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**Datasheet for the decision
of 12 July 2018**

Case Number: T 0287/16 - 3.3.05

Application Number: 05765549.0

Publication Number: 1783097

IPC: C01B31/04

Language of the proceedings: EN

Title of invention:
EXFOLIATED GRAPHITE SHEET

Patent Proprietor:
TOYO TANSO CO., LTD.

Opponent:
GrafTech International Holdings, Inc.

Headword:
Exfoliated graphite sheet/TOYO TANSO

Relevant legal provisions:
EPC Art. 52(1), 54(1), 54(2), 56, 100(a), 100(b), 100(c)

Keyword:
Grounds for opposition - added subject-matter (no) -
insufficiency of disclosure (no) - lack of patentability (no)

Decisions cited:

T 0482/09, T 2290/12

Catchword:



Beschwerdekammern

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Case Number: T 0287/16 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 12 July 2018

Appellant: GrafTech International Holdings, Inc.
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 9 December 2015
rejecting the opposition filed against European
patent No. 1783097 pursuant to Article 101(2)
EPC.**

Composition of the Board:

Chairman E. Bendl
Members: A. Haderlein
S. Fernández de Córdoba

Summary of Facts and Submissions

- I. The appellant (opponent) lodged an appeal against the decision of the opposition division rejecting the opposition against European patent No. 1 783 097. The patent in suit concerns an expanded graphite sheet.
- II. The opposition division held that the grounds for opposition mentioned in Article 100(c), 100(b) and 100(a) in conjunction with Articles 52(1), 54 and 56 EPC did not prejudice the maintenance of the patent as granted, having regard in particular to the following documents:
- E5: eGraf HS-400 material datasheet, 2002
 - E6: Graftech laboratory data (1)
 - E7: Graftech laboratory data (2)
 - E8: US 3 494 382 A
 - E10: Bonnissel, M., et al., Compacted exfoliated natural graphite as heat conduction medium, Carbon 39 (2001) 2151 to 2161.
 - E11: Marotta, E.E., et al., The Effect of Interface Pressure on Thermal Joint Conductance for Flexible Graphite Materials: Analytical and Experimental Study, In: ITherm 2002 - Eighth Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems
 - E14: ASTM E 1461-07
 - E23: US 2002/0166660 A1
 - E25: First Affidavit John Wetula
- III. With its grounds of appeal, the appellant filed *inter alia* the following documents:
- E29: Second Affidavit John Wetula
 - E30: Affidavit Gary Mills

E31: Affidavit Shaikh Shadab
E32: Surface Roughness (JIS B 0601-2001)
E33: Surface roughness by different processing methods

With further letters, it filed *inter alia* the following documents:

E14a: ASTM E 1461-01
E14b: ASTM E 1461
E37: US 2003/0184696 A1
E38: JP 2000-016808 A

With letter dated 8 June 2018, the appellant filed *inter alia* explanatory remarks and a table comprising thermal conductivities calculated on the basis of the data contained in document E7.

IV. The sole independent claim 1 of the patent as granted reads as follows:

"1. An expanded-graphite sheet with a thermal conductivity of $350 \text{ W}/(\text{m}\cdot\text{K})$ or more in a direction parallel to the surface and with an arithmetic mean surface roughness of less than $5\mu\text{m}$, wherein the difference between the highest and lowest values of local thermal conductivities at various spots on the expanded-graphite sheet is 10% or less of the overall mean thermal conductivity thereof."

Dependent claims 2 to 4 concern particular embodiments of the expanded-graphite sheet of claim 1.

V. The appellant essentially argued as follows:

Claim 1 contained added subject-matter because the

application as filed referred to "surfacewise directions" in the plural, whereas claim 1 referred to "a direction parallel to the surface" in the singular.

The requirement of sufficiency of disclosure was not met because the skilled person would not easily be able to ascertain whether or not a particular graphite sheet fell within the scope of claim 1. The method disclosed in the patent was not suitable for measuring the thermal conductivity in a direction parallel to the surface as evidenced by E14, E14a and E14b, nor did the patent disclose how many spots should be tested to ascertain the thermal conductivity.

E8 was novelty-destroying for the subject-matter of claim 1. The surface roughness values and the thermal conductivity dispersion called for in claim 1 were implicitly disclosed in E8, as evidenced by E30. The rolling speed referred to in E30 was a typical rolling speed at the date of priority of the patent in suit, the date at which novelty should normally be assessed. The prior use of HS-400 was also novelty-destroying. E6 and E7 showed the surface roughness and the thermal conductivity dispersion as required in claim 1. This was evidenced by E29. In view of E29, there was no need to rely on E25.

The requirement of inventive step was not met, in particular when starting from E8 as the closest prior art. Also, E11 and E23 and the prior use of HS-400 could serve as the closest prior art. The solution was obvious in view of the reproduction of E8 as evidenced by E30 and E31 and in view of E10, E11, E23, E32, E33, E37, E38 or the prior use of HS-400.

VI. The respondent essentially argued as follows:

Neither the ground for opposition pursuant to Article 100(c) EPC nor the one pursuant to Article 100(b) EPC prejudiced the maintenance of the patent. In particular, the appellant had not shown that the claimed subject-matter could not be arrived at when using the information contained in the patent and common general knowledge. Neither E8 nor the prior use HS-400 were novelty-destroying. None showed the required surface roughness and thermal conductivity dispersion. In particular, it was a mere allegation that the data in E7 were obtained from a single sheet cut into ten pieces. Likewise, it had not been shown that the properties disclosed in E6 were inherently disclosed in the HS-400 material made available prior to the effective date of the patent. The requirement of inventive step was also met. In this context, the problem to be solved was to avoid the formation of hot spots. There was no teaching in the prior art towards the proposed solution.

VII. The appellant requested that the contested decision be set aside and the European patent be revoked.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Amendments - Article 100(c) EPC

1.1 According to the appellant, the application as filed referred to "surfacewise directions" in the plural, whereas claim 1 referred to "a direction parallel to the surface". The original expression in the plural

implied that the thermal conductivity was required to have the claimed value in all surfacewise directions, whereas according to granted claim 1 this value needed to be fulfilled in a single direction only.

- 1.2 This argument is not persuasive. Apart from the argument appearing essentially semantic, the board observes that the application as filed explicitly discloses the expression "parallel direction" in the singular (see page 2, line 7 of the description dated 15 May 2006, corresponding to paragraph [0006] of the published application). Thus, there is an explicit basis for using the singular rather than the plural in claim 1.
- 1.3 Therefore, the ground for opposition pursuant to Article 100(c) EPC does not prejudice the maintenance of the patent.
2. Sufficiency of disclosure - Article 100(b) EPC
 - 2.1 The appellant essentially submitted two lines of arguments in order to support its objection of lack of sufficient disclosure. Firstly, it was not clear to the skilled person which method of measuring the thermal conductivity was to be used in order to ascertain whether a particular graphite sheet fell within the scope of claim 1. The laser flash method referred to in the patent was not suitable for measuring the thermal conductivity in a direction parallel to the surface, as evidenced by E14, E14a and E14b. Rather, it was the well-known Angstrom method which was suitable for this purpose. Secondly, it was also not clear to the skilled person how the "various spots on the expanded graphite sheet" referred to in claim 1 were to be chosen. Again, depending on how the spots were chosen, a particular

graphite sheet would or would not fall within the scope of claim 1.

- 2.2 Even assuming that, for the benefit of the appellant, E14a and E14b were admitted into the proceedings, the board is still not persuaded by either line of argumentation.

First and foremost, it is established case law that the question of whether a particular embodiment falls within the scope of a claim relates to the delimitation thereof and thus to the requirement of clarity rather than sufficiency of disclosure (see for instance T 2290/12, Reasons 3.1, and T 482/09, Reasons 2.1).

Also, neither the fact that the claim does not indicate the method to be used in order to measure the thermal conductivity nor the fact that the description discloses a method which allegedly is not suitable for measuring the thermal conductivity in a direction parallel to the surface of the graphite sheet constitutes a bar for the sufficiency of disclosure. As stated above, the lack of indication in the patent specification of a measurement method for a commonly known parameter in a claim is, according to the case law of the boards of appeal, not a matter of sufficiency of disclosure but rather of clarity (T 482/09, *loc.cit.*). In the case at hand, it is uncontested that the thermal conductivity called for in claim 1 is a commonly known parameter and that a well-known method (the Angstrom method) is available to the skilled person in order to determine this parameter, even if it were established that the method disclosed in the patent in suit (the Laser Flash method) were not suitable for measuring this parameter. Against this background, the argument that the patent only discloses

a method which allegedly is not suitable for measuring the thermal conductivity called for in claim 1 relates to clarity and not sufficiency of disclosure.

Likewise, the lack of more detailed information on the location of the "various spots" referred to in claim 1 does not constitute a bar to sufficiency of disclosure.

- 2.3 The appellant also submitted that the thermal conductivity dispersion referred to in claim 1 could also relate to thermal conductivity in the trough direction. This argument also at most relates to the clarity of the claim and does not call into question the sufficiency of disclosure of the invention. In particular, it is uncontested that the Laser Flash method referred to in the patent in suit is suitable for measuring thermal conductivity in the trough direction and, thus, even if the thermal dispersion in claim 1 were construed so as to refer to the thermal conductivity in the trough direction, the invention would be sufficiently disclosed.
- 2.4 The board also notes in this context that the appellant has not provided any evidence that would suggest that the skilled person using the information contained in the patent specification and common general knowledge would not be able to arrive at a graphite sheet having the features called for in claim 1 and using, for instance, the Angstrom method in order to determine the conductivity dispersion referred to therein.
- 2.5 The board thus concludes that the requirement of sufficiency of disclosure is met and the ground for opposition set forth in Article 100(b) EPC does not prejudice the maintenance of the patent.

3. Novelty

3.1 E8

3.1.1 It is uncontested that this document does not explicitly disclose either the surface roughness called for in claim 1 or the feature "wherein the difference between the highest and lowest values of local thermal conductivities at various spots on the expanded-graphite sheet is 10% or less of the overall mean thermal conductivity thereof" ("thermal conductivity dispersion").

3.1.2 According to the appellant, these features were implicitly disclosed in E8, as evidenced by the experimental data contained in its grounds of appeal obtained from graphite sheets made according to Example IV of E8, as evidenced by E30.

3.1.3 The board observes that, while E8 is silent about the rolling speed, according to E30, paragraph 5, the above data were obtained using a rolling speed of 12 ft/min. The appellant has neither shown nor contended that the roughness values and the thermal conductivity dispersion do not depend on the line speed used. Also, according to the patent in suit, these parameters do indeed depend on the rolling speed (see paragraph 0054]). Obtaining the data contained in the grounds of appeal using a specific rolling speed when reproducing example IV of E8 is therefore a specific selection over that example and cannot be said to prove an implicit disclosure of these data in E8. Whether the above rolling speed is a "typical line speed used at AET since at least 1990", as alleged in E30, paragraph 5, is not relevant here, because in order to argue an implicit disclosure it must be shown that nothing other

than the contentious feature forms part of the subject-matter disclosed (see Case Law of the Boards of Appeal of the European Patent Office, "Case Law", 8th edition, I.C.4.3). Moreover, contrary to the appellant's view, novelty is to be assessed at the date of publication of the prior art document and not at the priority date of the patent in suit (see *Case Law, supra*, I.C.2.3). Thus, the rolling speed used in order to obtain the data relating to the surface roughness and the thermal dispersion contained in the grounds of appeal cannot be said to be implicitly disclosed in E8. As a consequence, these data cannot be said to be implicitly disclosed in E8.

3.1.4 Therefore, the subject-matter of claim 1 differs from the graphite sheet obtained in E8 at least by the surface roughness values and the thermal conductivity dispersion and is thus novel over E8.

3.2 Prior use of HS-400

3.2.1 The opposition division found that the "HS-400 Heat Sink Material" having a thermal conductivity in a direction parallel to the surface of 370 W/mK and described in E5 was publicly available prior to the priority date of the patent in suit (see impugned decision, section 5). This finding is not contested.

3.2.2 The question that needs to be answered is whether HS-400 possessed all the features of claim 1 prior to the effective date of the patent in suit. In order to prove that HS-400 possessed surface roughness and thermal conductivity dispersion values falling within the claimed range, the appellant relies on E6 (surface roughness values) and E7 (Angstrom test).

3.2.3 In relation to these pieces of evidence, and as a response to the opposition division's rejecting as inadmissible document E25 (see section 2 of the impugned decision), the appellant filed document E29.

While in its grounds of appeal (see points 24 et seq.) the appellant considered that "at least some of" the documents, including E25, "should have been admitted into the proceedings" at the oral proceedings before the board, it stated that, in view of E29 referring to documents E6 and E7, it was not necessary to rely on document E25. There is therefore no need for the board to consider E25 or to assess whether the opposition division exercised its discretionary power correctly when rejecting document E25 as inadmissible.

Furthermore, in its submission of 30 August 2016, the respondent requested not to be admit E29 into the proceedings. Even when taking this document, in favour of the appellant, into consideration, HS-400 is not considered to be novelty-destroying (see below). Therefore, discussion of E29's admissibility is also not necessary.

3.2.4 It is undisputed that the data in D6 and D7 were produced after the priority date of the patent in suit. In its decision, the opposition division raised doubts as to whether the properties of the tested graphite sheets which form the basis for the results of D6 and D7 were identical to those of the graphite sheets available prior to the priority date of the patent in suit (see item 5 of the appealed decision). As stated above, affidavit E29 was submitted by the appellant to overcome any doubts in this respect.

However, paragraph 7 of E29, referring to the method for (re-)producing the graphite sheets, contains the following passage (emphasis added by the board): "*The wording [used in the previous affidavit] was intended to mean that the manufacturing methods, and therefore also the physical properties of the resulting graphite sheet, have not changed **to any material extent**. In other words, **no significant** changes have occurred ...*". Passage 9 of E29 goes on to state: "*However, as the graphite sheets were created **using the same method of manufacture**, they will have the same physical properties. The results shown in E6 and E7 are therefore within the acceptable margin of error for the graphite sheet available before the priority date of the European patent number 1783097.*"

To the board, the cited passages are contradictory or at least ambiguous. The first of the cited passages permits some (minor) changes in manufacturing methods as well as in the properties of the final expanded graphite sheet compared with the graphite sheets publicly available before the priority date. No further details about the nature and degree of such changes, apart from the subjective statement that they were "no[t] significant", are given. In contrast thereto, passage 9 of E29 stresses that the same method of manufacture (as in the past) was used and that therefore the product had the same physical properties, although this was relativised in the next sentence by a reference to a (quantitatively undefined) margin of error. Thus, it cannot be concluded without any doubt from E29 alone that the graphite sheets available before the priority date and the ones used later on were produced by **exactly** the same process and that they were therefore, as far as technically possible, identical.

Taking into account the fact that the question of whether production methods and product properties had changed over time had already been an issue in the first instance proceedings and that E29 was submitted to clarify this question, the board comes to the conclusion that the doubts as to the identity of the physical properties of the various graphite sheets still exist. The affidavit presented leaves it open whether the manufacturing methods applied/products used were, as far as technically possible, identical. For this reason alone the prior use HS-400 cannot be regarded as novelty-destroying.

- 3.2.5 Furthermore, the tests according to D6 and D7 were carried out at different points in time (in 2005 and 2006), and in each case only one of the required properties was determined. No proof has been submitted that the graphites tested in D6 and D7 were identical and that the combination of all the requirements as defined in claim 1 (surface roughness and thermal conductivity dispersion values) was met in every case.
- 3.2.6 In addition, the data contained in the appellant's letter dated 8 June 2018 and concerning the tests "before thermal cycling", i.e. the HS-400 material that was allegedly made available prior to the priority of the patent in suit (E7, "HS 400 Before Thermal Cycling Repeatability Test 1 of 10" to "10 of 10" on pages 95 to 99 of laboratory notebook 742-58 and pages 1 to 11 of laboratory notebook 742-61), shows thermal conductivities in the range of 365 to 375 W/mK.

While these values seem essentially to match the value of 370 W/mK disclosed in E5, there is no evidence that they were obtained by cutting several pieces from a

single graphite sheet and carrying out thermal conductivity measurements on those sheets. While the appellant contends that the ten pieces tested were cut from a single piece (see appellant's letter dated 8 June 2018, page 8, fifth paragraph), there is no evidence that would support this contention.

For these reasons too, the board is not convinced that the above data relate to a single sheet of graphite. Thus, the data provided fail to prove that the publicly available material HS-400 possessed the thermal conductivity dispersion called for in claim 1.

- 3.2.7 Concerning document E6, this excerpt from a laboratory notebook contains a page dated 8 October 2006. A printed sheet seems to be glued onto that page, the printed sheet bearing a different date, i.e. 13 November 2006. The appellant has not provided a convincing reason as to why these two dates are different. For this reason, too, the board is not convinced that the surface roughness data contained in E6 necessarily relate to HS-400 material in the form which was available to the public before the effective date of the patent in suit.
- 3.2.8 In conclusion, it has not been established that the material HS-400 which was publicly available before the effective date of the patent possessed the surface roughness values and thermal conductivity dispersion falling within the ranges of claim 1.
- 3.2.9 The subject-matter of claim 1 is therefore also novel in view of the publicly available material HS-400.
- 3.3 In conclusion, the ground for opposition set forth in Article 100(a) in conjunction with Articles 52(1) and

54(1), (2) EPC does not prejudice the maintenance of the patent.

4. Inventive step

4.1 The patent concerns an expanded graphite sheet.

4.2 Concerning the closest prior art, in its written submissions the appellant started from E8, E11 and E23 and the prior use of HS-400, whereas at the oral proceedings before the board, when asked for the closest prior art, it started from E8. The board therefore considers it appropriate to start from the latter document as the closest prior art.

As concluded in point 3.1.4 above, the subject-matter of claim 1 differs from the disclosure of E8 at least by the surface roughness values and the thermal conductivity dispersion.

4.3 According to the appellant, the problem was the provision of a graphite sheet with improved uniformity in thermal conductivity resulting from the smoothness of its surface.

4.3.1 As correctly pointed out by the respondent, such a formulation of the problem includes an element of the solution which is not permissible according to established case law (*Case Law, supra*, I.D.4.4).

4.3.2 Rather, the problem underlying the patent is, as submitted by the respondent, how to avoid the formation of heat spots (cf. paragraphs [0013] and [0014] of the patent in suit).

- 4.4 As a solution to this problem, the patent proposes an expanded graphite sheet as defined in claim 1, characterised at least by an arithmetic mean surface roughness of less than 5µm and the difference between the highest and lowest values of local thermal conductivities at various spots on the expanded graphite sheet being 10% or less of the overall mean thermal conductivity thereof.
- 4.5 It is common ground that the problem referred to above at 4.3.2 is successfully solved. Thus, there is no need to reformulate the problem.
- 4.6 As to obviousness, even when admitting, to the benefit of the appellant, documents E30 to E33, E37 and E38 into the proceedings, there is no document in the proceedings that would show both the surface roughness and the thermal conductivity dispersion as required in claim 1, let alone a piece of prior art that would teach to implement these features in E8 in order to solve the problem posed.
- 4.6.1 The surface roughness and thermal dispersion data provided in the grounds of appeal (point 24 et seq., documents E30 and E31), are not inherently disclosed in E8 (see point 3.1 above), but were obtained with knowledge of the patent after the effective date thereof. Therefore, these data cannot be used in order to show that it was obvious to arrive at the claimed subject-matter.
- 4.6.2 In its grounds of appeal, the appellant also referred to E10, which "the skilled person may also consult", but failed to give any indication as to the relevance of this document. It is also not apparent to the board

how this document could hint at the proposed solution.

- 4.6.3 E11 discloses a surface roughness within the claimed range (see Table 2 on page 7), but is silent about any effect associated therewith. Moreover, E11 does not disclose the required thermal conductivity dispersion.
- 4.6.4 E23 does not contain any teaching with respect to surface roughness.
- 4.6.5 E32 and E33 relate very generally to surface roughness and do not contain any teaching with respect to thermal conductivity or formation of heat spots on graphite sheets.
- 4.6.6 While E37 discloses a surface roughness of 1.0 μm (paragraph [0101]), the appellant has not shown that this document would not only teach to apply this roughness in E8 but would also lead to the skilled person arrive at a thermal dispersion as called for in claim 1.
- 4.6.7 According to the appellant, E38 taught that unevenness of the graphite sheet improved the uniformity of heat conductivity. The board observes that the appellant has not indicated any passage in this document that would support this contention. While the abstract of this document mentions elimination of unevenness and "excellent" heat conductivity, the board cannot recognise any teaching in this document towards the roughness values and thermal conductivity dispersion called for in claim 1.
- 4.6.8 Also, the public prior use of HS-400 cannot lead the skilled person to the claimed solution, as this material was not shown to possess the contentious

features of surface roughness and thermal conductivity dispersion (see point 3.2 above).

- 4.6.9 Finally, at the oral proceedings the appellant also submitted that it was obvious to arrive at the claimed subject-matter starting from E8 when using common general knowledge, i.e. the commonly employed rolling speed as mentioned in item 5 of E30, necessarily resulting in the required surface roughness values and thermal conductivity dispersion.

This argument must also fail, because there is no evidence that would show that the skilled person would have employed the aforementioned rolling speed in order to solve the problem posed.

- 4.6.10 For these reasons, it was not obvious to arrive at the subject-matter when starting from E8. Likewise, it was also not obvious to arrive at the claimed subject-matter when starting from the other pieces of evidence submitted by the appellant, i.e. E11, E23 and the prior use of HS-400.

In conclusion, the subject-matter of claim 1 involves an inventive step as required by Article 56 EPC. The same reasoning applies *mutatis mutandis* to dependent claims 2 to 4. The ground for opposition set forth in Article 100(a) in conjunction with Articles 52(1) and 56 EPC thus does not prejudice the maintenance of the patent.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



K.Götz-Wein

E. Bendl

Decision electronically authenticated