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**Datasheet for the decision
of 8 January 2025**

Case Number: T 0525/23 - 3.3.02

Application Number: 16824904.3

Publication Number: 3320571

IPC: C07F7/24, C23C16/50, C23C14/06,
H01L51/44, H01G9/20

Language of the proceedings: EN

Title of invention:
PEROVSKITE MATERIAL LAYER PROCESSING

Patent Proprietor:
Hunt Perovskite Technologies, L.L.C.

Opponent:
De Clercq & Partners

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 13(2)

Keyword:
Inventive step - (no)
Amendment after notification of Art. 15(1) RPBA communication
- exceptional circumstances (no)



Beschwerdekammern

Boards of Appeal

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Case Number: T 0525/23 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 8 January 2025

Appellant: De Clercq & Partners
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
16 January 2023 concerning maintenance of the
European Patent No. 3320571 in amended form.**

Composition of the Board:

Chairman M. O. Müller
Members: A. Lenzen
L. Bühler

Summary of Facts and Submissions

I. This decision concerns the appeal filed by the opponent (appellant) against the opposition division's decision (decision under appeal) that European patent No. 3 320 571 (patent) in amended form meets the requirements of the EPC.

II. Reference is made in the present decision to the following documents filed with the opposition division:

- E3 Stoumpos, C.C. et al., *Inorg. Chem.* 2013, 52, pages 9019 to 9038
- E4 Pang, S. et al., *Chem. Mater.* 2014, 26, pages 1485 to 1491
- E5 Hu, M. et al., *J. Mater. Chem. A* 2014, 2, pages 17115 to 17121
- E9 WO 2014/045021 A1
- E12 Expert declaration of Michael Holland (14 pages)

III. With the statement of grounds of appeal, the appellant filed the following documents:

- E26 Declaration of Bruce M. Foxman (7 pages)
- E27 Goldschmidt, V.M., *Naturwissenschaften* 1926, 14(21), pages 477 to 485
- E28 Megaw, H.D., *Crystal Structures*, Saunders, 1973, pages 284 to 305
- E29 Glazer, A.M., *Acta Crystallogr. B* 1972, 28(11), pages 3384 to 3392
- E29a Excerpt from Semantic Scholar
- E29b Burns, G. et al., *Space Groups for Solid State Scientists*, 2nd edn, Academic Press, Inc., 1990, front matter and pages 326, 327 and 330

- E30 Woodward, P.M., Acta Crystallogr. 1997, B53, pages 44 to 66
- E31 Chenavas, J. et al., J. Solid State Chem. 1975, 14(1), pages 25 to 32
- E32 Zhu, H. et al., J. Phys. Chem. Lett. 2018, 9(15), pages 4199 to 4205

IV. With the reply to the statement of grounds of appeal, the patent proprietor (respondent) filed the following documents:

- E33 Expert declaration of Michael Holland (3 pages)
- E34 Talanov, V.M. et al., Crystallography Reports 2014, 59(5), pages 650 to 661
- E35 Ducau, M. et al., Mat. Res. Bull. 1992, 27, pages 1115 to 1123
- E36 Laven, R. et al., J. Phys. Chem. Lett. 2023, 14, pages 2784 to 2791
- E37 Kim, M. et al., Joule 2019, 3, pages 2179 to 2192
- E38 Statement of grounds of appeal, provided with annotations from the respondent

V. By letter dated 5 March 2024, the appellant filed the following documents:

- E39 Castelli, I.E. et al., APL Mater. 2014, 2, 081514
- E40 Gao, H. et al., ACS Appl. Mater. Interfaces 2015, 7, pages 9110 to 9117

VI. In preparation for the oral proceedings, which had been arranged at the parties' request, the board issued a communication under Article 15(1) RPBA.

VII. By letter dated 8 November 2024, the respondent filed the sets of claims of auxiliary requests 1 to 7 and the following document:

E41 Pham, H.T. et al., Nano Energy 2021, 87, 106226

VIII. By letter dated 7 January 2025, the respondent filed the following document:

E42 Experimental evidence (11 pages)

IX. Oral proceedings before the board were held by videoconference on 8 January 2025 in the presence of both parties.

During these proceedings the board decided:

- not to admit the respondent's submission as regards inventive step based on E41
- not to admit E42
- not to admit the appellant's novelty objection based on E5
- not to admit the respondent's assertion that the distinguishing feature over E5 was the claimed cubic primitive crystal structure as compared with a trigonal or hexagonal structure, and that this distinguishing feature resulted in improved moisture and thermal stability and performance due to the isotropic structure and the close-to-ideal bandgap of the cubic structure.

At the end of the oral proceedings, the chair announced the order of the present decision.

X. The parties' requests were as follows.

The appellant requested:

- that the decision under appeal be set aside and the patent be revoked in its entirety
- that auxiliary requests 1 to 7 not be admitted
- that E33 to E38, E41, E42 and the submissions in the letter dated 7 January 2025 not be admitted.

The respondent requested:

- that the appeal be dismissed, implying that the decision under appeal be confirmed and the patent be maintained in the amended form held allowable by the opposition division
- in the alternative, that the patent be maintained in amended form based on one of the sets of claims of auxiliary requests 1 to 7, filed by letter dated 8 November 2024
- that E26 to E29, E29a, E29b, E30 to E32, E39 and E40 not be admitted.

XI. Summaries of the parties' submissions relevant to the present decision and key aspects of the decision under appeal are set out in the reasons for the decision below.

Reasons for the Decision

Main request - Inventive step (Article 56 EPC)

1. The main request on appeal is the patent in amended form which the opposition division considered allowable. Claim 1 reads as follows:

"A photovoltaic device (6500) comprising:

a thin film perovskite material comprising formamidinium lead iodide (FAPbI₃) (6504) having a cubic primitive crystal structure."

The crystal structure of a compound can be described in different ways. The most precise way is by its space group. The 230 different space groups can be subdivided e.g. according to the crystal system (triclinic, monoclinic, orthorhombic, tetragonal, trigonal, hexagonal, cubic), or according to the centring type of the unit cell (primitive (P), base-centred (A, B or C), body-centred (I), face-centred (F)).

2. The parties agreed that E5 could be considered as the closest prior art for the subject-matter of claim 1.
3. E5 discloses that there are two isomers for FAPbI₃, a black and a yellow perovskite phase. The black perovskite phase has a trigonal symmetry (space group P3m1), the yellow one a hexagonal symmetry (space group P6₃mc). A solar cell is produced with a film of FAPbI₃, the structure of which corresponds to that of the black trigonal perovskite phase (E5, page 17117, right-hand column, second paragraph to page 17118, right-hand column, first paragraph). At the same time, E5 also discloses that the FAPbI₃ in the solar cell has cubic symmetry (page 17119, left-hand column, second paragraph, last sentence; section "Conclusions", page 17120, right-hand column, first paragraph, second sentence).
4. Distinguishing feature
 - 4.1 In view of the above, the parties agreed that E5 discloses a photovoltaic device comprising a thin film of a crystalline FAPbI₃ perovskite material.

However, they disagreed as to whether E5 discloses that the crystalline FAPbI_3 perovskite material has a cubic crystal structure.

- 4.2 As set out above, the structure of the FAPbI_3 perovskite material in the solar cell of E5 is characterised as trigonal, but at the same time also clearly as cubic (page 17117, right-hand column, second paragraph to page 17118, right-hand column, first paragraph vs. section "Conclusions", page 17120, right-hand column, first paragraph, second sentence). According to the appellant, these contradictory statements regarding the structure of the FAPbI_3 perovskite material (trigonal vs. cubic) merely expressed that it was very difficult to distinguish between a trigonal and a cubic structure of the perovskite material in question (FAPbI_3). The board agrees with the appellant that, in view of the clear statement, it must be concluded that the FAPbI_3 perovskite material has a cubic structure.

Therefore the subject-matter of claim 1 differs from E5 only in that the crystal structure of the FAPbI_3 perovskite material is primitive.

5. The respondent did not agree with the distinguishing feature set out above. Starting with its letters following the board's communication under Article 15(1) RPBA, the respondent argued that the distinguishing feature over E5 was not just that the claimed crystal structure of the FAPbI_3 perovskite material was primitive, as argued by the appellant, but that it was a primitive and cubic crystal structure as compared with the trigonal or hexagonal structures of E5. In those letters and at the oral proceedings, the

respondent argued that this distinguishing feature resulted in improved moisture and thermal stability and performance due to the isotropic structure and the close-to-ideal bandgap of the claimed cubic structure.

Upon the appellant's request, the board decided not to admit these assertions at the oral proceedings. The reasons are as follows.

- 5.1 Under Article 13(2) RPBA, a board shall not take into account any amendment to a party's appeal case made after notification of a communication under Article 15(1) RPBA unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned. The point of reference for examining whether there is an amendment to a party's appeal case under Article 13 RPBA is the statement of grounds of appeal or the reply thereto (Case Law of the Boards of Appeal, 10th edition, 2022 (CLBA), V.A.4.2). Since the present case concerns the admittance of submissions made by the respondent, the relevant point of reference is its reply to the statement of grounds of appeal (hereinafter "reply").
- 5.2 To put the respondent's reply into perspective, the further document E9 as well as the opposition division's decision and the appellant's statement of grounds of appeal as regards E5 and E9 must be considered.

In its decision, the opposition division concluded that E9 disclosed a photovoltaic device comprising a thin film of cubic FAPbI_3 perovskite material. The subject-matter of claim 1 of the main request on appeal was novel over E9 because this document did not disclose that the cubic crystal structure was primitive. As

recognised by the respondent (reply, page 8, penultimate paragraph), the opposition division's objective technical problem was that of "finding an alternative to the material for the photovoltaic device of E9". The opposition division acknowledged an inventive step.

The opposition division did not explicitly assess novelty vis-à-vis E5. However, its assessment of inventive step starting from E5 clearly followed that starting from E9, with "primitive" being the distinguishing feature and explaining why an inventive step was to be acknowledged.

In its statement of grounds of appeal, the appellant raised novelty objections based on E9 and E5. At best, "primitive" could be the distinguishing feature over E9 and E5. However, an inventive step could then not be recognised.

5.3 In the inventive-step section of the reply (section 7 starting on page 8 of the reply), the respondent did not address the appellant's inventive-step objection starting from E5 at all, but only the one starting from E9. If anything, it must be concluded that the respondent agreed with the opposition division's assessments

- (i) that E9 discloses a photovoltaic device comprising a thin film of cubic FAPbI_3 perovskite material and that therefore "primitive" is the only feature which distinguishes the subject-matter of claim 1 from E9 (reply, page 9, third-last paragraph: *"As acknowledged by the Appellant, none of the cited prior art*

- explicitly discloses a cubic primitive structure for this material."*) and
- (ii) that the objective technical problem is to provide essentially an alternative to E9, the solution to which involves an inventive step (reply, page 8, penultimate paragraph: *"We submit that the Opposition Division's objective technical problem of "finding an alternative to the material for the photovoltaic device of E9" should hold. The EPO Opposition Division did not misapply themselves on this point."*).

In the section on inventive step, there is therefore no indication that the respondent relied on "cubic primitive" (as opposed to simply "primitive") as being the actual distinguishing feature vis-à-vis E9, let alone E5. Consequently, there is also no reference to technical effects associated with this distinguishing feature. The fact that the respondent refers several times in its reply to one aspect of the above-mentioned technical effect (stability, see e.g. page 8, last paragraph to page 9, first paragraph) does not change this conclusion, because the statements in question are not made in relation to a distinguishing feature (be it "primitive" or "cubic primitive"), but rather in relation to the product of claim 1 as such.

- 5.4 In the novelty section of the reply (page 8, first paragraph), the respondent addresses E5 in substance in a single paragraph. By referring in a sweeping manner to its submissions before the opposition division, the respondent states that it disagrees with the opposition division's conclusion that E5 discloses a thin film FAPbI_3 perovskite with a cubic crystal symmetry. Further, according to the respondent, E5 was at least

similarly deficient to E9 as it did not disclose a primitive crystal structure.

However, in view of the opposition division's adverse conclusion, the respondent could not just leave it at a mere dissent in its reply. A reference to its submissions before the opposition division, at least if it is made in a sweeping manner as in the present case, cannot replace an explicit account of the legal and factual reasons why the respondent disagreed with the opposition division. The board concurs with the appellant that, in the present circumstances, it does not clearly emerge from the above-discussed first paragraph of page 8 of the respondent's reply whether or not the respondent intended to rely on "cubic primitive" as opposed to simply "primitive" as the actual distinguishing feature vis-à-vis E5. In the present case, the situation is aggravated by the fact that the respondent also pointed to "primitive" as a common distinguishing feature over E5 and E9, and that only this distinguishing feature is discussed in the section on inventive step in the reply (see above). In view of the absence of any discussion of inventive step for the main request starting from E5, the most that can be inferred from the reply, if at all, is that the respondent relied on "primitive" as the distinguishing feature over this document.

5.5 It follows that the distinguishing feature "cubic primitive" and the effects asserted to be linked to it in the respondent's submissions made subsequent to the board's communication under Article 15(1) RPBA are an amendment of its appeal case.

5.6 The respondent did not in fact invoke any exceptional circumstances for the amendment of its appeal case. At

the oral proceedings, therefore, the board decided not to admit the corresponding assertions (Article 13(2) RPBA).

- 5.7 In view of this non-admittance decision, it is irrelevant whether E12 and E41, cited by the respondent to prove the technical effects associated with the distinguishing feature "cubic primitive", are actually suitable for this purpose.

As a result of the decision not to admit the respondent's submission on the distinguishing feature "cubic primitive" and the technical effects allegedly linked to it, the respondent's submission as regards inventive step based on E41 could not be considered. It is therefore not necessary to provide reasons for the board's decision not to admit the respondent's submission as regards inventive step based on E41.

- 5.8 Apart from the assertions which were not admitted by the board, the respondent did not put forward any further argument supporting any additional distinguishing feature apart from that acknowledged by the appellant ("primitive").

6. Technical effect and objective technical problem

The appellant argued, and this was not disputed by the respondent, that the sole distinguishing feature set out above ("primitive") is not associated with a technical effect. Therefore the board agrees with the objective technical problem formulated by the appellant, which is to provide an alternative photovoltaic device comprising a FAPbI_3 perovskite material.

7. Obviousness

As is evident from the foregoing, the solution offered by the patent ultimately resides in having found a new crystal form (FAPbI₃ having a cubic primitive crystal structure) of a compound (FAPbI₃) whose use in a different crystalline form (FAPbI₃ having a cubic crystal structure as disclosed in E5) for the same application (film material within a photovoltaic device) was already known. Against this background, the board shares the appellant's view that an inventive step for this form could only be acknowledged if it is shown either (i) that the claimed crystal form exhibits an unexpected property over the material disclosed in the closest prior art or (ii) that there is a technical prejudice against obtaining it.

7.1.1 As stated above, the respondent did not dispute the appellant's submission that the distinguishing feature "primitive" is not associated with a technical effect. It must therefore be concluded that the crystal form of claim 1 of the main request does not exhibit an unexpected property over that of the closest prior art E5.

7.1.2 On the basis of E3, E4 and E5, the respondent argued in its written submissions that there was a technical prejudice against obtaining FAPbI₃ having a cubic primitive crystal structure. At the oral proceedings before the board, it clarified this by stating that the prejudice was that FAPbI₃ with a cubic primitive crystal structure was not stable.

The board does not agree. As correctly set out by the appellant, the case law of the boards of appeal is very strict when it comes to recognising the existence of a

technical prejudice, i.e. a widely held but incorrect opinion of a technical fact (CLBA I.D.10.2). In this regard, the respondent relied on a rather low number of scientific articles, which cannot serve as evidence of a technical prejudice.

The respondent's argument would not be convincing even if E3, E4 and E5 were accepted as evidence that a technical prejudice against obtaining stable FAPbI_3 with a cubic primitive crystal structure existed before the effective date of the patent. As set out above, with regard to the distinguishing feature "primitive" cited by the appellant in relation to E5, the respondent did not rely on a technical effect, and in particular not on a stability attributable thereto. Therefore, in the context of the present decision, it cannot be assumed that the FAPbI_3 having a cubic primitive crystal structure is necessarily stable. Consequently, the question of whether there existed a technical prejudice against obtaining stable FAPbI_3 with a cubic primitive crystal structure is irrelevant.

7.2 Thus neither does the crystal form of claim 1 exhibit an unexpected property over the closest prior art E5 nor was there a technical prejudice against obtaining it before the effective date of the patent.

8. Based on E42, the respondent argued that the crystal form of the patent was only obtained through trial and error and repeated experimentation. On this ground too, an inventive step should be acknowledged.

8.1 At the oral proceedings and at the appellant's request, the board decided not to admit E42. The reasons are as follows.

- 8.1.1 The respondent filed E42 in the late afternoon of 7 January 2025, the day before the oral proceedings before the board. This was after the board's communication under Article 15(1) RPBA. Article 13(2) RPBA is applicable to E42.
- 8.1.2 The filing of a new document such as E42 constitutes an amendment of the respondent's appeal case. Incidentally, the respondent never claimed the opposite either. Under Article 13(2) RPBA, such an amendment should not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons.
- 8.1.3 In the respondent's view, the filing of E42 only after the board's communication under Article 15(1) RPBA was prompted by this very communication. In it, the board had pointed out the lack of evidence for the argument in the respondent's reply that the crystal form of claim 1 was only obtained through trial and error and repeated experimentation. This was an exceptional circumstance and E42 should be admitted.

However, as set out by the board during the oral proceedings, the reference to a lack of evidence in its communication under Article 15(1) RPBA with regard to one of the respondent's allegations merely expresses the general legal principle that each party bears the burden of proof for the facts it alleges (CLBA III.G. 5.1.1). This should have been known to the respondent at the time when it filed its reply. Unless the allegation was previously accepted (which it was not in the present case), a subsequent reference to a lack of proof of an allegation does not constitute an exceptional circumstance within the meaning of Article 13(2) RPBA.

8.1.4 Even assuming in the respondent's favour that the board's statement in its Article 15(1) RPBA communication constituted an exceptional circumstance within the meaning of Article 13(2) RPBA, this still could not justify the fact that E42 had been filed late in the afternoon on the day before the oral proceedings. This essentially deprived the appellant and the board of the opportunity sufficiently to consider E42.

8.2 Without E42 in the proceedings, the respondent's argument that the crystal form of claim 1 was only obtained through trial and error and repeated experimentation was merely an unsubstantiated allegation, and as such not convincing.

9. The claimed material is thus obvious in view of E5. The subject-matter of claim 1 of the main request is not based on an inventive step and the main request is not allowable.

Auxiliary requests 1 to 4 - Inventive step (Article 56 EPC)

10. Claim 1 of auxiliary requests 1 to 4 differs from claim 1 of the main request by the following additional features:

- auxiliary request 1: "*wherein the $FAPbI_3$ (6504) has a $Pm-3m$ space group*"
- auxiliary request 2: "*wherein the $FAPbI_3$ (6504) has an X-ray diffraction pattern having peaks, in terms of 2θ , at 14.06 ± 0.1 and 24.30 ± 0.1 degrees*"
- auxiliary request 3: "*wherein the $FAPbI_3$ (6504) has an X-ray diffraction pattern having peaks, in terms of 2θ , at 14.06 ± 0.1 , 19.84 ± 0.1 , 24.30 ± 0.1 ,*

28.15 ± 0.1 , 31.55 ± 0.1 , 34.63 ± 0.1 , 40.30 ± 0.1 ,
 42.78 ± 0.1 , 45.48 ± 0.1 , 49.77 ± 0.1 , 51.79 ± 0.1 ,
 58.13 ± 0.1 , 58.70 ± 0.1 , 62.02 ± 0.1 , 65.75 ± 0.1 ,
 67.43 ± 0.1 , and 72.81 ± 0.1 degrees"

- auxiliary request 4: "*wherein the FAPbI₃ (6504) has a lattice parameter, a, equal to about 6.35 Å*"

These additional features further define the crystal form of claim 1 in structural terms. At the oral proceedings, the respondent did not refer to any technical effect associated with these additional features, and accepted the objective technical problem set out by the appellant, which was the same as for claim 1 of the main request, i.e. to provide an alternative photovoltaic device comprising a FAPbI₃ perovskite material. The reasoning above for the subject-matter of claim 1 of the main request applies *mutatis mutandis*. Therefore the subject-matter of claim 1 of auxiliary requests 1 to 4 is not based on an inventive step. Auxiliary requests 1 to 4 are not allowable.

Auxiliary requests 5 to 7 - Inventive step (Article 56 EPC)

11. Product-by-process claim 1 of auxiliary requests 5 to 7 differs from product claim 1 of the main request in each case in that it specifies process steps with which the claimed FAPbI₃ perovskite material is produced. However, as conceded by the respondent at the oral proceedings, these process steps do not further distinguish the FAPbI₃ perovskite material compared with that of claim 1 of the main request. Therefore the reasoning for the subject-matter of claim 1 of the main request equally applies to claim 1 of each of auxiliary requests 5 to 7. The subject-matter of claim 1 of

auxiliary requests 5 to 7 is not based on an inventive step and auxiliary requests 5 to 7 are not allowable.

Further points

12. At the oral proceedings, the board decided not to admit the appellant's novelty objection based on E5. Reasoning for this decision is not required as the final decision to revoke the patent is in the appellant's favour.

13. As evident from the discussion above, none of documents E26 to E29, E29a, E29b, E30 to E32, E39 and E40, which the respondent requested not be admitted, is relevant to this decision. There was therefore no need at the oral proceedings to decide on their admittance.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:



U. Bultmann

M. O. Müller

Decision electronically authenticated