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Datasheet for the decision of 14 January 2020

Case Number: T 0781/17 - 3.3.10

Application Number: 10835884.7

Publication Number: 2511360

IPC: C09K11/06, C07D519/00, H01L51/50

Language of the proceedings: EN

Title of invention:
ORGANIC LIGHT-EMITTING MATERIAL AND ORGANIC LIGHT-EMITTING ELEMENT

Applicant:
NIPPON STEEL Chemical & Material Co., Ltd.
Kyushu University, National University Corporation

Headword:

Relevant legal provisions:
EPC Art. 83

Keyword:
Sufficiency of disclosure - (no)

Decisions cited:

Catchword:

Europäisches Patentamt
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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 0781/17 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 14 January 2020

Appellant: (Applicant 1)	NIPPON STEEL Chemical & Material Co., Ltd. 13-1, Nihonbashi 1-chome Chuo-ku Tokyo 103-0027 (JP)
Appellant: (Applicant 2)	Kyushu University, National University Corporation 10-1, Hakozaki 6-chome Higashi-ku Fukuoka-shi, Fukuoka 812-8581 (JP)
Representative:	Vossius & Partner Patentanwälte Rechtsanwälte mbB Siebertstrasse 3 81675 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 6 October 2016 refusing European patent application No. 10835884.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairwoman	C. Komenda
Members:	R. Pérez Carlón
	W. Van der Eijk

Summary of Facts and Submissions

I. The appellants (applicants) lodged an appeal against the decision of the examining division refusing European patent application No. 10835884.7.

II. Claim 1 of the main request before the examining division reads as follows:

"*An organic light-emitting material which emits fluorescence and delayed fluorescence, the organic light-emitting material comprising a compound having a difference between excited singlet energy and excited triplet energy of 0.2 eV or less, wherein said compound emits fluorescence and delayed fluorescence.*"

III. The examining division concluded that the claimed invention was not sufficiently disclosed for it to have been carried out by the person skilled in the art, who could only have found compounds which met the energy difference required by claim 1 by trial and error. The claim was thus no more than an invitation to perform a research programme. This reasoning applied in the same manner to claim 1 of all the requests then pending.

IV. The documents cited during the proceedings include the following:

D15 Tokumaro, "Organic Photochemical Reaction Theory", 1973, pages 78 to 81 (original and partial translation)

D16 Köhler, Beljonne, "The Singlet-Triplet Exchange Energy in Conjugated Polymers", *Adv. Funct. Matter.* 2004, *14*, 11-18

D17 Kanemitsu, Takeo "Basics and New Development of Light-emitting Material - Solid-state

Illumination and Display Material - " 2008, pages 54 and 55 (original and partial translation)

D18 Horie, Ushiki, "Science of Photofunctional Molecules - Molecular Photonics", 4th Ed. 1995, pages 58 to 75 (original and partial translation)

D19 Thoms, Okada, Chen, Furugori, "Improved host material design for phosphorescent guest-host systems", Thin Solid Films 436 (2003) 264-268

D20 Declaration from A. Kawada dated 15 November 2019

V. With a letter dated 15 November 2019, the appellants filed their main request and auxiliary requests 3, 5 and 9, each request with versions "a" and "b". All requests previously filed were withdrawn.

VI. Versions "a" and "b" of each request differ by how the required energy difference is determined, as follows:

"*wherein the difference between the excited singlet energy and excited triplet energy is determined by a method as disclosed in the description.*" (versions "a")

"*wherein the difference between the excited singlet energy and the excited triplet energy is determined based on the wavelengths of the fluorescence emission and the phosphorescence emission of an emission spectrum of said compound upon irradiation with light of a N2 laser having a wavelength of 337 nm at a temperature of 5K.*" (versions "b")

Claim 1 of the main request in these appeal proceedings contains all the features of claim 1 of the main request before the examining division, adding those of version "a" or of version "b" as above.

Claim 1 of auxiliary request 3 contains all the

features of claim 1 of the main request and further requires an "*organic light-emitting material comprising a compound having no metal atom in the molecule*".

Claim 1 of auxiliary request 5 reads as follows:

"*A fluorescence and delayed fluorescence type organic light-emitting element, comprising: a substrate; and at least one light-emitting layer comprising an organic light-emitting material which emits fluorescence and delayed fluorescence, the organic light-emitting material having a difference between excited singlet energy and excited triplet energy of 0.2 eV or less and having no metal atom in the molecule, the light-emitting layer being provided on the substrate,* [add wording of version "a" or version "b"]."

Claim 1 of auxiliary request 9 reads as follows:

"*A fluorescence and delayed fluorescence type organic light-emitting element, comprising:*

a substrate; and

at least one light-emitting layer comprising

an organic light-emitting material which emits fluorescence and delayed fluorescence, the organic light-emitting material having a difference between excited singlet energy and excited triplet energy of 0.2 eV or less and having no metal atom in the molecule, and

a host material having at least any one of excited singlet energy and excited triplet energy higher than those of the organic light-emitting material,

the light-emitting layer being provided on the substrate, [add wording of version "a" or "b"]."

VII. The appellants argued that the claimed invention was sufficiently disclosed for it to have been carried out by the person skilled in the art, who could have found compounds having the required difference between excited singlet and excited triplet among fluorescent organic compounds. The skilled person would only have needed to select, by computer simulation, those having a small overlap of the HOMO (highest occupied molecular orbital) and LUMO (lowest unoccupied molecular orbital). In addition, the energy difference between the first excited triplet and the first excited singlet energy levels was known for many molecules (D18). The skilled person would only have needed to modify the structure of those molecules in order to arrive at compounds with the required energy difference. D16 showed the influence of different substituents, and the examples of the application further provided teaching in this respect. The claimed invention was pioneering and of a fundamental nature and the inventors were for this reason entitled to a large scope of protection. The claimed invention had been granted in every other jurisdiction.

The appellants requested that the case not be remitted to the examining division unless the board concluded that it was sufficiently disclosed. The appellants were aware that this implied that the appeal fee could only be refunded if the appeal was allowable.

VIII. Oral proceedings before the board of appeal took place on 14 January 2020.

IX. The appellants requested that the decision under appeal be set aside and that the case be remitted to the examining division for further examination on the basis of their main request or one of their auxiliary requests 3, 5 and 9, all requests with versions a and b, as filed with the letter of 15 November 2019.

The appellants further requested that the appeal fee be reimbursed for the reason that a substantial procedural violation had occurred during examination.

X. At the end of the oral proceedings, the chairperson announced the decision.

Reasons for the Decision

1. The appeal is admissible.

2. Versions "a" and "b" of the requests on file merely differ by the method for determining the difference between excited singlet energy and excited triplet energy. The appellants acknowledged that this difference did not have a bearing on the issue of sufficiency of disclosure. In the following, the board refers to the appellants' requests regardless of their version.

Sufficiency of disclosure

3. Main request

3.1 Claim 1 of the main request relates to an organic light-emitting material which emits fluorescence and

delayed fluorescence, the organic light-emitting material comprising a compound having a difference between excited singlet energy and excited triplet energy ("ΔE") of 0.2 eV or less, in which this compound emits fluorescence and delayed fluorescence.

3.2 The requirements of sufficiency of disclosure are met if the claimed invention could have been performed by the person skilled in the art without undue burden, using common general knowledge and having regard to the information in the patent in suit (Case Law of the Boards of Appeal, 9th edition 2019, II.C.5.4).

When carrying out the invention, a reasonable amount of trial and error is permissible, provided that the skilled person would find adequate information leading necessarily and directly towards success through the evaluation of initial failures (Case Law of the Boards of Appeal, 9th edition 2019, II.C.6.7).

3.3 The application provides a way to carry out the claimed invention as it discloses five compounds having a ΔE below the threshold set by claim 1: (11), (31), (130), (183) and (192). All of them contain one or more indolocarbazol groups linked to a triazine unit.

Claim 1, however, is not limited with respect to the structure of the compounds required. The issue to be examined is whether the skilled person would have been able to obtain reliably working embodiments within the ambit of the light-emitting materials of claim 1, in particular with respect to compounds with a ΔE below the threshold set by claim 1.

3.4 The appellants argued that the wording of claim 1 limited the suitable materials to fluorescent organic

compounds. The board agrees. Compounds having a double bond and thus a π* bonding orbital generally fluoresce (D15).

The appellants further argued that the ΔE was a function of the overlapping of the HOMO (highest occupied molecular orbital) and LUMO (lowest unoccupied molecular orbital), as disclosed for example in D15, last full sentence, on page 2. The board can also share this view.

The appellants argued that semi-empirical calculation was standard in the art of light-emitting compounds, as shown for example by document D19. The board can also accept this argument.

3.5 According to the declaration filed as D20, the geometry of the HOMO and LUMO can vary if a molecule contains aromatic moieties. The skilled person would have taken a compound having multiple aromatic moieties as a basic structure and systematically calculated the values of the ΔE of compounds derived from it by changing the number or the position of additional aromatic moieties. Following this strategy, the skilled person would have obtained information and narrowed down the candidates for the desired compound. After that, the compounds would have been synthesised and the ΔE measured experimentally.

The appellants considered that this would not have amounted to an undue burden.

3.6 The board cannot share this view. The skilled person would merely have known that a potential candidate should have aromatic moieties. The moieties may vary in nature, number and relative position. They may contain

further substituents of any kind, in any amount. For each candidate, the ΔE needs to be obtained.

The appellant argues that in the silico calculation of the ΔE would have posed no difficulty and would only have required one or two days of calculation. However, the issue is not the ease of the calculation but the selection of candidates for it. Even among organic compounds containing various aromatic moieties the number of potential candidates is enormous. Retrieving the ΔE value for all these possibilities is nothing other than trial and error.

As the skilled person could only have used trial and error to find which of the large amount of organic materials having aromatic groups and a π* orbital allowing fluorescence could have a small HOMO-LUMO overlap and thus a ΔE within the limit set by claim 1, the claimed invention is not sufficiently disclosed for it to have been carried out by the person skilled in the art (Article 83 EPC).

3.7 The appellants argued that the skilled person would have started from compounds whose ΔE was known, such as those in Table 1.7 of document D18. By changing their basic structure, they argued, skilled person could have easily modulated the ΔE so that it fell below the threshold of 0.2 eV.

The board cannot share this view. From the compound of Table 1.7 of D18 having the closest ΔE to the upper limit defined in claim 1, which is Rhodamine B (ΔE = 0.26 eV), there is no teaching on how to modify it to reduce the ΔE. The skilled person could only have chosen a structural change and check the result, i.e. resort to trial and error.

This argument is thus not convincing.

3.8 The appellants argued that D16 provided the required information to turn any failure into success. Table 1 of D16 disclosed the influence of different residues "R" on the ΔE, which ranged from 0.83 eV to 0.61 eV, and this teaching was generally applicable. They argued that by using this knowledge, the skilled person would have arrived at further working embodiments of the claimed invention.

However, the group "R" in document D16 is a biradical spacer linked to two acetylene units. It is not apparent how this building block could be combined with the structures disclosed in D17 or with those disclosed in the patent, let alone how such a combination could lead to a compound having a ΔE of 0.2 eV or less. In fact, none of the values of the ΔE disclosed in D16 comes even close to that threshold as they are always higher than 0.59 eV, which is at least thrice the required value.

3.9 The appellants further argued that the ΔE variation in D16 showed that electron-withdrawing groups "R" provided the effect sought.

However, there is no evidence on file showing that the groups "R" of D16 are electron withdrawing. In fact, phenyl groups are usually considered weak donors (spacer 2), in particular if alkoxylated (spacer 3). Spacer 13, which led to the lowest ΔE, is also a weak donor. There is thus no apparent link between the ΔE and the electron-withdrawing ability of the spacers.

These arguments are thus also not convincing.

3.10 The appellants also argued that the examples of the patent in suit would have taught the skilled reader that a combination of one donor and one acceptor side-group (compound 130) led to the best results in terms of a low ΔE. This teaching would reliably have led the skilled person to further embodiments of the claimed invention.

However, compound (130) does not only differ from the other examples of the patent application for which the ΔE values are available by having one donor and one acceptor group. It contains a (1-phenylindolo)[3,2-d]carbazol-1-yl side group not present in any of the other examples, which bear the [2,3-d] isomer, and is sterically less hindered. Thus, the skilled person could not have foreseen which structural feature could be responsible for its low ΔE.

This argument is also not convincing.

3.11 The appellants argued that light-emitting devices based on fluorescence and on phosphorescence were well known before the priority date and that the energy levels of suitable compounds were documented. Fluorescence data provided the energy difference between ground singlet (S0) and excited singlet state (S1); phosphorescence the energy difference between triplet (T1) and ground singlet (S0) state energy. The skilled person would merely have needed to choose among these compounds those having the required ΔE, they argued.

However, the appellants have failed to show that compounds having the required difference between triplet (T1) and excited singlet (S1) were known before

the effective filing date. Had the the technical field been so well researched, the board sees no reason why the appellants were not able to provide examples of molecules suitable for the claimed invention over and above those disclosed in the patent application and those post-published.

This argument is also not convincing.

3.12 The appellants argued that the invention was pioneering and of a fundamental nature. It opened new possibilities in the field of light-emitting elements resulting in a large number of scientific publications subsequent to the claimed invention. In view of their contribution to the art, the inventors were entitled to a large scope of protection.

However, the EPC does not provide for exceptions to the requirements of Article 83 EPC. In fact, pioneering inventions often require very detailed disclosures, not the opposite.

This argument is also not convincing.

3.13 The appellants argued that the large number of post-published scientific papers showed that the claimed invention could in fact be carried out.

However, the evidence provided is an extensive list of first-rate scientific publications. Each of them is in fact the result of scientific research carried out to provide further embodiments or other aspects of the claimed invention.

This argument is also not convincing.

3.14 Lastly, the appellants argued that the claimed invention had been granted in every other jurisdiction. As the criteria applied with respect to the issue of sufficiency of disclosure were very similar, the appellants could not have expected that the EPO would raise any objection in this respect.

However, the granting of a patent in other jurisdictions is in itself not an indication that the requirements of the EPC are satisfied.

This argument is also not convincing.

4. Auxiliary requests

4.1 The appellants acknowledged that the arguments provided with respect to the main request applied analogously to the material of claim 1 of auxiliary request 3. This request is thus not allowable for the same reasons as the main request.

4.2 The appellants argued that the additional features of claim 1 of auxiliary requests 5 and 9 further limited the compounds suitable for the claimed invention and thus solved the issue of lack of sufficient disclosure.

The appellants, however, did not further elaborate on the impact of such limitations on the issues explained with respect to the main request. In fact, the features additional to those of claim 1 of the main request merely relate to the construction of the light-emitting element, not to the required compounds. For this reason, the arguments set out above apply analogously to the invention as claimed in auxiliary requests 5 and 9, which are thus also not allowable.

5. As the appeal is not allowable, reimbursement of the appeal fee cannot be granted (Rule 103(1)(a) EPC), and the alleged procedural violation can be left uncommented.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairwoman:

C. Rodríguez Rodríguez C. Komenda

Decision electronically authenticated