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Case Number: T 2559/11 - 3.3.05

Application Number: 98203777.2

Publication Number: 906896

IPC: C04B 35/52, C04B 35/56, F27B 9/04, F27B 9/10

Language of the proceedings: EN

Title of invention:
Process for producing a dense, self-sintered silicon carbide/ carbon-graphite composite

Patentee:
THE MORGAN CRUCIBLE COMPANY PLC

Opponent:
ESK Ceramics GmbH & Co. KG

Headword:
Silicon carbide/THE MORGAN CRUCIBLE COMPANY PLC

Relevant legal provisions:
EPC Art. 76(1), 54, 56, 111(1), 100(b), 100(c)

Keyword:
"Disclosure of claimed subject-matter in the parent application as filed - yes"
"Sufficiency of disclosure - yes"
"Novelty and inventive step - yes"
"Remittal - no"

Decisions cited:
T 0249/93

Catchword:
-

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Case Number: T 2559/11 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 20 December 2012

Appellant: (Patent Proprietor)	THE MORGAN CRUCIBLE COMPANY PLC Quadrant, 55-57 High Street Windsor, Berkshire SL4 1LP (GB)
Representative:	Boff, James Charles Phillips & Leigh 5 Pemberton Row London EC4A 3BA (GB)
Respondent: (Opponent)	ESK Ceramics GmbH & Co. KG Max-Schaidhauf-Strasse 25 D-87437 Kempten (DE)
Representative:	Merkle, Gebhard ter Meer Steinmeister & Partner GbR Mauerkircherstrasse 45 D-81679 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 12 October 2011 revoking European patent No. 906896 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman: B. Czech
Members: H. Engl
S. Hoffmann

Summary of Facts and Submissions

I. The appeal is from the decision of the opposition division revoking European patent No. 0 906 869. Corrected European patent specification EP 0 906 869 B9 is based on European patent application EP 98 203 777, a divisional application of EP 94 909 546. The date of mention of the grant of the patent in suit was 26 April 2006 (Bulletin 2006/17) and the Corrigendum was issued on 14 March 2007 (Bulletin 2007/11). The patent was granted with 10 claims.

II. The single independent claim of the patent as granted reads as follows:

"*1. A process for producing a dense, self-sintered silicon carbide and carbon-graphite composite material comprising the steps of:*

(a) providing a particulate mixture comprising:

(i) carbon-bonded graphite of between 2 and 30 percent by weight of the mixture, the carbon-bonded graphite comprising at least 5 percent by weight carbon-precursor binder, the balance being graphite,

(ii) between 1 and 10 percent by weight of a binder,

(iii) between 0.1 and 15 percent of a sintering aid,

(iv) between 1 and 5 percent by weight of a lubricant, and

(v) the balance being silicon carbide; and

(b) shaping the mixture to form a green body;

(c) heating the green body in a non-oxidising atmosphere at a carbonizing temperature above 371°C (700°F) to carbonize the binder; and

(d) sintering the carbonized body at a temperature ranging from 1900°C to 2300°C in a substantially inert atmosphere at or below atmospheric pressure to produce a sintered body having a density of at least 80 percent of theoretical and a microstructure in which the average grain size of the carbon-graphite is larger than the average grain size of the silicon carbide."

Dependent claims 2 to 10 as granted define further embodiments of the process of claim 1.

III. The European patent was opposed under the grounds for opposition according to Articles 100(a) (lack of inventive step) and 100(b) EPC (insufficiency of disclosure). The ground for opposition according to Article 100(c) EPC) was admitted to the proceedings by the opposition division although it was only raised after the expiry of the opposition period.

IV. During the opposition proceedings *inter alia* the following documents were cited:

V. D1: JP-A-63-260 861 A (translation into English)

D2: T. Fetahagic and D. Kolar, *"Microstructure development in α-SiC";* Cer. Acta 2, no. 2, pages 31 to 37 (1990)

D3: T. Mizrah et al., *"Pressureless Sintering of α-SiC";* Reprint from powder metallurgy international vol. 16, no.5, pages 217 to 220, (1984)

D4: R.D. Nixon et al., *"Correlation of steady-state creep and changing microstructure in polycrystalline SiC sintered with powder derived via gaseous reactants in an arc plasma";* J. Mater. Res. 3 (5), pages 1021 to 1030 (1988)

D5: DE-C2-33 29 225

D7A: WO-A-94/18141 (PCT publication of the parent application of the patent in suit)

VI. In the contested decision, the opposition division *inter alia* held that the opposed patent as granted did not fulfil the requirements of Articles 76(1), 123(2) and 100(c) EPC, since the parent application did not disclose the combination of features of claim 1 of the patent in suit. More particularly, the parent application did not disclose a combination of the process steps (a), (b) and (d) as recited in claim 12 thereof with the more general form of step (c), comprising features derived from page 7, lines 18 to 19, thereof. The auxiliary requests then on file were also held to be objectionable under Article 100(c) EPC.

VII. The patentee's (appellant's) statement setting out the grounds of appeal was accompanied by an amended set of claims as new third auxiliary request and by Annexes 1 to 3 (containing further arguments and a Figure).

VIII. The respondent (opponent) filed its observations by a letter dated 29 May 2012, maintaining *inter alia* its earlier objection under Articles 76(1) and 100(c) EPC against the claims as granted (appellant's main request). It also requested that the case be remitted to the first instance in case one of the appellant's requests were held non-objectionable under Article 100(c) EPC.

IX. A further submission of the appellant, dated 11 September 2012, was accompanied by amended sets of claims as new third, fourth and fifth auxiliary requests and the following new documents:

D7: Extract from *"Concise Encyclopaedia of Advanced Ceramic Materials"*, Pergamon Press, R.J. Brook, Ed.; Headword "*Silicon Carbide*", pages 426 to 429; and

D8: Printout dated 2012 (three pages) from the webpage www.malvern.com.

X. Oral proceedings before the board took place on 20 December 2012. The appellant filed new sets of amended claims as new main and first to fifth auxiliary requests, in replacement of all previously pending requests. The appellant also expressly withdrew its request for reimbursement of the appeal fee.

XI. As far as they concern its main request, the arguments of the appellant can be summarised as follows:

Regarding Articles 100(c) and 76(1) EPC:

The difference between granted claim 1 and claim 12 of D7A (the parent application) consisted essentially in the replacement of a narrower feature in part (c) by a broader feature disclosed as such in the description of D7A (page 7, lines 18 to 19).

In the present case, such replacement was allowable under the principles expressed in the Guidelines for examination and the case law. As regards "intermediate generalisations", the general test to be applied was whether the omitted features were inextricably linked with the remaining features.

The patent as granted stood this test, because the claimed method was described in D7A as comprising four sequential separate and independent steps achieving different purposes and because no new technical information was provided by the steps set out in claim 1 in comparison with the steps set out in claims 12 of D7A. Therefore, claim 1 did not infringe Article 76(1) EPC.

Regarding Article 100(b) EPC:

The appellant maintained its arguments put forward in opposition proceedings and accepted by the opposition division in the summons to oral proceedings posted on 17 June 2011, paragraph 6.1.

Regarding inventive step:

The appellant agreed to argue on the basis of document D1 representing the closest prior art. The presence of a lubricant in the mixture and the use of an

intermediate carbonizing step contributed to ensure a more uniform product and to reduce voids and cracking in the final composite.

Accordingly, the appellant defined the problem to be solved as providing a process improving the density and freedom from cracking of the materials known from D1.

The solution consisted in the claim features which synergistically interacted to improve density and reduced the propensity to cracking of the sintered body.

A comparison of examples 1 to 4, 7 and 8 with examples 9 to 18 of the patent in suit showed that the use of carbon-bonded graphite as an ingredient of the raw material mixture resulted in better densities and water absorption values. Moreover, Annex 3 presented synoptically the results of Figure 2 of D1 and of examples 12 and 18 of the patent in suit. The improvement in terms of density was evident. Therefore, the problem posed was credibly solved.

The claimed solution was not obvious in the light of the available prior art, because to specifically avoid a mandatory feature of D1 (the granulation step), and to include an intermediate carbonisation step, a binder and a lubricant, was not obvious from the art cited, including documents D2 and D5.

XII. The respondent essentially argued as follows:

Regarding Articles 100(c) and 76(1) EPC:

The claims in accordance with the main request (claims 1 and 2 as granted) contravened the requirements of Article 100(c) EPC in conjunction with Article 76(1) EPC. The crucial issue was whether amended claim feature (c) reading:

"(c) heating the green body in a non-oxidizing atmosphere at a carbonizing temperature above 371°C (700°F) to carbonize the binder"

was directly and unambiguously derivable from the parent application as originally filed, i.e. whether the amendments introduced subject-matter extending beyond the content of the parent application.

The respondent observed that said amended step (c) was not, as such, disclosed in the parent application (see document D7A): The feature *"in a non-oxidizing atmosphere"* was missing in claim 12 thereof, and the treatment temperature was required to be in the range of "*800 to 900°C*".

On the other hand, the description, page 7, lines 18 to 19, of D7A disclosed that

"The shaped green body is carbonized in a non-oxidizing atmosphere above 700°F.",

without, however, mentioning that the step was performed in order *"to carbonize the binder"*.

In summary, the parent application failed to disclose the combination of the three features

- non-oxidizing atmosphere
- temperature above 371°C (700°F)
- in order to carbonize the binder.

Furthermore, although the process steps a) to d) were not mutually independent, other more specific features disclosed in connection with step (c) as described on page 7, lines 18 to 19, of the parent application had not been incorporated into claim 1 at issue.

Regarding Article 100(b) EPC:

The respondent, referring to its notice of opposition, page 3, point 3, observed that of the examples depicted in Figure 2, supposed to illustrate the invention, only examples 9, 16, 17 and 18 actually yielded the desired result, namely a dense and impervious product with no water absorption. All others failed or showed some lamination. The description of the opposed patent did not explain why so many of the allegedly inventive examples failed with respect to these characteristics. Therefore, the claimed invention could not be carried out without an undue burden of trial and error experimentation, contrary to what was allowed in accordance with the case law.

Regarding Article 100(a) EPC:

Document D1 was to be considered as the closest prior art. However, in the absence of conclusive comparative evidence, the alleged effects, i.e. an increase in density of the final product, and its homogeneity and freeness of cracks could not be taken into account in the assessment of inventive step. The opposition

division was wrong in concluding that all of the examples according to the invention, i.e. examples 9 to 18, showed a higher density and lower water absorption than the corresponding comparative examples 1 to 8. For example, water absorption in examples 10 to 15 was unacceptably high and the densities achieved in examples 10 to 18 were lower than that reported for example 1.

Starting from the disclosure of document D1 as closest prior art, the technical problem was thus merely to provide an alternative process. Adding a lubricant was an obvious measure, as illustrated *e.g.* by document D2. Foreseeing an intermediate carbonisation step was suggested by document D5, in particular examples 4 and 9 thereof.

XIII. Requests

The appellant requested that the decision under appeal be set aside and that the patent be maintained with the claims according to the main request and the description and the figures of EP 0 906 896 B9 or, alternatively, on the basis of the claims according to one of the auxiliary requests 1 to 5, all requests filed during the oral proceedings.

The respondent requested that the appeal be dismissed. Moreover, it requested that the case be remitted to the department of first instance for further prosecution in case the claims according to one of the appellant's requests were found not to be objectionable under Article 100(c) EPC.

Reasons for the Decision

1. Admissibility of the appellant's main request

1.1 The claims according to *inter alia* the main request were filed during oral proceedings, in response to objections raised by the board in connection with the question of whether the granted dependent claims, and in particular granted claim 3, met the requirements of Article 76(1) EPC.

1.2 The fact that the back-references of the dependent claims at issue were broadened compared to the back-references in claims 13 to 21 of the parent application, each of which referred back only to claim 12, had already been observed and addressed in writing by the respondent. However, the crucial question of whether the parent application as filed actually disclosed the specific combination of features according to claim 3 of the patent as granted, referring back as it does to claims 1 or 2 as granted, was addressed for the first time at the oral proceedings.

1.3 The proposed amendment constitutes a reaction to a newly identified, potential deficiency. It consists in the deletion of dependent claims 3 to 10. No new issues and no increase in complexity can be seen to arise from this amendment.

1.4 Considering these specific circumstances, the board, in the exercise of the discretion conferred on it by Article 13(1) and (3) RPBA, therefore decided to admit the claims according to the main request at issue to

the appeal proceedings despite there very late filing.

2. Original disclosure of the claimed subject-matter (main request)

2.1 Whereas the independent process claim 12 of the parent application as filed (see document D7A) discloses a process including the step of

"*(c) heating the green body at a temperature ranging from 800°C to 900°C to carbonize the binder;*",

step (c) in the process claim 1 at issue reads as follows:

"(c) heating the green body ***in a non-oxidizing atmosphere*** *at a* ***carbonizing*** *temperature* ***above 371°C (700°F)*** *to carbonize the binder" (emphasis added by the board).*

Moreover, the description of D7A, page 7, lines 18 to 19, discloses that

"[t]he shaped green body is carbonized in a non-oxidizing atmosphere above 700°F".

2.2 The amendment of the features of step (c) as recited in claim 1 does not, in the board's opinion, contravene the requirements of Article 76(1) EPC, for the following reasons.

2.2.1 The first question to be answered is whether the skilled person, upon reading the parent application as a whole, would directly and unambiguously derive

therefrom the information that in the process of claim 12 the temperature range for carbonizing the binder could be replaced by the broader range as disclosed in the description on page 7, lines 18 to 19.

The board answers in the affirmative, because it is clear from the description of the parent application as a whole that the very purpose of this intermediate carbonisation step is, in general terms, to convert the green body containing a binder into a carbonized body which is subsequently subjected to the sintering step (d) mentioned in claim 12. It is also evident to those of skill in the art that carbonisation of a binder used in forming the green body may commence already at the lower temperatures above 700°F (371°C), depending in particular on the type of "*carbon-precursor binder*" used. Therefore, the skilled person would understand that the carbonising step described on page 7, lines 18 to 18, may be fitted into the overall process disclosed in claim 12 of the parent application.

The board also sees no contradiction in the passage on page 8, lines 9 to 12, of document D7A, cited by the respondent, which states that

"[t]his density may be achieved, since during carbonization, part of the carbon-precursor binder for the graphite volatilizes, leaving voids, while the remainder forms a coke residue on the graphite."

In the board's view, this statement does not imply that the binder was not fully carbonized during step (c), but only that a part of it forms a coke residue, while the remainder is volatilised.

2.2.2 The second question to be answered is whether the above mentioned amendments in step (c) would necessarily require consequential amendments in the other steps (a), (b) and/or (d) recited in the independent process claim.

In this connection, the respondent already conceded that process steps (a) through (d) were intermediate steps to be performed in the prescribed order to thereby obtain the final SiC/carbon-graphite composite products and that each of these steps served its own distinct purpose (see letter of 29 May 2012, page 6, penultimate paragraph).

The board is not convinced by the respondent's argument that step (c) as recited in claim 1 as granted was only disclosed in the parent application in the context of the description of processes requiring a specific kind of binder (a resin binder), in a specific amount of 5%, or posing additional restrictions on the choice of the sintering aid and the lubricant which were not recited in claim 1 as granted. Said parts of the description only recite typical examples of a binder and their amounts which were found suitable in the process, without however restricting the claimed invention to the said examples. The same applies to what is said about the sintering aid and the lubricant.

For the board, the amended process features in step (c) of claim 1 at issue are not inextricably linked with any of the other more specific characteristics of the preceding or subsequent steps mentioned in the overall "detailed description" of the process on pages 4 to 8 of D7A. This is for instance apparent from the "summary

of the invention" on page 3, lines 27 and 28, comprising the following very general statement, without any indication of a temperature range, and without any reference to the preceding or subsequent steps: "*The green body is heated to carbonize the carbon-precursor binder*". Moreover, the skilled person would understand from the sentence on page 7, lines 25 to 26, of D7A, reading "*other suitable carbonization cycles may be used*", that the particular temperature range specified in claim 12 of the parent application is a preferred and not a mandatory aspect of the process disclosed.

Hence, even without any restricting amendments to steps (a), (b) and (d), the amendments in step (c) of the independent process claim, and in particular the broadening of the applicable temperature range, do not result in defining subject-matter that was not disclosed in the parent application as filed.

2.3 In summary, claims 1 and 2 according to the main request at issue do not define subject-matter extending beyond the content of the parent application as filed.

2.4 Except for the unchallenged replacement of a slash ("/") by "and" in claim 1, claims 1 and 2 at issue are identical to claims 1 and 2 of the divisional application as filed. This was not in dispute.

2.5 Hence, the patent in the version according to the main request at issue is not objectionable under Article 100(c) EPC.

3. Sufficiency of disclosure (main request)

3.1 The respondent's objection is, in essence, based on the allegation that from examples nos. 9 to 18, shown in Figure 2 of the patent in suit and supposed to illustrate the invention, only four examples, namely nos. 9, 16, 17 and 18 actually yielded the desired result, namely a dense, impervious product with a water absorption of 0%. All others were allegedly either insufficiently densified, had an unacceptably high level of water absorption and/or showed lamination. In the respondent's argumentation, a failure in 6 out of 10 examples could not be regarded as occasional. Because the description did not explain why the desired characteristics could not be obtained, the claimed invention could not be carried out without undue burden of trial and error experimentation, contrary to what was allowed by the case law.

3.2 The board is not convinced by these arguments for the following reasons.

3.2.1 It is noted that the respondent did not argue that the claimed process could not be performed by the skilled person, upon reading of the description and taking into account common technical knowledge. The respondent did not deny that by carrying out a process falling within the terms of claim 1 one would be able to obtain a self-sintered SiC and carbon/graphite composite article having a density of at least 80% of theoretical density and a microstructure as defined in the claim.

3.2.2 As regards the other characteristics of the products so obtained, the board observes that a total avoidance of

water absorption and/or lamination is not a mandatory characteristic of the claimed process. Therefore, the question whether or not all the samples prepared by a process according to claim 1 (examples nos. 9 to 18; making use of carbon-bonded graphite as raw material) meet some stricter requirements considered essential by the respondent in view of the description of the patent in suit (paragraph [0008]), such as total imperviousness, 0% water adsorption and/or no lamination, needs not be considered in this context.

3.2.3 In any event, the examples in accordance with the claimed invention (nos. 9 to 17) were shown to provide higher densities and lower water absorption values than the respective comparative examples nos. 1 to 4, 7 and 8. The comparative examples were obtained using the same sintering temperatures, graphite loadings and raw material mix (SiC, phenolic resin binder, sintering aid and lubricant), but used "non-carbon-bonded graphite" (KS6 or KS150). The respective increases in density and reductions in water absorption can be gathered from the following synoptic table (data taken from Table 2 of the opposed patent):

Ex.No.	Graphite wt-%	Sintering temperature	Final density	water absorption
1 (comp)	4.6	2070	2.95	0.12
9	4.6	2070	3.03	0
2 (comp)	8.7	2070	2.79	1.48
10	8.7	2070	2.83	1.18

3 (comp)	16	2070	2.56	4.8
11	16	2070	2.78	0.21
4 (comp)	22.2	2070	2.28	8.59
12	22.2	2070	2.48	3.87
7 (comp)	15	2090	2.45	6.02
8 (comp)	15	2090	2.49	5,00
13	15	2090	2.63	0.72
14	15	2090	2.65	1.08
15	15	2090	2.73	2.36
16	15	2090	2.74	0
17	15	2090	2.75	0

These experimental results show a range of materials and process conditions suitable for obtaining the dense, self-sintered silicon carbide bodies that were aimed for according to the patent in suit, even with high (up to 15 wt.-%) amounts of graphite, 0% water absorption and no lamination. More particularly, the description expressly addresses the issue of lamination which may occur upon removal of the body from the die when the graphite particle size is too large and, in such a case, teaches the "sizing" of the graphite by sieving it through a 75 µm sieve (see paragraph [0028]). The favourable effect of this measure is illustrated by examples 9 to 13, where unsieved graphite ("unsized") is used and some lamination may occur (see examples 10 and 11), in comparison with examples 14 to 18, employing sized graphite, and which do not show lamination. Sizing of the graphite/carbon binder mixture is also part of the process disclosed in the flow sheet of Figure 1.

3.3 In summary, the board is satisfied that the examples and the description of the opposed patent contain sufficient instruction and guidance for enabling the skilled person to carry out the claimed invention, i.e. to produce a dense, and even impervious, self-sintered silicon carbide and carbon-graphite composite having a density of at least 80 percent of theoretical and a microstructure in which the average grain size of the carbon-graphite is larger than the average grain size of the silicon carbide.

3.4 The patent in the version according to the main request is thus not objectionable under Article 100(b) EPC.

4. Novelty (main request)

4.1 Novelty was not under dispute. The board is satisfied that none of the available prior art documents discloses a process having, in combination, all the characteristics of the process of claim 1 at issue.

4.2 In particular, the differences of the claimed process compared to the process disclosed in D1 become apparent under point 5.2 below.

4.3 The subject-matter of claim 1 and, consequently, of claim 2 dependent thereon is thus novel (Articles 52(1) and 54(1)(2) EPC).

5. Inventive step (main request)

5.1 *Object of the invention*

The present invention is concerned with a process for

manufacturing self-sintered silicon carbide / carbon-graphite composite materials of high density (see paragraph [0001] of the patent as granted). As set out in the description of the patent in suit (see paragraph [0003]), a self-sintered process is one which does not require the application of pressure during the heating for sintering to occur. Due to the incorporation of graphite into the sintered SiC body, the products prepared by the claimed process are self-lubricating (see paragraphs [0004] and [0005]).

5.2 *Closest prior art*

5.2.1 Document D1 is considered to represent the closest prior art as it also deals with the preparation of self-lubricating sintered materials comprising SiC and graphite. D1 addresses the same aim as the patent in suit, namely to produce sintered SiC products of a high density comprising substantial proportions of graphite (see D1, page 3, claims 1 and 2; and page 5, summary).

5.2.2 More particularly, D1 discloses a process for the manufacture of a silicon carbide/graphite self-lubricating body from compositions comprising 5 to 40% by volume of a graded granular graphite powder comprising phenolic resin as a binder and having particle diameters of 60 to 250 mesh (see page 3, second paragraph; page 9, second paragraph). The process comprises the steps of dry-mixing the graded granular graphite powders and a granular silicon carbide powder, pre-moulding the mixture, moulding it by a cold hydrostatic moulding press process and sintering at a temperature of 2180°C for 45 minutes (see pages 8 and 9, Examples). The silicon carbide

which is used as raw material for the matrix layer may be admixed with a sintering aid such as boron carbide and a binding agent, e.g. phenolic resin, after which it is granulated, e.g. by spray drying, to obtain a granulated powder of prescribed particle size (see page 6, last paragraph; examples). The density (relative to theoretical) of the products so obtained varies from about 95% (at 0% by volume of graphite) to about 75% (at 40% of graphite) (see Figure 2 of D1).

5.2.3 It was common ground between the parties that D1 neither discloses an intermediate process step of heating the green body in a non-oxidising atmosphere at a carbonising temperature above 371°C (700°F) to carbonise the binder (step c) of the opposed patent), nor the use of an additional "*lubricant*" within the meaning of claim 1, i.e. of a "*die lubricant*" such as oleic acid, as a component of the material composition used.

5.2.4 The parties had different views concerning the question of whether or not D1 disclosed
- a raw material mix meeting the definition given in part a) of claim 1 at issue, and
- a sintered end product "*wherein the average grain size of the carbon graphite is larger than the average grain size of the silicon carbide*".

However, the board can leave these issues open, as the presence of an inventive step ultimately does not depend on them, in view of the reasons given hereinafter.

5.3 *Technical problem*

Starting from the process disclosed in document D1 as the closest prior art, the appellant defined the technical problem to be solved by the invention as providing an improved process leading to increased densities and freedom from cracking of the materials so produced.

5.4 *Solution*

As a solution to the above-defined problem, the patent in suit proposes the process according to claim 1, characterized in particular in that it comprises, as an intermediate step (c) before the sintering step, "*heating the green body in a non-oxidising atmosphere at a carbonizing temperature above 371°C (700°F) to carbonize the binder*", and in that the green mixture contains "*between 1 and 5 percent by weight of a lubricant*".

5.5 *Success of the solution*

5.5.1 It is evident that the presence of a lubricant in the raw material composition is beneficial in the moulding process. In particular, it is plausible and remained undisputed that the lubricant not only facilitates the removal from the die, thereby preventing lamination, but also acts as a pressing aid to assist in uniform pressing of the material, as was submitted by the appellant.

5.5.2 Moreover, since during the carbonization the binder is thermally degraded to residual carbon and gaseous degradation products (water and carbon dioxide), the

provision of the intermediate carbonisation step (c) allows these gaseous degradation products to evolve and escape gradually through the green body's porosity before the actual sintering commences. Therefore, it is plausible that the porosity closes only during the subsequent sintering step (d) (see also paragraph [0022] of the patent in suit). Consequently the board accepts, in the absence of evidence to the contrary, that the formation of voids and cracks in the final sintered product can, thereby, be essentially avoided.

5.5.3 For the board, the beneficial effects of the quoted characterising features are corroborated by the comparative data submitted as Annex 3 under cover of the statement of grounds of appeal. In Annex 3, the Relative Density (%) values achieved according to examples 12 and 18 of the patent in suit are compared with "density / graphite content" curves taken from Figure 2 of document D1. The comparison shows that for comparable graphite contents the densities achieved according to the patent in suit are always higher than the ones achieved according to D1, irrespective of the graphite granule size used according to D1.

As pointed out by the respondent, the examples of D1 and examples 12 and 18 of the patent in suit are not directly comparable due to some differences in starting materials and process conditions.

Nevertheless, it is to be noted that the sintering of the green body in D1 was carried out at 2180°C for 45 minutes (see page 9, second paragraph), whereas in examples 12 and 18 of the patent substantially lower sintering temperatures of 2070°C and 2090°C were used,

typically with a heat-up phase of eight hours and a sintering period of one hour (see paragraph [0021]). The board observes that the authors of document D1 (see page 5, Summary) also expressly aimed for high density composites, and that higher sintering temperatures generally lead to a higher densification velocity. Hence, the board accepts that the comparisons made in Annex 3 show that a relative increase in density will be obtained when performing the process according to claim 1 at issue using comparable starting materials and process conditions.

5.5.4 The board is thus satisfied that the addition of a lubricant and the intermediate step (c) of carbonising the binder before sintering according to step (d) both contribute to obtaining a material having an increased density and a homogenous microstructure, which is essentially free of cracks and has relatively low water absorption values, as illustrated by examples 9 to 18 of the patent in suit (see also points 3.2.2 and 3.2.3 above).

5.6 *Obviousness*

It remains to be decided whether the claimed solution is obvious having regard to the prior art.

5.6.1 Modifying the process disclosed in document D1 by providing the intermediate carbonisation step (c) is not, for the following reasons, suggested by the prior art invoked by the respondent.

Regarding current claim feature c), the respondent referred to document D5 in order to demonstrate

obviousness. It argued that according to example 9, referring back to example 4, of D5 a green body of SiC, up to 30 vol.-% of graphite, 0.5% B_4C and 6 wt.-% of phenolic resin was prepared by wet mixing, drying, sieving the mixture and moulding it to a ring-shaped body, which was subsequently calcined and sintered at 2050°C at ambient pressure in an Ar atmosphere (see example 4: *"… unter Bildung von ringförmigen Körpern geformt, die dann* ***calciniert*** *und bei 2050°C unter Atmosphärendruck in einer Argonatmosphäre gesintert wurden"; emphasis added*). In the respondent's view, the above mentioned step of calcining clearly corresponded to an intermediate step of heating the green body in a non-oxidising atmosphere at a carbonising temperature above 371°C (700°F) to carbonise the binder.

The board cannot, however, agree with the respondent's interpretation of D5. The wording *"calcined and … sintered at 2050 °C…"* does not describe a distinct process step of carbonising the binder. For the board, a simultaneous calcination and sintering appears to be implied. There is also no indication elsewhere in D5 of a distinct carbonisation step for the binder, or of different calcining, respectively sintering conditions. The board concludes that since D5 does not directly and unambiguously disclose the provision of an intermediate step of binder carbonisation before the actual sintering step, it cannot, without the benefit of hindsight, suggest modifying the process disclosed in D5 by foreseeing such an intermediate step.

For this reason, the respondent's obviousness argument based on a combination of D1 and D5 must fail.

5.6.2 Neither in its written submissions nor during the oral hearing, did the respondent rely on other combinations of documents in arguing lack of inventive step.

Documents D2, D3 and D4 relate to the pressureless sintering of SiC, but without any previous addition of carbon-bonded graphite (D2 and D4), and do not aim at preparing sintered SiC composites comprising large carbon-graphite grains (D2 to D4). The board is thus satisfied that they do not, in combination with D1, render the claimed subject-matter obvious.

5.7 In summary, the subject-matter of claim 1 of the main request involves an inventive step (Articles 52(1) and 56 EPC). Consequently, the same applies to dependent claim 2.

6. As the main request is allowable, the appellant's auxiliary requests need not be dealt with.

7. Procedural matters

7.1 The impugned decision of the opposition division only dealt with the ground for opposition under Article 100c) EPC, in conjunction with Articles 76(1) and 123(2) EPC.

7.2 The respondent therefore requested that the case be remitted to the department of first instance for further prosecution, in case the claims were found not to be objectionable under Article 100(c) EPC.

7.3 The appellant asked the board to take a final decision rather than to remit the case. It pointed out that the patent expired in 2013 and that in case the board were

to order a remittal it was unlikely that a final decision on the merits would be handed down before that date.

7.4 It is established jurisprudence that parties have no absolute right to have an issue decided upon by two instances. Pursuant to Article 111(1), second sentence, EPC, it is within the discretion of a board to decide itself on the merits of the case.

7.5 The board has, in principle, some sympathy for the appellant's argument that a remittal should not be ordered if a final decision was unlikely to be reached until after expiry of the patent (*cf. e.g.* T 249/93, of 27 May 1998, Reasons, point 2.2). However, this argument weighs less in the present case of a divisional application which was filed 5 years after the priority date.

7.6 In the appeal proceedings, the factual framework of the case has not substantially changed compared to the opposition proceedings. In their written submissions and at the oral proceedings both the appellant and the respondent have argued exhaustively on all the grounds of opposition that have been raised. The board, in possession of the parties' full argumentations, was therefore able to render a final decision on the merits.

7.7 Under these circumstances, the board considers it to be in the interest of procedural economy and efficiency to decide upon all outstanding issues, including those not decided by the first instance.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent in the following version:

   – claims 1 and 2 according to the main request filed during oral proceedings;

   – description, columns 1 to 7 of EP 0 906 896 B9;

   – figures 1 to 5D of EP 0 906 896 B9.

The Registrar The Chairman

C. Vodz B. Czech