup>11</sup> “Grafguard™160-50A[:] . . . ‘160’ refers to the onset temperature at which intercalated acid begins to be released and exfoliation of the graphite occurs. ‘50’ indicates the average size of the flakes is 50 mesh, which is 300  $\mu\text{m}$ . A, B, and N show the conditions of the sample surface, which are acidic, basic, and neutral.” (p. 72.)

To investigate the surface condition of expanded graphite, XPS (X-Ray Photoelectron Microscopy) data were collected and analyzed. Figure 2.15 shows the sulfur/carbon and nitrogen/carbon ratio of the expanded graphite. Sulfur content suggests the existence of sulfuric acid while nitrogen implies nitric acid. At 600°C treatment, the sulfur and nitrogen components were detected even after 10 minutes of treatment. At 800°C, these components were almost removed from the sample after 5 minutes of treatment. *At 1000 °C, it required about 2 minutes to remove these components.* Figure 2.16 shows the XPS results of expanded graphite by microwave treatment. In this case, *the sulfur and nitrogen component were removed after 2 minutes treatment at 910W and 1300W.* This implies that the microwave treatment also has advantage over conventional heating process in terms of removal of the residual intercalates.

(Emphasis added.) Figure 2.16 shows that the sulfur and nitrogen components were not removed after a 5 minute treatment at 780W. (p. 93.)

Evidence of secondary considerations must be reasonably commensurate with the scope of the claims. This does not mean that an applicant is required to test every embodiment within the scope of his or her claims. If an applicant demonstrates that an embodiment has an unexpected result and provides an adequate basis to support the conclusion that other embodiments falling within the claim will behave in the same manner, this will generally establish that the evidence is commensurate with scope of the claims.

*In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (citations omitted).

Appellants' "claims are silent regarding wattage of the claimed microwaves or radiowaves, the particulars of the devices used to apply the microwaves or radiowaves, the amount of power applied to the graphite, and any other parameters required to particularly point out what exactly is made

by the microwaving or radio frequency treating of graphite.” (Ans. 12.) The claims do not recite the particle size of the graphite, identify the particular intercalcant or its reaction time with the graphite. (*See* Ans. 13.) “Thus, the [] claims read on a wide variety of [compositions and] products due to these unknown and unclaimed factors.” (Ans. 12; *cf.* Spec. [0076] (“microwave frequency across a wide range can be used”); Fukushima dissertation p. 71 (“microwave systems are available in many sizes and power levels”).)

The Examiner finds Appellants’ evidence is not commensurate in scope with the claims, and concludes that Appellants have not demonstrated a difference between the claimed and prior art expanded graphite platelets. (Ans. 13-14.) We agree for the reasons detailed by the Examiner in the Answer.

We have taken into account Prof. Drzal’s testimony that Mr. Fukushima’s dissertation “illustrates [] graphite expanded by a microwave process has superior properties as compared to graphite expanded by a heat treatment.” (Dec. ¶4.) However, even accepting this statement as accurate, we find the evidence in the dissertation (and in the Specification) insufficient to support a conclusion that graphite expanded under conditions which were not tested, but still fall within the scope of the claims, would be expected to behave in the same manner. For example, the dissertation evidence shows residual intercalates can be removed in the same amount of time, 2 minutes, using either conventional heating conditions, i.e., 1000 °C (*see* Saito col. 2, ll. 59-65), or microwave treatments at 910W and 1300W. However, complete removal of residual intercalates is not possible at a microwave treatment of 780W for 5 minutes. Thus, a conventional heat treatment of the type used by Saito would appear to provide superior cleanness results to a

microwave treatment falling within the scope of the claims. Likewise, as acknowledged by Mr. Fukushima, particle size has an effect on expansion. (*See* Fukushima dissertation p. 82 *supra* p. 8) Therefore, depending on the particle size of the graphite, a microwave treatment may only give “the same” degree of expansion as conventional heating. (*Id.*) While Mr. Fukushima conducted heat treatments and microwave treatments over a number of different temperatures and microwave powers, there is no evidence the same results would be achieved for different treatment times, i.e., times which were either less than or greater than 3 minutes.

Accordingly, because Appellants have not shown a difference between the claimed and prior art graphite platelets, we affirm the rejections under 35 U.S.C. §102(b) & §103(a).

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).

AFFIRMED

NAGUMO, *Administrative Patent Judge*, concurring

I respectfully dissent from the affirmance of the rejection for lack of written description of the process limitation of “boiling the intercalant with radiofrequency or microwaves for up to five minutes.” The purpose of the written description requirement is to prevent an applicant from claiming, at some date after filing the application for patent, an invention that was not originally described. The majority is willing to accept that zero time is excluded because the process of boiling requires a finite amount of time. (Op. 4.) The Specification states that “[t]he graphite absorbs the RF or microwave energy very quickly without being limited by convection and conduction heat transfer mechanisms.” (Spec. 21 [0075].) In my view, this description provides support for boiling times down to the physical limits afforded by the cross section for RF or microwave absorption by the graphite and the processes by which that energy is converted to the random motions of heat. This results in very broad claims indeed, but, in my view, less broad than, for example, original claims 1-3, which specify no time limits. I am unable to see what substantive value is gained by attempting to impose a greater precision in claim language than the art normally requires.

The problems associated with providing such a broad definition of the process are, in my view, more than adequately dealt with by requiring Appellants to distinguish the claimed subject matter from the prior art. This the Examiner has done. I join the majority in affirming the rejections over prior art.

kmm