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Datasheet for the decision of 4 August 2015

Case Number: T 1875/12 - 3.3.05

Application Number: 02719184.0

Publication Number: 1390994

IPC: H01M10/0525, H01M4/485, H01M4/505, H01M4/525

Language of the proceedings: EN

Title of invention:
IMPROVED CATHODE COMPOSITIONS FOR LITHIUM-ION BATTERIES

Patent Proprietor:
3M Innovative Properties Company

Opponents:
THE DOW CHEMICAL CO.
H.C. Starck GmbH

Headword:
Cathode composition/3M

Relevant legal provisions:
EPC Art. 83, 114(2)

Keyword:
Sufficiency of disclosure (no) - undue burden

Decisions cited:
T 0409/91, T 0435/91, T 1743/06, T 0641/07, T 1276/08, T 0045/09

Catchword:

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Case Number: T 1875/12 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 4 August 2015

Appellant 2: (Opponent 2)	THE DOW CHEMICAL CO. 2030 Dow Center Midland, Michigan 48674 (US)
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Representative:	Ambor, Volker H.C. Starck GmbH Patentabteilung Im Schleeke 78-91 38642 Goslar (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on**

12 June 2012 maintaining European patent No. 1390994 in amended form.

Composition of the Board:

Chairman	G. Raths
Members:	J.-M. Schwaller
	P. Guntz

Summary of Facts and Submissions

I. The present appeals lie from the interlocutory decision of the opposition division to maintain European patent No. 1 390 994 in amended form on the basis of the set of claims according to the second auxiliary request filed during the oral proceedings of 8 May 2012, with independent claim 1 reading:

"*1. A cathode composition for a lithium-ion battery having the formula*

$$Li[Ni_yCo_{1-2y}Mn_y]O_2$$

where $0.25 \leq y \leq 0.375$ and wherein said composition is in the form of a single phase having an O3 crystal structure that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C using a discharge current of 40mA/g, between 2.5 and 4.4 V."

II. The following documents cited in the opposition proceedings are relevant for the present decision:

A1: EP 0 782 206 A1

A2: English translation of CN 1 097 526 A

A38: DELMAS C. et al: "*Electrochemical Intercalation of Sodium in Na_xCoO_2 Bronzes*", SOLID STATE IONICS, volume 3/4, 1981, pages 165 to 169

A39: K. A. JARVIS et al.: "*Atomic Structure of a Lithium-Rich Layered Oxide Material for Lithium-Ion Batteries: Evidence of a Solid Solution*", CHEM. MATER., volume 23, 2011, pages 3614 to 3621.

III. According to the contested decision, document A38 was late-filed and thus not admitted into the proceedings. Furthermore, the main request did not meet the requirements of Article 83 EPC because the testing of a cathode composition in a battery could take several months, which put an undue burden on the skilled person.

IV. With its grounds of appeal dated 12 October 2012, opponent II ("appellant II") submitted that the claims as maintained by the opposition division (auxiliary request 2 of 8 May 2012) contravened Articles 84, 54, 56 and 123 EPC, and that the invention was insufficiently disclosed under Article 83 EPC.

V. With its grounds of appeal dated 19 October 2012, the proprietor ("appellant I") contested the decision and requested that the patent be maintained as granted.

Claims 1, 2 and 3 as granted read as follows:

"*1. A cathode composition for a lithium-ion battery having the formula*

$$Li[Ni_yCo_{1-2y}Mn_y]O_2$$

where 0.167 < y < 0.5 and wherein said composition is in the form of a single phase having an O3 crystal structure that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and a final capacity of 130 mAh/g using a discharge current of 30 mA/g."

"*2. A cathode composition for a lithium-ion battery having the formula*

$$Li[Li_{(1-2y)/3}Ni_yMn_{(2-y)/3}]O_2$$

where $0.083 \leq y \leq 0.5$ and wherein said composition is in the form of a single phase having an O3 crystal structure that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and a final capacity of 130 mAh/g using a discharge current of 30 mA/g."

"*3. The cathode composition according to claim 2, wherein $0.167 < y < 0.5$.*"

VI. With its response dated 2 May 2013, appellant II contested the novelty and inventive step of the granted claims.

VII. With letter of 3 July 2015, appellant I submitted a set of observations accompanied *inter alia* by the following documents:

A39': G.-A. NAZRI: "*Lithium Batteries, Science and Technology*", Kluwer Academic Publishers, Chapter 14: Cathodes based on $LiCoO_2$ and $LiNO_2$, pages 410 to 444 (2004)

A46: Z. LU et al.: "*Superlattice Ordering of Mn, Ni and Co in Layered Alkali Transition Metal Oxides with P2, P3, and O3 Structures*", Chem. Mater., 12, 3583 to 3590 (2000).

Appellant I also filed two new sets of claims as auxiliary requests 1 and 2, with auxiliary request 1 differing from the main request only in that in claim 2 "≤" now reads "<", and auxiliary request 2 differing from auxiliary request 1 in that claims 2 and 3 (dependent on 2) were deleted.

VIII. By letter of 15 July 2015, appellant II requested that these new requests, arguments and documents not be admitted into the proceedings.

IX. At the oral proceedings, which took place on 4 August 2015 in the presence of both parties, the discussion focused on the issue of sufficiency of disclosure of the invention. This issue was in particular discussed in view of the disclosure of documents A38, A39, A39' and A46.

X. After closing the debate, the chairman established the parties' requests as follows:

Appellant I requested that appellant's II appeal be dismissed or that the decision under appeal be set aside and that the patent be maintained as granted or, alternatively, in amended form on the basis of one of the sets of claims according to the first or second auxiliary request dated 3 July 2015.

Appellant II requested that the decision under appeal be set aside and that the patent be revoked.

Reasons for the Decision

1. Admissibility of documents A38, A39, A39' and A46

The above documents were late-filed, but as their content is highly relevant - as can be seen below - the board decides under Article 114(2) EPC and, regarding document A 39', under Article 13(1) of the Rules of Procedure of the Boards of Appeal (RPBA) to admit them into the proceedings.

2. Article 83 EPC - Disclosure of the invention

2.1 Statutory law and jurisprudence

It is established jurisprudence that the requirements for sufficiency of disclosure are met if:

(a) the invention as defined in the claims can be performed at the filing date of the application by a person skilled in the art in the whole area claimed without undue burden, using common general knowledge and having regard to further information given in the patent in suit (see e.g. T 409/91, OJ 1994, 653, reasons 3.5; T 435/91, OJ 1995, 188, reasons 2.2.1; T 1743/06, reasons 1.1).

(b) when the definition of the claimed invention moreover includes one or more parameters, the skilled person is also able to check whether the parameters are complied with while the invention is carried out (see e.g. decisions T 0045/09, reasons 1.1 and 1.3; T 1276/08, reasons 1.1; T 0641/07, reasons 1).

2.2 Present case

In the case at issue, the invention includes the parameter that the composition is in the form of

(1) "*a single phase having an O3 crystal structure*"

(2) "that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and a final capacity of 130mAh/g using a discharge current of 30mA/g".

Claim 1 as granted is identical to claim 1 of auxiliary requests 1 and 2.

Claim 1 of the sets of claims maintained by the opposition division (auxiliary request 2 of 8 May 2012) differs from claim 1 as granted in that:

- the range *"0.167 < y < 0.5"* has been restricted to *"0.25 ≤ y ≤ 0.375";*
- the feature *"a final capacity of 130 mAh/g"* has been deleted*;*
- the discharge current value of *"30mA/g"* has been amended to *"40mA/g";*
- the feature that the composition has been cycled *"between 2.5 and 4.4V"* has been added.

In other words, the feature "*a final capacity of 130 mAh/g*" is no longer part of this request.

2.2.1 General instructions

Regarding the first issue (see 2.1 (a)), namely whether the invention as defined in the claims could be performed at the filing date of the application by a person skilled in the art, according to the patent (paragraph [0013]) the compositions may be synthesised *"by jet milling or by combining precursors of the metal elements (e.g., hydroxides, nitrates, and the like), followed by heating preferably in air at temperatures of at least about 600°C, more preferably at least 800°C, with the higher temperatures being preferred because they lead to materials with increased crystallinity*".

2.2.2 Specific recipe

This preparation process being state of the art - as

acknowledged by the parties and as can be seen from e.g. documents A1 (page 4, lines 3 to 7) and A2 (page 6, lines 13 to 21) - appellant I explained that it was necessary to use the specific recipe (hereinafter "the recipe") defined in paragraphs [0021], [0022] and [0034] of the patent (i.e. specification of the respective amounts of components, and handling steps such as dissolution, stirring, filtration, washing, drying, and pressing into pellets) for obtaining a cathode composition that was "*in the form of a single phase having an O3 crystal structure that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and a final capacity of 130mAh/g using a discharge current of 30 mA/g.*"

2.3 Incomplete teaching

2.3.1 Missing evidence

The board observes that although this recipe is used in all the examples of the patent specification, there is no evidence in the patent - apart from the composition according to example 1 - that it makes it possible to prepare further compositions falling under the wording of claims 1 or 2 as granted.

2.3.2 Lack of guidance

As to the question whether the patent provided sufficient guidance to the skilled person to perform the invention in the whole area claimed, appellant I stated that the recipe would make possible the preparation of further compositions falling under the definition given in claims 1 or 2 as granted. It

referred in this respect to the declaration dated 14 February 2011 from Mr Ebermann, which showed that the composition according to example 20 also fell under the wording of the granted claims.

Appellant I further argued that appellant II had the burden of proving the contrary, but since it had not reworked any of the examples in the patent, it should be accepted that the skilled person was able to perform the invention over the whole area claimed.

This reasoning may have some merit, but if according to the patent only two examples (examples 1 and 19) illustrate the invention and if an additional experiment has to be filed to prove that a further example, namely example 20, is an invention example, then the remaining examples 2 to 18 which turn out not to actually exemplify the invention carry little weight for disclosure purposes.

2.4 Impossibility of verifying the parameters

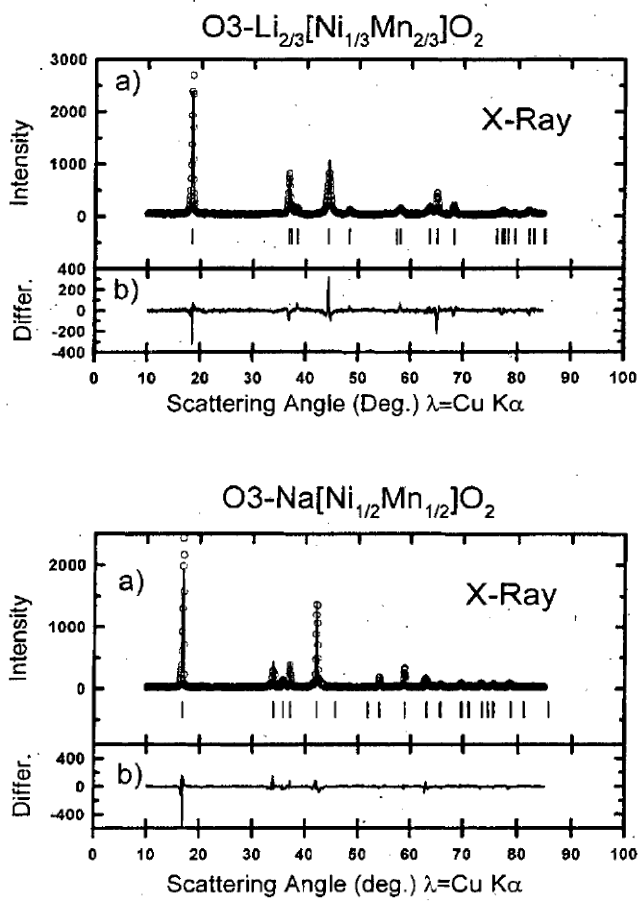
Regarding the second issue (see 2.1(b)), namely whether the skilled person is able to check without undue burden, using common general knowledge and having regard to the information given in the patent in suit, whether the parameter defining the compositions claimed is complied with while the invention is being carried out, the board observes the following.

2.4.1 Missing definition

The patent does not provide any definition of the "*O3 crystal structure*", and it also does not describe the method for identifying this parameter.

(1) Appellant I referred in this respect to the XRD diagrams of the compositions prepared in the examples of the patent and stated that the skilled person trying to reproduce the invention could check whether the O3 crystal structure was complied with by simply comparing its data with the XRD data disclosed in the patent. Document A46 furthermore gave evidence that the "O3 crystal structure" was common general knowledge for the skilled person at the priority date of the patent.

(2) The board cannot accept these arguments, because the XRD diagrams representative of "O3" structures in A46 - see below -



do not correspond to those disclosed in particular in Figures 4a to 4d (see below). Indeed, the XRD diagrams

of Figures 4a to 4d show, in addition to the peaks disclosed in A46, further peaks at about 21 degrees.

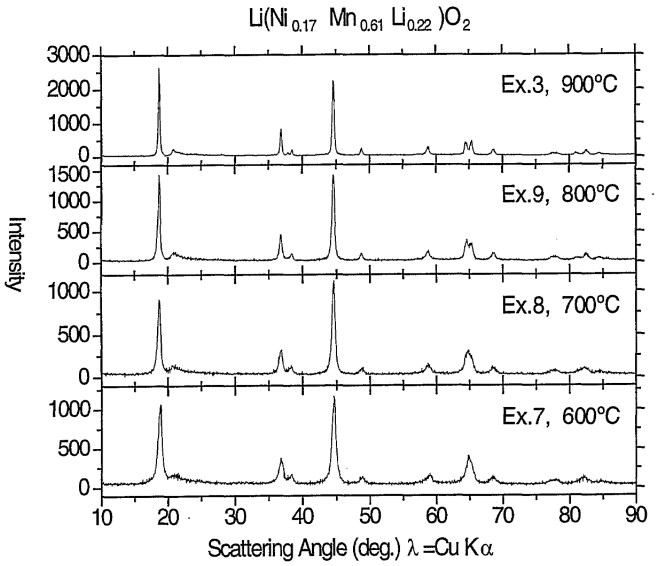


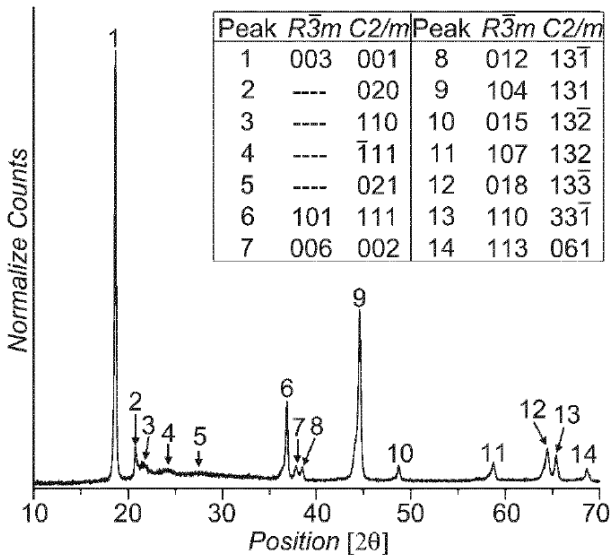
Fig. 4a

Fig. 4b

Fig. 4c

Fig. 4d

As explained by appellant II, the peaks at about 21 degrees appear rather to belong to an additional monoclinic phase identified as peaks 2, 3, 4 and 5 in Figure 3 of document A39 - reproduced below.



Peak	$R\bar{3}m$	$C2/m$	Peak	$R\bar{3}m$	$C2/m$
1	003	001	8	012	$13\bar{1}$
2	----	020	9	104	131
3	----	110	10	015	$13\bar{2}$
4	----	$\bar{1}11$	11	107	132
5	----	021	12	018	$13\bar{3}$
6	101	111	13	110	$33\bar{1}$
7	006	002	14	113	061

Figure 3. Experimental XRD pattern with major peaks numbered. The peaks are labeled according to $R\bar{3}m$ and $C2/m$ symmetry in the inset table. The dashes for peaks 2—5 in the $R\bar{3}m$ column indicate that there are no allowed reflections at these positions for the $R\bar{3}m$ space group.

As further argued by appellant II, the XRD diagrams of

Figures 4a to 4d might also be representative of an "O3' phase having monoclinic distortions", as described in document A37 (page 166, left column).

(3) In any case, the board is not convinced that the additional peaks in Figures 4a to 4d are representative of a "single phase having an O3 crystal phase" as defined in claims 1 or 2 at issue.

2.4.2 Incomplete teaching

It follows from these considerations that the skilled person trying to check whether the "O3 crystal structure" is complied with while reproducing the invention cannot merely make a comparison - as alleged by appellant I - with the XRD data disclosed in the patent. So, in the present case, he is confronted with an apparently untractable problem, since instead of getting XRD data having a "single phase O3 structure", certain data refer to compositions including an additional second phase identifiable as the peaks at about 21 degrees illustrated in Figures 4a to 4d of the patent.

The board has noted appellant's I statement that only the compositions of examples 1, 19 and 20 would fall under the scope of protection of the claims, and this statement would explain the different XRD data of compositions which do not fall under the scope of protection of the claims at issue, i.e. the statement would confirm the presence of a two-phase structure.

2.4.3 Ineffective reference to general common knowledge

Document A46 cannot help either, since the skilled person does not know which compositions in the patent

are supposed to illustrate the invention and which ones do not.

2.4.4 Desiderata

It appears that the feature

(2) "that does not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and has a final capacity of 130mAh/g using a discharge current of 30mA/g"

is to be considered as a *desideratum* or a result to be achieved.

However, there are no instructions as to what measures have to be taken in case of failure to achieve this result.

If, on the one hand, this feature is automatically achieved with cathode compositions having the formula $Li[Ni_yCo_{1-2y}Mn_y]O_2$ *where* $0.167 \leq y \leq 0.5$, then characterising the composition with these features would be superfluous. If, on the other hand, this feature is not an inherent feature, then specific measures have to be taken to achieve it. But there is no indication of these measures.

2.4.5 Undue burden

In this context and in the absence of information in the patent as to how "*a single phase having O3 crystal structure*" can be identified, the board comes to the conclusion that it would be an undue burden for the skilled person to check for any compositions obtained

according to the general instruction and the specific recipe in order to identify those which do "*not undergo a phase transformation to a spinel crystal structure when incorporated in a lithium-ion battery and cycled for 100 full charge-discharge cycles at 30°C and a final capacity of 130 mAh/g using a discharge current of 30 mA/g*". Indeed, this would amount to a research programme.

2.4.6 Conclusion

For the board, it follows from the above considerations that the skilled person, seeking to assess whether or not the claimed invention is complied with, is left without information as regards the definition and determination of the "single phase having an O3 crystal structure". Since this missing information is also not available from common general knowledge, and since the patent does not identify those examples which fall under the scope of protection of claim 1 at issue and those which do not, the board concludes from these multiple information gaps that the skilled person is not in a position to reproduce the invention without undue burden, since he has to conduct his own investigations in order to ascertain which specific operating features would lead him to it. The examples furthermore do not provide any further guidance since the skilled person has to find out which example is to be followed and which modifications he has to carry out in order to arrive at a composition falling within the terms of the subject-matter claimed.

Therefore, it is concluded that the disclosure of the contested patent is not sufficiently clear and complete for the invention to be reproduced by a person skilled in the art, contrary to Article 83 EPC.

This conclusion applies to claim 1 as granted and to claim 1 of auxiliary requests 1 and 2.

As to claim 1 of auxiliary request 2 of 8 May 2012, besides the fact that deleting the feature *"a final capacity of 130 mAh/g"* would also contravene Article 123(3) EPC, the requirements of Article 83 EPC are also not met.

The fact that the y range has been restricted to "0.25 ≤ y ≤ 0.375", that the discharge current has been increased to 40 mA/g and that the composition has been cycled "between 2.5 and 4.4V" does not help the skilled person seeking to assess whether or not the claimed invention is complied with. He is still left without any guidance as regards the definition and determination of the parameter "*single phase having an O3 crystal structure*". The patent still lacks the information as to which compositions fall or do not fall under the scope of protection of claim 1 at issue. And there is still the desideratum related to the prevention of a phase transformation to a spinel crystal structure. It follows that the reasons for concluding that the contested patent is insufficiently clear and complete for the invention to be carried out by a person skilled in the art, as established in points 2.3.1, 2.3.2 and 2.4 (2.4.1 to 2.4.3) above, are still valid and are applicable to the request at issue.

3. As none of the sets of claims underlying the requests meets the requirements of Article 83 EPC, the interlocutory decision of the opposition division cannot be upheld.

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 G. Raths

Decision electronically authenticated