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D E C I S I O N
of 30 June 2005

Case Number: T 0364/03 - 3.4.2

Application Number: 97927621.9

Publication Number: 1015664

IPC: C25B 3/08

Language of the proceedings: EN

Title of invention:

Electrochemical fluorination using interrupted current

Applicant:

MINNESOTA MINING AND MANUFACTURING COMPANY

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes) "

Decisions cited:

T 0939/92

Catchword:

-



Case Number: T 0364/03 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 30 June 2005

Appellant: MINNESOTA MINING AND MANUFACTURING COMPANY
3M Center
P.O. Box 33427
St. Paul, MN 55133-3427 (US)

Representative: VOSSIUS & PARTNER
Postfach 86 07 67
D-81634 München (DE)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 30 October 2002
refusing European application No. 97927621.9
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: A. G. Klein
Members: M. A. Rayner
J. H. P. Willems

Summary of Facts and Submissions

- I. The patent applicant has appealed against the decision of the examining division refusing European patent application number 97 927 621.9 (International publication number WO 98/50603) relating to electrochemical fluorination using interrupted current. The examining division was of the opinion that the subject matter of claim did not meet the requirements of Article 56 EPC as it could not be considered to involve an inventive step having regard to document D1 (= WO94/13857).
- II. In its decision, the division remarked that selectivity of fluorinated compounds is increased by use of interrupted current in example 4 of document D1. The division considered that an interruption at a cycle time of 0.4 seconds or more could not be derived unambiguously from this example and thus the subject matter of claim 1 was considered novel over this prior art. In example 5 of document D1, which does not disclose a method of applying interrupted current, it can be seen that 15% v/v of perfluorodimethylether is produced. While examples 4 and 5 are directed to selective fluorination of organic compounds, it can nevertheless be seen that production of a certain amount of perfluorinated compounds is unavoidable. It must be concluded that the form of the current pulses, as well as the other conditions applied in the cell are crucial with regard to the final result. A skilled electrochemist knows that during such reactions a spectrum of differently fluorinated compounds is obtained, so that reaction conditions have to be optimised if the maximum yield of a certain compound is

desired. In the patent application, interrupted current is used to increase the amount of perfluorinated compounds.

Claim 1 is completely silent with regard to electrode material, to nature and concentration of the organic substrate, to concentration of hydrogen fluoride and possibly other additives used in the reaction solution. Neither voltage nor current nor waveform of the pulses applied are defined. Moreover the applicant failed to demonstrate that an interruption of an undefined current at a cycle time of 0.4 seconds or more, as part of an otherwise entirely undefined current pulse, solves the problems underlying the invention (i.e. to reduce the amount of electrical energy that is wasted as dissipated heat energy and to reduce the need for conductivity additives) regardless of the conditions chosen. The feature wherein the current is interrupted in such a manner that the resistance of the cell operated with interrupted current is lower than the resistance of the cell operated with uninterrupted current represents merely a desired result, which is not suitable to distinguish the subject matter of claim 1 from the prior art. As the applicant failed to demonstrate that an inventive step exists over the whole claimed range, claim 1 is not allowable, the requirements of Article 56 EPC are not met.

III. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of a main or an auxiliary request. A request is also made on an auxiliary basis for oral proceedings.

In support of its position, the appellant has indicated its disagreement with the argument of the examining division that interrupted current is used to increase the amount of perfluorinated compounds. According to the invention, interrupted current is used to reduce that amount of energy used to produce a given amount of a product that is substantially perfluorinated by lowering the quantity that is usually referred to as the total resistance of the cell. The essence of the invention is the interruption of current and it would be impossible to specify, for example, cathode material since the fluorination is an anodic reaction. The range of convenient cathode as well as anode material is known to the skilled person. The nature of the organic substrate is only restricted to having hydrogen atoms which can be replaced by fluorine atoms and there is no reason to believe that interrupted current will not work with any particular compound.

IV. Claim 1 according to the main request of the appellant is worded as follows.

"1. A process of electrochemical perfluorination of an organic substrate, the process comprising the steps of: providing an organic substrate comprising at least one carbon-bonded hydrogen; preparing a reaction solution comprising the substrate and hydrogen fluoride; passing electric current through the reaction solution sufficient to cause replacement of the hydrogens of the substrate with fluorine, the electric current being interrupted through a current cycle defined by current levels comprising an elevated current and a reduced current so that the value of the current is

periodically changed through a regular, repeating cycle wherein the reduced current is substantially zero, or is in the range from about 0 to 2 milliamps per square centimetre;
wherein the current is interrupted at a cycle time of 0.4 seconds or more; and
wherein the current is interrupted in such a manner that the resistance of the cell operated with interrupted current is lower than the resistance of the cell operated with uninterrupted current."

Reasons for the Decision

1. The appeal complies with the provisions referred to in Rule 65(1) EPC and is therefore admissible.

2. *Prior art*

In the proceedings before the first instance, document D1 was taken to represent the closest prior art, the appellant repeats this point of view in its statement of appeal (see section 2.3 on page 3). One could argue about whether choice of this document is really as appropriate as a document focused on perfluorination, but for the purposes of the present appeal, the board will proceed on this basis.

3. *Novelty*

3.1 Claim 1 of the main request concerns a process of electrochemical **per**fluorination of an organic substrate comprising at least one carbon-bonded hydrogen... to cause replacement of the hydrogens of the substrate

with fluorine. Therefore perfluorination is concerned in the claim, which means that, as recited, the hydrogens of the substrate are replaced by fluorine. On the other hand, the main thrust of document D1 is towards production of a compound of formula $R-O_n-(R^1)_m-CHF_2$. According to document D1, the partially fluorinated derivative $R-O_n-(R^1)_m-CHF$ may be produced with high selectivities (>60% and even 80%), despite the presence of a further hydrogen atom available for substitution by fluorine to produce a compound $R-O_n-(R^1)_m-CF_3$.

- 3.2 In example 5 of document D1, perfluorodimethylether is produced at 15%v/v, without current interruption. As the examining division conceded, from example 4 where there is interruption, a cycle time of 0.4 seconds or more cannot be derived unambiguously. In fact, 0.2 second is mentioned in example 4 of document D1, where there is also no quantification of reduced current values. In addition the last comparative feature of the claim is not disclosed in document D1.

The board therefore considers the subject matter of claim 1 of the main request to be novel over the disclosure of document D1.

4. *Inventive step*

- 4.1 The problem addressed by the novel features of claim 1 is to reduce the energy necessary in a process of electrochemical perfluorination. Document D1 teaches that pulsing the anode potential increases selectivity with which the group $-CH_2F$ is fluorinated to the group $-CHF_2$. The board does not see an obvious link towards why

the question of selectivity should be applied to the present perfluorination case. After all, a process of perfluorination, without selection of a fluorinated product, is concerned, whether or not the current is interrupted. From document D1 it does not seem obvious that the amount of energy used for perfluorination is reduced because the cell resistance is reduced, i.e. less energy is used for the perfluorinated product. Indeed, if current interruption increases selectivity of fluorination to CHF₂, the board considers example 4 in this respect less relevant to perfluorination than example 5, disclosing perfluorodimethylether at 15%v/v without current interruption. It seems rather more a case of hindsight to consider because interrupting the current is a known possibility in selective fluorination, the skilled person obviously applies this measure, choosing the novel features claimed, to reduce the energy necessary in a process of electrochemical perfluorination.

- 4.2 The examining division also advanced an argument referring to decision T 939/92, in the context of inventive step, to the claim being silent about a number of matters including electrode materials, nature and concentration of the organic substrate, and concentration of hydrogen fluoride and possible other additives. The claim does not concern a group of chemical compounds and the case distinguishes from decision T 939/92 as it is not a question as to whether or not a technical effect is achieved by all the chemical compounds. Thus, while the board does not consider the examining division incorrect about features about which the claim is silent, it is not these features, but, other things being the same, the

differing features relating to reducing energy according to the technical contribution of the applicant which the board has considered in its assessment of inventive step. Accordingly, the argument that the claim is silent on the features mentioned by the examining division does not persuade the board as to lack of inventive step.

4.3 Accordingly, the subject matter of claim 1 can be considered to involve an inventive step having regard to the disclosure of document D1.

5. *Auxiliary request*

Since the board does not agree with the refusal of the examining division based on claim 1 of the main request, the present appeal proceedings can be terminated without consideration of the auxiliary request in the present decision or holding oral proceedings.

6. *Further procedure*

A speedy resolution of a case, at least before the board as presently composed, is often more likely if an ex parte appellant furnishes a complete and correct set of application papers. In the present case, the application papers presented for the appeal involve manuscript amendments in the statement of claim so that errors cannot be excluded, and moreover, still contain a number of matters needing attention, including for example whether and, if so, how (a) the entire description should be adapted for consistency with the process of electrochemical perfluorination according to the independent claim or (b) document D1 discussed in

the context of the prior art. Furthermore, appropriateness of references to "incorporation of prior art documents" needs to be reviewed. The board considers further examination before the examining division to be appropriate and therefore remits the case for resolution to the examining division.

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 for further prosecution.

The Registrar:

The Chairman:

P. Martorana

A. G. Klein