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D E C I S I O N
of 21 October 2004

Case Number: T 0460/01 - 3.4.2

Application Number: 94909274.6

Publication Number: 0688470

IPC: H01M 4/00

Language of the proceedings: EN

Title of invention:
A disordered multiphase nickel hydroxide solid solution

Patentee:
OVONIC BATTERY COMPANY, INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54(2), 54(3), 56, 83, 100(a), 100(b), 111(1), 114(1)

Keyword:
"Withdrawal of opposition by sole opponent/respondent"
"Sufficiency of disclosure (yes)"
"Novelty and inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0460/01 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 21 October 2004

Appellant: (Proprietor of the patent)
OVONIC BATTERY COMPANY, INC.
1707 Northwood Dr.
Troy, MI 48084 (US)

Representative:
Kügele, Bernhard
Novagraaf SA
25, Avenue du Pailly
CH-1220 Les Avanchets - Geneva (CH)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 12 March 2001 revoking European patent No. 0688470 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
M. J. Vogel

Summary of Facts and Submissions

I. The appellant (patent proprietor) has lodged an appeal against the decision of the opposition division dated 12 March 2001 revoking European patent No. 0 688 470 (based on European application No. 94909274.6). The notice of appeal was filed on 23 April 2001 and the appeal fee was paid on the same date, and the statement of grounds of appeal was received on 14 July 2001.

The opposition filed by the respondent (opponent) against the patent as a whole was based on the grounds of lack of novelty and of inventive step (Article 100(a) EPC) and on the ground of insufficiency of disclosure (Article 100(b) EPC).

During the appeal proceedings the respondent withdrew its opposition by letter dated 30 August 2002.

II. In the decision under appeal the opposition division referred *inter alia* to the following documents:

D1: WO-A-94 11910,

D5: EP-A-0 390 677,

D6: "Effect of coprecipitated metal ions on the electrochemistry of nickel hydroxide thin films: Cyclic voltammetry in 1 M KOH" by D. A. Corrigan *et al.*; Journal of the Electrochemical Society, Vol. 136 (1989), US; pages 723 to 728, and

D7: "Some effects of cobalt hydroxide upon the electrochemical behaviour of nickel hydroxide

electrodes" by R. D. Armstrong *et al.*; Journal of Power Sources, Vol. 25 (1989), CH; pages 89 to 97,

and held that the subject-matter of the amended claim 1 then on file was novel but did not involve an inventive step (Article 100(a) together with Articles 52(1) and 56 EPC).

III. Oral proceedings were held before the Board on 21 October 2004 in the presence of the appellant.

The appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of claims 1 to 5 and description pages 7 to 12 filed during the oral proceedings together with description pages 2 to 6 and 13 and Figures 1 to 5 of the patent as granted.

At the end of the oral proceedings the Board gave its decision.

IV. Claim 1 according to the request of the appellant reads as follows:

"A high capacity, long cycle life positive electrode for use in an alkaline rechargeable electrochemical cell comprising:
a solid solution nickel hydroxide material having a multiphase structure, having microcrystalline and/or amorphous structure, that comprises at least one polycrystalline γ-phase with at least one chemical modifier, the γ-phase having a 2^+ oxidation state and a 3,5 or greater oxidation state depending on the state of charge, and

at least three compositional modifiers incorporated into said solid solution to disrupt the formation of large crystallites, and to promote said multiphase structure,
the chemical modifier being incorporated non-substitutionally around plates of the nickel hydroxide material."

Dependent claims 2 to 5 all refer back to claim 1.

V. The arguments of the appellant in support of its requests can be summarised as follows:

The prior art discloses solid solution nickel hydroxide materials having a multiphase structure comprising γ-phase; however, the γ-phase of the prior art is not stable and causes a drastic decrease in the capacity with cycle life (Figure 5 of the patent) and for this reason the γ-phase was seen in the prior art as detrimental to the performance of the electrode material. The inventors, however, have realized that compositional modifiers can be incorporated so as to promote the multiphase structure and inhibit formation of large crystallites; in this way, by inducing microcrystallinity and by stabilising the capacity-improving γ-phase, swelling is inhibited and the cycle life is increased while maintaining the high initial capacity upon electrochemical cycling. Although this effect can be achieved with only one compositional modifier, the effect can be more efficiently and easily achieved when at least three compositional modifiers are used.

The prior art fails to teach towards small crystallites to solve the problem of avoiding swelling and maintaining a high capacity through a longer cycle life, it even fails to disclose electrode materials with a high capacity and a long cycle life in presence of the γ-phase.

During the oral proceedings the appellant presented experimental evidence of the electrochemical performances, and in particular of the improved evolution of the capacity throughout the cycle life of the electrode materials according to the invention.

Reasons for the Decision

1. The appeal complies with the requirements mentioned in Rule 65(1) EPC and is therefore admissible.

2. *Procedural issues*

Since the appeal is against the revocation of the patent by the opposition division, the withdrawal of the opposition during the appeal proceedings has no direct procedural significance other than the fact that the former opponent is - as far as the substantive issues are concerned - no longer considered as party to the proceedings (see "Case Law of the Boards of Appeal" 4th ed. 2001, EPO, chapter VII, section D-11.2). The Board must therefore decide on the allowability of the pending appeal on the basis of the appellant's requests, i.e. it must examine the substance of the contested decision and assess whether the patent as amended satisfies the requirements of the EPC and in particular

whether the grounds for opposition initially invoked by the then opponent would prejudice the maintenance of the patent in amended form. In carrying out this examination the Board has to consider the appeal on its own merits and - notwithstanding the fact that the respondent no longer supports its case - may of its own motion (Article 114(1) EPC) and within the limits imposed by considerations of procedural expediency, also consider the submissions made by the former respondent before the opposition was withdrawn.

3. *Amendments to the patent*

The Board is satisfied that the amendments brought to the patent documents according to the present request of the appellant comply with the formal requirements of the EPC. The Board notes in particular that present claim 1 essentially corresponds, except for the deletion in the claim of the chemical and compositional modifiers listed in dependent claims 2 and 4 as granted, to the amended claim 1 on which the decision is based and that the opposition division already found that the latter claim satisfied the requirements of Articles 123(2) and (3) EPC. Furthermore, the set of dependent claims and the description as granted have been brought into conformity with the invention as defined in present claim 1 (Article 84 EPC and Rule 27(1) EPC).

4. *Prior art*

4.1 Document D1, published on 26 May 1994 and claiming priority date of 12 November 1992, discloses a positive electrode for use in alkaline cells comprising a

disordered multiphase nickel hydroxide host matrix (abstract). At least one modifier, preferably three of them, are incorporated into the host matrix for tailoring the chemical and the structural order of the material and improving the electrochemical charging/discharging efficiency and the storage capacity (page 26, line 32 to page 27, line 10).

4.2 Document D5 discloses a nickel hydroxide positive electrode material for electrochemical cells (abstract). The document proposes the use of the electrochemical cycling between the α and the γ phases to reduce swelling and teaches the incorporation of cobalt in order to stabilise the α-phase (column 1, line 24 to column 2, line 19 and Example 4). The document reports a good capacity performance throughout a cycle life of about 100 cycles (column 7, lines 37 to 43, and Example 7 together with Figure 6).

4.3 Document D6 describes the effects of co-precipitated metal ions on the electrochemistry, and in particular on the redox reaction (paragraphs bridging pages 726 and 727 and the Bode diagram on page 727) of nickel hydroxide thin films (abstract and Table I), and discusses the use of the metals as an alternative to cobalt as an additive in nickel hydroxide battery electrode materials (first paragraph on page 723).

4.4 Document D7 analyses the effects of cobalt addition on the morphology (Figure 3) and on the capacity (Figure 2) of nickel hydroxide electrode materials and describes the stabilising effect of cobalt on the redox process between the α and γ phases (abstract together with sections "Discussion" and "Conclusions").

5. *Grounds for opposition under Article 100(a) EPC*

5.1 Novelty

In its decision the opposition division held that the subject-matter of claim 1 then on file was novel over the disclosure of the prior art cited in the decision. The opposition division held in particular that none of documents D5 to D7 discloses the use of at least three compositional modifiers. This feature is also recited in present claim 1 and the Board adheres to the view of the opposition division that the feature is not anticipated by the disclosure of any of documents D5, D6 and D7.

As regards document D1 which constitutes state of the art within the meaning of Article 54(3) EPC with regard to the patent in suit claiming a priority of 8 March 1993, this document mentions the incorporation of three modifiers into a nickel hydroxide host matrix electrode material (point 4.1 above). However, the document fails to differentiate between the incorporation of modifiers as chemical and as compositional modifiers within the meaning of the present invention. Accordingly, the document does not anticipate the structural and the functional features required by the claimed subject-matter and relating to the incorporation of at least one chemical modifier and at least three compositional modifiers as claimed and consequently the subject-matter of claim 1 is also novel over the disclosure of document D1 (Articles 52(1) and 54(3) EPC).

The Board concludes that the subject-matter of present claim 1 is novel over the disclosure of the prior art considered by the opposition division (Articles 52(1) together with 54(2) and (3) EPC). The same conclusion applies to claims 2 to 5 by virtue of their dependence on claim 1.

5.2 Inventive step

5.2.1 In its decision the opposition division also held that the feature referred to in point 5.1 above relating to the use of at least three compositional modifiers was the single feature distinguishing the claimed subject-matter from the disclosure of each of documents D5 to D7 which were regarded by the opposition division as constituting alternative closest states of the art. The opposition division further held that there was no evidence that any combination of three compositional modifiers incorporated into the solid solution material at unspecified concentrations would achieve an improvement over the material of any of documents D5 to D7 and that for this reason the distinguishing feature was obvious. The opposition division concluded on the basis of these findings that the claimed-subject matter did not involve an inventive step.

5.2.2 The Board, however, cannot follow the opposition division's reasoning in this respect. Claim 1 does not only require that at least three compositional modifiers are incorporated into the solid solution of the electrode material, but also specifies that the compositional modifiers are incorporated into the material "to disrupt the formation of large crystallites, and to promote said multiphase structure".

This expression does not merely specify a desirable technical effect or a non-limiting intended purpose of the modifiers as appears to have been implicitly assumed by the opposition division, but defines in functional terms a further limiting technical feature of the compositional modifiers, namely that the compositional modifiers are so incorporated into the solid solution that they achieve disruption in the formation of large crystallites and promotion of the multiphase structure.

In addition, although - as correctly held by the opposition division - documents D5 to D7 disclose the incorporation of one compositional modifier into the material, there are no technical arguments or supporting evidence on file that would indicate that the compositional modifiers are incorporated into the materials of documents D5 to D7 so as to achieve the functional features recited in the claim, i.e. disrupting the formation of large crystallites and promoting the multiphase structure. Accordingly, in the absence of arguments or evidence to the contrary, the Board concludes that the aforementioned functional feature constitutes an additional technical feature distinguishing the claimed subject-matter over the disclosure of each of documents D5, D6 and D7.

5.2.3 According to the submissions of the appellant and the evidence presented by the appellant during the oral proceedings (see point V above), the γ-phase structure of the nickel hydroxide materials of the prior art improves the capacity of the electrodes at the expense of a decrease in cycle life, and the invention proposes making use of the beneficial effect of the γ-phase on

the capacity while at the same time incorporating modifiers to increase the operational lifespan by minimizing swelling.

Accordingly, the distinguishing structural and functional features identified above reduce swelling and achieve the technical effect of maintaining the initial high capacity throughout a longer cycle life.

Consequently, the technical problem solved by the claimed electrode, and more particularly by the distinguishing structural and functional features identified in point 5.2.2 above, over the electrode disclosed in any of documents D5 to D7 can be seen in the improvement of the electrochemical cycle life of the electrode material while maintaining a high capacity throughout the operational cycle life of the electrode.

5.2.4 However, none of the documents cited in the decision suggests the solution claimed in the patent in suit. In particular, document D5 addresses the problems of achieving a high capacity upon cycling and reducing swelling but only focuses on the incorporation of a single compositional modifier during the production of the material in order to obtain a stable α-phase structure (point 4.2 above) and therefore fails to teach or to suggest the structural and the functional distinguishing features identified above. Documents D6 and D7 are silent as to the technical problem formulated above and more particularly are silent as regards the problems of swelling and the electrochemical cycling lifespan of the electrode material (points 4.3 and 4.4 above). In addition,

document D6 (page 727, second column, third paragraph) and the patent specification as granted (page 7, lines 7 to 40) refer to the simultaneous use of two (Cd and Co) and three modifiers (Zn, Cd and Co), respectively, in nickel hydroxide materials of the prior art; however, there is no corresponding teaching that the modifiers are incorporated into the material so as to achieve the functional features required by the claimed subject-matter.

Thus, none of the documents teaches or suggests the incorporation of at least three compositional modifiers so as to disrupt the formation of large crystallites and to promote the multiphase structure as claimed.

5.2.5 Having regard to the above, the prior art considered by the opposition division in its decision does not render obvious the subject-matter of claim 1, nor that of claims 2 to 5 appendant thereto, within the meaning of Article 56 EPC.

6. *Grounds for opposition under Article 100(b) EPC*

6.1 The opposition division confined the reasons for the decision to the issues addressed under the grounds for opposition of lack of novelty and of inventive step (Article 100(a) EPC) and, in view of its negative view on the latter ground, the opposition division did not address in the decision the ground for opposition under Article 100(b) EPC. However, in view of the fact that the opposition has been withdrawn by the respondent, the Board, in the exercise of its discretion under Article 111(1) EPC, second sentence and in order to avoid further unnecessary delays, saw no reason to

remit the case to the opposition division to examine the opposition ground under Article 100(b) EPC.

6.2 The Board has considered the issues addressed during the proceedings under Article 100(b) EPC (see points I and 2 above) and has concluded that the patent as amended satisfies the requirements of sufficiency of disclosure set forth in Articles 100(b) and 83 EPC.

In particular, although the patent specification contains no explicit example of the claimed subject-matter involving the use of at least three compositional modifiers, the patent specification contains lists of modifiers (page 9, lines 1 to 4) and examples of incorporation of one compositional modifier that disrupts the formation of large crystallites and promotes the multiphase structure, and this information would in the Board's view enable the skilled person to carry out the invention as claimed.

Furthermore, both claim 1 and the description of the patent as granted (see page 7, lines 53 and 54, page 8, line 57 to page 9, line 14, and page 9, lines 50 to 55) define the structural and functional features distinguishing the compositional and the chemical modifiers from each other, and the description of the patent contains instructions as how to substitutionally and non-substitutionally incorporate modifiers into the solid solution of the electrode material (page 9, lines 15 to 18, page 9, line 56 to page 10, line 9, page 10, lines 23 to 39, and page 11, lines 3 to 7).

In addition, although the expression "the γ-phase having a 2^+ oxidation state and a 3,5 or greater oxidation

state" in present claim 1 is - as acknowledged by the appellant during the proceedings - not fully congruent with the standard terminology used in the technical field, the skilled person would understand in the context of the patent the actual technical meaning of the expression, especially in view of the description in the patent specification of the lower and the higher oxidation states of the nickel hydroxide material (page 6, lines 22 to 53, page 10, lines 19 to 24, and examples 1 to 3 together with Tables 1 and 2) and the characterisation of the β and the γ phases in terms of the X-ray diffraction lines in Figures 3 and 4 of the patent. Consequently the aforementioned expression does not, in the Board's view, affect the reproducibility of the invention.

7. The Board is therefore satisfied that the patent as amended according to the appellant's request and the invention to which it relates meet the requirements of the EPC. Accordingly, the contested decision is to be set aside and the patent maintained in amended form (Article 102(3) EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent as amended on the basis of the following documents:

   – claims: claims 1 to 5 as filed during the oral proceedings on 21 October 2004,

   – description: pages 2 to 6 and 13 of the patent as granted and pages 7 to 12 as filed during the oral proceedings on 21 October 2004, and

   – drawings: Figures 1 to 5 of the patent as granted.

The Registrar: The Chairman:

P. Martorana A. G. Klein