

Internal distribution code:

- (A) [-] Publication in OJ
- (B) [-] To Chairmen and Members
- (C) [-] To Chairmen
- (D) [X] No distribution

**Datasheet for the decision
of 30 September 2022**

Case Number: T 1294/20 - 3.3.09

Application Number: 13169274.1

Publication Number: 2666807

IPC: C08J5/24, C08K7/06, C08L101/00

Language of the proceedings: EN

Title of invention:

A PREPREG AND CARBON FIBER REINFORCED COMPOSITE MATERIALS

Patent Proprietor:

Toray Industries, Inc.

Opponent:

Teijin Carbon Europe GmbH

Headword:

PREPREG AND COMPOSITE MATERIALS/TORAY

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - main request (no) - auxiliary requests (no)

Decisions cited:



Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1294/20 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 30 September 2022

Appellant: Toray Industries, Inc.
(Patent Proprietor) 1-1, Nihonbashi-Muromachi 2-chome
Chuo-ku
Tokyo, 103-8666 (JP)

Representative: Mewburn Ellis LLP
Aurora Building
Counterslip
Bristol BS1 6BX (GB)

Respondent: Teijin Carbon Europe GmbH
(Opponent) Kasinostr. 19-21
42103 Wuppertal (DE)

Representative: Henkel & Partner mbB
Patentanwaltskanzlei, Rechtsanwaltskanzlei
Maximiliansplatz 21
80333 München (DE)

Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 17 March 2020
revoking European patent No. 2666807 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chairman A. Haderlein
Members: C. Meiners
F. Blumer

Summary of Facts and Submissions

- I. This decision concerns the appeal filed by the patent proprietor (appellant) against the opposition division's decision to revoke the patent in suit ("the patent").
- II. In its notice of opposition, the opponent (respondent) had requested that the patent be revoked in its entirety on, *inter alia*, the ground for opposition under Article 100(a) EPC in combination with Article 56 EPC (lack of inventive step).

In its decision, the opposition division found, *inter alia*, that the then third auxiliary request lacked an inventive step (Article 56 EPC).
- III. With its statement setting out the grounds of appeal, the appellant filed a main request and 12 auxiliary requests.
- IV. The board summoned the parties to oral proceedings and issued a communication under Article 15(1) RPBA 2020 in which it set out its preliminary opinion.
- V. Together with a letter dated 27 September 2022, the appellant filed a new main request (previous auxiliary request 4 submitted with the grounds of appeal) and auxiliary requests 1 to 8 (corresponding to previous auxiliary requests 5 to 12 submitted with the grounds of appeal).
- VI. Claim 1 of the main request of 27 September 2022 reads:

"1. A prepreg for use in making a carbon fiber resin reinforced composite material for an aircraft structural member, the prepreg containing a carbon fiber [A] and a thermosetting resin [B], and in addition, satisfying the following:
a thermoplastic resin particle [C] and a conductive particle [D] are contained, and weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000."

VII. Claim 1 of auxiliary requests 1 to 3 comprises optional features and thus includes the scope of claim 1 of the main request. Claim 1 of auxiliary request 4 has the additional limitation: "[;] wherein the prepreg does not contain a thermoplastic resin fiber nor a conductive fiber."

Claim 1 of auxiliary requests 5 to 8 corresponds to claim 1 of auxiliary requests 1 to 4, respectively, but comprises the additional limitation that the aircraft structural member be "selected from a main wing, tail wing, flap, aileron, cowl, fairing, or rocket motor case".

VIII. The following documents are relevant to the decision:

D13-1	WO98/26912 A1
D13-2	Translation of WO 98/26912 A1 into English
D14-1	S. Daimo et al., " <i>Study of Interlaminar Toughening of CFRP Laminates with Fine Titanium Particle Dispersion</i> ", 46th Conference on Structural Strength, 140-2
D14-2	Translation of S. Daimo et al. into English
D26	US 2005/0070185 A1

- D29 G. Gardiner, "Lightning Strike Protection For Composite Structures", Composites World, July 2006
- D31 1st declaration of Prof. Hajime Kishi
- D32 2nd declaration of Prof. Hajime Kishi
- D33 Experimental Report Teijin Limited

IX. The appellant's arguments relevant to the decision may be summarised as follows.

Documents D31 and D32 should be admitted, whereas document D33 should not be admitted into the proceedings.

The main request and the auxiliary requests met the requirements of the EPC. Document D13 was not a suitable starting point for the discussion of inventive step. The teachings of D13 and D14 were self-contained and mutually incompatible. The hypothetical combination of the teachings of D13 and D14 would result in a prepreg unsuitable for the fabrication of aircraft structural members. All requests met the requirements of Article 56 EPC in view of D26 as the closest prior art. D26 explicitly taught away from the use of thermoplastic particles in carbon fibre reinforced resin preregs.

X. The respondent's arguments relevant to the decision may be summarised as follows.

Auxiliary requests 1 to 8 should not be admitted.

In addition, none of the claim requests involved an inventive step in view of D13 as the closest prior art in view of D14 as a secondary source of information. This assessment applied irrespective of whether the

objective technical problem in view of D13 was to provide alternative or improved prepregs. D14 taught expressly to include fine metal particles between the carbon fibre layers of adjacent prepregs. Thus, in D14, in addition to the improvement of electrical conductivity, the toughness and in particular the mode I interlaminar fracture toughness of the prepregs was improved.

XI. Requests

The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request or any of auxiliary requests 1 to 8, all requests as filed with the letter of 27 September 2022.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Admittance of documents D31 to D33

- 1.1 The appellant requested that document D33 not be admitted into the appeal proceedings.

The board takes the view that the teaching of document D33 was considered in the opposition division's decision and that its admission by the opposition division is implied. As the appealed decision is based on, *inter alia*, D33, the reference to D33 by the respondent cannot be considered an amendment to its case within the meaning of Article 12(4) RPBA 2020.

1.2 Likewise, the board sees no reason not to take documents D31 and D32, filed by the patent proprietor in the opposition proceedings, into account. Both documents were also taken into account in substance in the decision appealed in the discussion of inventive step. Again, the board takes the view that their admittance into the first-instance proceedings is implied.

1.3 Hence, the board considers documents D31 to D33 to form part of the appeal proceedings.

2. *Inventive step (Article 56 EPC) - Main request*

2.1 The patent

The patent is directed towards the provision of a prepreg and the resulting carbon fibre reinforced composite material having an excellent impact resistance (compressive strength after impact, CAI) and electrical conductivity in thickness direction (see paragraphs [0004] and [0009] of the patent).

2.2 Closest prior art

In the appealed decision, the opposition division held document D13 to be the closest prior art for the assessment of inventive step of the subject-matter of claim 1.

By contrast, the appellant considers D26 to be the closest prior art and contests that D13 can serve as a suitable starting point for assessing inventive step. In the following, the translation of document D13-1

into English, designated as D13-2 in the appealed decision, is referred to as D13.

The appellant's arguments against the suitability of D13 as a starting point for inventive merit centred around the consideration that D13 was unable to "set the skilled person on a journey that would lead in an obvious way to the invention".

Thus, the appellant takes the question of the obviousness of the effect ascribable to the distinguishing feature(s) into account when assessing that D26 was a more promising starting point. Essentially, the appellant argues in its submission of 27 September 2022 that the board's reasoning set out in its preliminary opinion was based on a flawed understanding of the purpose of the patent and thus in conflict with established case law. The board, it argued, had failed to take account of the fact that excellent impact resistance *and* electrical conductivity in thickness direction was achieved *together* in the patent.

The board, however, observes that such a formulation of the purpose underlying the patent and the prior art is too narrow and not in line with the established case law of the boards. This approach would mean discarding a document not addressing the technical problem addressed in the patent as suitable closest prior art even if such a document addresses the same or a similar purpose to the one of the patent.

However, whether the closest prior art would lead to the claimed invention in an obvious way can only be decided after having established the *objective*

technical problem causally related to the distinguishing technical feature(s).

Moreover, a teaching towards the distinguishing feature(s) may come from another item of prior art or the skilled person's common general knowledge. The closest prior art does not have to disclose *all* the problems allegedly solved by the claimed invention, and it certainly does not have to disclose the *objective* technical problem (which is established in the *next* step; see Case Law of the Boards of Appeal of the European Patent Office, 10th edn. 2022, Chapters I.D. 3.2 and I.D.3.4.1). Applied to the case at hand, this means that the closest prior art does not need to be directed towards the optimisation of CAI *and* conductivity in thickness direction *together*.

Hence, also the considerations made by Prof. Kishi in declarations D31 and D32 and the corresponding line of argument put forward by the appellant that a skilled person would not realistically consider D13 a good starting point for arriving at prepregs useful for the preparation of composites having good CAI and electrical conductivity in thickness direction cannot change the picture in this regard. In declaration D32, Prof. Kishi held the teaching of D26 to be a more relevant technical proposal for addressing the problems as defined in the patent compared to the published European patent application based on D13 and D14.

As argued by the respondent, D26 discloses thermoset and thermoplastic resins as alternative polymer matrices, and carbon fibres are mentioned among other fibre materials (such as glass fibres) for the described composite materials. The combination of these materials is thus only obtained after selections from

two lists. D26, however, addresses the material properties CAI and lightning strike protection (LSP). Nevertheless, given the finding that the subject-matter of claim 1 does not involve an inventive step in view of D13 as the closest prior art for the reasons provided below, whether D26 would be an even *more* suitable starting point for inventive step, as put forward in D32 in light of the teaching of D29, can be left unanswered.

D13 also mentions structural members in the aerospace area as a suitable application area for the manufactured prepregs. In-plane electrical conductivity, ascribable to the conductivity of the carbon fibres, is moreover inherent to carbon fibre laminates.

D13 also addresses the problem of providing laminates exhibiting good impact resistance properties, as expressed by CAI, and hence the first of the two material properties to be optimised in the patent in suit. Like in the patent, thermoplastic particles located and accumulated within the surface zone of the prepreg bring about this effect. D13 is thus directed towards the same or a similar purpose as the patent in suit and is, in the view of the board, a suitable starting point for the assessment of inventive step under the problem-solution approach.

2.3 Distinguishing features

It is common ground between the parties that the prepreg of claim 1 of the main request differs from the prepreg disclosed in D13 in that i) it contains (electrically) conductive particles and that ii) the

weight ratio expressed by particles [C]/particles [D] is from 1 to 1000.

2.4 Associated technical effect and objective problem

2.4.1 The appellant argues that an acceptable balance of CAI and thickness direction electrical conductivity (of the cured composite materials resulting from the prepregs claimed) was achieved across the full scope of claim 1. This was shown in the examples and illustrated in Figure 2 of the patent. The steep, non-linear increase of volume resistivity above a weight ratio of [C]/[D] of 1000 was surprising, as was the non-linear increase of CAI at a [C]/[D] ratio of 1 compared to lower ratios. Consequently, the end points for the ratio of [C]/[D] in claim 1 were not arbitrary. By contrast, the respondent had failed to provide any evidence for its allegation that the end points were meaningless. LSP was not only important for primary structural members but also for secondary structural members, including interior components of an aircraft such as floor beams (see D29, first and second paragraphs on page 1). Furthermore, the indication "for use in making a carbon fiber resin reinforced composite material for an aircraft structural member" in claim 1 required the airworthiness of the resulting structural member. This imposed a limitation on the scope of claim 1, and there was no requirement to indicate every measure for implementing the claimed invention in the claim.

2.4.2 The board concurs with the respondent that the purported effect is not achieved over the whole scope claimed because features are missing from claim 1 which appear necessary for achieving the sought technical effect. For instance, only the relative weight ratios of particles [C]/[D] in the prepregs are specified in

claim 1 and not their absolute amounts. However, it is not credible that it is possible to establish a conductive path in thickness direction across the interlayers of the resulting composites when using only small amounts of electrically conductive particles (see paragraph [0091] of the patent). The necessity of forming a conductive path is described in paragraph [0020] of the patent, as outlined by the respondent. This finding is all the more relevant given that claim 1 does not specify the absolute particle size (diameter) of component [D] either. As a result, when the conducting particles are too small, they can penetrate into the carbon fibre layers instead of localising in the resin-enriched interlayers (see paragraph [0078]). Furthermore, it follows from the patent that the conductive particles [D] have to be larger than the thermoplastic particles [C] for them not to be buried in the insulating interlayer of the thermoplastic particles (see paragraph [0077]). The board agrees with the respondent that LSP is not a feature of claim 1 either.

Whether these features are disclosed in the patent's description is, however, irrelevant. Applied to the current case, features necessary for achieving the sought electrical conductivity in thickness direction cannot be read into claim 1 if they are missing from it. This would mean selecting suitable feature combinations for implementing the sought purpose "for use in making ... aircraft structural member" and interpreting into the claim that it inherently required electrical conductivity in thickness direction in view of the indicated purpose as specified in claim 1.

- 2.4.3 For these reasons, the board is not convinced that all embodiments of claim 1 lead to composite materials

exhibiting electrical conductivity in thickness direction, requiring a conductive path formed in the thickness direction of the resulting composites. It also follows that the respondent's assessment is convincing that the ratio from 1 to 1000 for thermoplastic resin particles [C] to conductive particles [D] is not credibly associated with the sought acceptable balance between CAI and electrical conductivity in thickness direction. Such a balance is suggested in the patent specification (see paragraph [0169] and Figure 2).

Therefore, the board concludes that the objective technical problem credibly solved across the full breadth of independent claim 1 is to provide an alternative prepreg.

2.5 Obviousness

- 2.5.1 The appellant takes the view that, in view of D13, a skilled person would not have expected to obtain prepregs suitable for the fabrication of aircraft structural parts exhibiting airworthiness when adding metal particles to the interlayers of the composites. D13 mentioned all the types of particles which should be present in the prepregs it described. Metal particles, however, were not mentioned in D13 as suitable components of the prepregs. There was no motivation to combine metal particles with nylon particles in the prepregs of D13.

Similarly, D14 only described metal particles in the interlayer. The teaching of D13 and D14 was self-contained and mutually incompatible. Including non-metal particles would go against the aim of D14 to

provide both conductivity and mechanical stability using titanium particles.

While a skilled person could have applied the teaching of D14 to the prepregs of D13 by adding metal particles, there was no pointer for them to do so. By contrast, they would have adopted one of the commercially proven and emerging surface-based solutions (as described in D29) for providing LSP rather than risk undoing the improvements in mechanical strength accomplished in D13 by including loosely held titanium particles. The surface-based solutions implied lateral dissipation of electrical energy. In 2006, providing LSP to such composites had been accomplished by means of adding separate layers onto, or just below, the composite's surface, rather than integrating LSP into a prepreg itself. This was explained by Prof. Kishi in declaration D31, as corroborated by the teaching of documents D29 and D14. D31 and D32 explained the realistic expectations from the technical perspective of a skilled person in 2006.

- 2.5.2 As to this line of argument, the board takes the view that, in the context of the problem-solution approach applied by the boards, a skilled person merely wishing to provide an alternative prepreg suitable for the fabrication of aircraft structural members such as a main wing would not require an explicit pointer (or "tangible evidence") to combine a secondary source of information with the closest prior art. In such a scenario, they would have considered modifying the prepregs of D13 to arrive at alternatives not previously accomplished. They would thus also have consulted secondary documents on the same technical area, such as document D14, that would have provided a "pointer" to accomplishing such alternatives. Put

differently, in considering the teaching of D14, they would have had a reasonable expectation of success to solve the less ambitious problem of creating an alternative to the existing embodiments of D13.

- 2.5.3 The argument that D14 was an academic paper featuring preliminary results rather than providing a mainstream solution to LSP for (primary) aircraft structural parts has, in the opinion of the board, no bearing on the obviousness of the subject-matter claimed. The appellant argued that D14 was a "proof of principle-study" rather than a realistic avenue towards imparting LSP properties to carbon fibre reinforced polymer composites.

However, there is no distinction in the EPC between different sources of information forming part of the prior art under Article 54(2) EPC. Likewise, there is no basis for not considering an academic paper under the problem-solution approach for the assessment of inventive step when it comes to the obviousness of a solution to a technical problem in light of pieces of information.

- 2.5.4 The appellant also put forward that a skilled person would infer from the teaching of D14 that the titanium particles showed poor matrix resin adhesion and that the deformation behaviour of the shape memory alloy (SMA) particles as a mechanism for avoiding microcracking and delaminations of D26 would fundamentally differ from the mechanism proposed in D14 for the titanium particles. The authors of D14 suggested that the microcracks propagated around the titanium particles, meaning that the microcracks were diverted rather than terminated. The mode of action of the metal particles was a one-off, sacrificial effect

that brought about irreversible damage to the composite. This made such composites unsuitable for composites intended for aircraft structural members. For the latter, maintaining "airworthiness" after impact was critical. Hence, combining the teachings of D13 and D14 would result not in an alternative but in an inferior alternative not suitable for use in manufacturing aircraft structural members to achieve airworthiness.

- 2.5.5 Claim 1 does not require any level of "airworthiness". By contrast, all the variants of claim 1 not containing the above-mentioned essential features missing from the claim are prepregs within the meaning of the patent suitable "for use in making a carbon fiber resin reinforced composite material for an aircraft structural member". The patent and claim 1 do not exclude titanium particles lacking a surface treatment and/or cured prepregs showing a specific mechanical failure mode of the composites (such as in the mode II interlaminar fracture toughness G_{IIR} tests carried out in D14) either. This would mean excluding embodiments of claim 1 for which mechanical tests have shown potentially accelerated microcrack advancement due to fine metal particles poorly adhering to the resin matrix (see first two paragraphs on page 142 of D14-2).

The corresponding explanations in sections 2 and 3.5 to 3.8 of D31 do not form part of the patent and its technical teaching. These statements therefore cannot alter the assessment of what has been objectively achieved across the full breadth of claim 1. They merely constitute subjective expectations of a skilled person not commensurate with the full scope of the claim and the corresponding contribution to the art.

2.5.6 Like document D13, D14 relates to carbon fibre reinforced prepregs impregnated with an epoxy resin as a thermosetting resin. These prepregs are proposed for the manufacture of (primary) structural members in the aerospace industry such as wings, the tail assembly and the fuselage. D14 teaches that the electrical interlaminar conductivity and the fracture toughness can be increased by dispersing fine metal particles between the layers of prepreg laminates: "[h]ere, in terms of new methods, a method is conceivable in which conductivity is improved by dispersing fine metal particles between the layers. This method can be expected to deliver not only in terms of improving conductivity, but also in terms of reducing weight and improving toughness" (D14-2: abstract; page 140, left column, lines 2 to 3 and 11 to 13; page 140, sentence bridging left/right columns; page 141, first paragraph, lines 3 to 6). As put forward by the respondent, D13 (on page 23, second paragraph) teaches that composites manufactured from the corresponding prepregs exhibit high impact strength and interlaminar shear strength. Documents D13 and D14 thus have compatible teachings and are not mutually incompatible. D14 suggests that improving the adhesion between the matrix resin and the titanium particles will mitigate the reduced interlaminar fracture toughness G_{IIR} and increase interlaminar fracture toughness in general (right column on page 142 of D14-2; corresponding remarks in point 3.6 of D31).

2.5.7 Thus, a skilled person would, in view of the teaching of D14, be prompted to include conductive metal (titanium) particles, also in weight ratios relative to thermoplastic resin particles [C] as required in claim 1, in prepregs in accordance with the teaching of D13 to merely create an alternative prepreg for use in the

manufacture of a composite material for a (primary) aircraft structural member. The subject-matter of claim 1 is thus obvious to a skilled person and does not meet the requirements of Article 56 EPC.

3. *Inventive step (Article 56 EPC) - Auxiliary requests 1 to 8*

3.1 The appellant did not produce additional arguments in favour of the allowability of auxiliary requests 1 to 8 on file for the requirement of Article 56 EPC when asked by the board in the oral proceedings whether it would like to comment on this point. Instead, the appellant stated that it wished to rely on its written submissions.

3.2 The board notes that claim 1 of auxiliary requests 1 to 3 includes the scope of claim 1 of the main request. Furthermore, the limitation to claim 1 of auxiliary request 4, namely "[;] wherein the prepreg does not contain a thermoplastic resin fiber nor a conductive fiber.", has no bearing on the finding that the combined technical teaching of D13 as the closest prior art, taken in combination with D14 as a secondary information source, renders the combined use of thermoplastic particles and conductive particles in prepregs obvious. The mentioned limitation to claim 1 of auxiliary request 4 does thus not lead to a different assessment of inventive step than set out above for claim 1 of the main request.

Claim 1 of auxiliary requests 5 to 8 corresponds to claim 1 of auxiliary requests 1 to 4, respectively, but comprises the additional limitation that the aircraft structural member be "selected from a main wing, tail wing, flap, aileron, cowl, fairing, or rocket motor

case". The prepregs of D13 and D14, however, are proposed for use in the fabrication of such parts/ structural members (see first paragraph of the left-hand column on page 140 of D14-2). Consequently, this limitation does not confer inventive merit either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



M. Schalow

A. Haderlein

Decision electronically authenticated