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Datasheet for the decision of 22 May 2007

Case Number: T 1327/04 - 3.4.03

Application Number: 01913733.0

Publication Number: 1273065

IPC: H01M 8/12

Language of the proceedings: EN

Title of invention:
Solid oxide fuel cell as well as a method of manufacturing said solid oxide fuel cell

Applicant:
Danmarks Tekniske Universitet

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1327/04 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 22 May 2007

Appellant: Danmarks Tekniske Universitet
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 12 July 2004 refusing European application No. 01913733.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. G. O'Connell
Members: V. L. P. Frank
T. Bokor

Summary of Facts and Submissions

I. This is an appeal from the refusal of European patent application 01 913 733.0 for lack of inventive step (Article 56 EPC).

II. Claim 1 is now worded as follows (differences with respect to the refused claim are marked):

> "A method of manufacturing a solid oxide fuel cell for oxidation of gases, such as methane, coal gas or hydrogen, and comprising a solid oxide electrolyte, which is preferably formed by YSZ, and where a fluid-controlling coupling layer in form of a number of mutually separated columns (13) of a ceramic material is placed ~~between~~ **on both** the anode and the cathode side, characterised by stamping out of columns (13) from a plate of the unsintered ceramic material, said columns (13) ~~may be~~ **being** fixed to a layer of paper, whereafter the columns (13) are subjected to a sintering after being placed on both the anode and the cathode side, said columns (13) during the sintering being subjected to a mechanical load."

Claims 2 to 9 are dependent on claim 1.

III. The following prior art document was cited in the examination procedure:

D1: WO 92 09116 A

IV. In the decision under appeal it is stated that the application was refused based "on the applicant's

continuing reluctance to deal with the Examining Division's repeated objections raised under Art. 56 EPC. No serious attempt to demonstrate why the waste of material should be less than with the method disclosed in D1 was made in the letter dated 03.05.04 … No suitable counterarguments or suitable amendments of the claims have been received." (point 7 of the reasons in the decision under appeal). It is further stated that "As for independent claim 1 the existence of an inventive step has not been, as required by Art. 56 EPC, demonstrated by the applicant, the application had to be refused under Art. 97(1) EPC." (*ibid,* point 8).

At point 5 of the reasons it is stated that "it is only remarked that the claimed method, comprising stamping out of cylindrical columns form a plate, always leaves some material between the columns unused. This material can be collected and used again. No essential difference to the method described in D1 can be recognized, as in D1 green ceramics are used which are pressed into the desired net shape… Any remaining material can be used again in exactly the same manner as in the claimed method." However, it is explained at point 7 of the reasons that the refusal was not based on the argument set out at point 5, which was presented for the first time in the decision under appeal.

V. The appellant applicant argued essentially as follows:

– The fluid-controlling coupling layer was manufactured, according to the application, by stamping out columns of ceramic material. This allowed the use of a base made of a different material from that of the columns, or dispensing

with the base altogether. Moreover, tolerance problems and problems due to shrinkage during sintering were solved by subjecting the columns to a mechanical load during sintering.

– In contrast, the columns disclosed in document D1 were integral with a ceramic base, which base required additional ceramic material. The shrinkage during sintering could result in contact problems requiring the use of a bonding agent to wet the contact surfaces (D1, page 13, lines 10 to 15).

VI. The appellant applicant requests that the decision under appeal be set aside and a patent granted in the following version:

Description: pages 1, 2, 2a, 3 to 13 faxed 10 May 2007.

Claims: 1 faxed 10 May 2007 and amended by phone on 21 May 2007;
2 to 9 faxed 10 May 2007.

Drawings: sheets 1, 3 to 7 as originally filed;
sheet 2 faxed 10 May 2007.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments (Article 123(2) EPC)*

Claim 1 has been amended to indicate that the fluid-controlling coupling layer is placed on both the anode and the cathode sides, not between them.
This feature was originally disclosed
(page 1, lines 7 to 8; page 2, lines 9 to 10).

The description has been adapted to the claims.

The board is therefore satisfied that Article 123(2) EPC is not contravened.

3. *Inventive step*

3.1 The application relates to the manufacturing of solid oxide fuel cells. In such cells suitable gases have to be diverted through the anode and the cathode to the solid electrolyte where the reaction takes place. Usually hydrogen or hydrocarbon gases are used as fuel and oxygen or air as oxidant, while the operating temperature of the cell is between 700 and 1100°C. A fluid-controlling coupling layer with gas supply channels is provided on the anode and the cathode sides of the cell.

3.2 Document D1 discloses a fuel cell comprising coupling layers made from a block of ceramic material in which the gas channels are delimited by ribs 60, fins 64 or posts 70 of ceramic material (Figs. 5A to 5C). These structures are made from "green ceramic" tapes, ie unsintered ceramic material, composed of ceramic powder, binder and plasticizer. The tapes are cut and formed into the desired shape by compression moulding or

pressing, rolling, or by cutting grooves into the tapes. The complete cell is assembled by sequentially stacking individual fuel cells (a complete cell may comprise over two hundred individual cells) and heat treated to sinter and densify the ceramics (page 9, line 26 to page 10, line 15; page 10, line 29 to page 11, line 28).

Alternatively, a smaller number of individual cells may be assembled, or even only an individual fuel cell, and partially heat treated at a temperature sufficient to sinter the respective anode, electrolyte, cathode and interconnect ceramics (page 12, lines 3 to 14). The assembled elements are only partially sintered to at least 25%, preferably between 80 to 100%, of the total required sintering, so that the initial shrinkage is done before assembling the full cell (page 13, lines 2 to 9). The sintered and densified components are then assembled and the contacting surfaces wetted by a bonding agent (page 13, lines 10 to 14). The final heat treatment is then performed to sinter the ceramic elements and the bonding agent. This two step sintering and densifying process reduces *inter alia* the thermal induced cracking, while allowing the cell to have a very high number of individual cells. During the assembly of the sintered subassemblies into the stacked monolith and during its heat treatment, a compressive force may be applied to promote contact and bonding at the adjacent surfaces (page 14, lines 15 to 24).

3.3 The manufacturing method of claim 1 differs from the method disclosed in D1 in that

(a) the coupling layer is formed by a number of mutually separated columns,

(b) the columns are stamped out from a plate of unsintered ceramic material,

(c) the columns are fixed by a layer of paper, and in that

(d) the columns are subjected to a mechanical load during sintering.

3.4 The application discloses that the coupling layers involve a relatively cost-intensive manufacture because they must be made of a relatively expensive ceramic material, and furthermore **they require relatively much material** (page 2, lines 9 to 14 - board's emphasis).

3.5 The examining division saw this as the problem addressed by the invention and objected that it was not apparent why the claimed method would result in savings of material with respect to the method disclosed in document D1, since the removed material could be reused in both methods. However, it failed to recognize that, as pointed out by the appellant's representative, by employing the claimed method a ceramic base plate on which the columns are mounted can either be made from a different material or be dispensed with, since the columns forming the coupling layer can contact directly the anode and the cathode. This contrasts with the coupling layers disclosed in D1 in which a base is always an integral part of the coupling layer (Fig. 5).

3.6 The board considers therefore that the saving of ceramic material can be regarded as the objective technical problem addressed by the invention.

3.7 There is no prior art on file which discloses or suggests producing a layer of mutually separated columns by stamping them out from a plate and fixing them to a layer of paper. The board cannot discern therefore how the differentiating features mentioned at point 3.3 above would be obvious to the skilled person. It is further remarked that the step of subjecting the columns to a mechanical load during sintering is also not rendered obvious by the disclosure of document D1, since in D1 a mechanical load is only applied when joining the subassemblies to promote contact and bonding between them (page 14, lines 15 to 24).

3.8 The board notes *en passant* that the examining division concluded in the decision under appeal that "the existence of an inventive step has not, as required by Article 56 EPC, been demonstrated by the applicant" (point 8 of the reasons). It is however a logical impossibility to demonstrate either the absolute novelty or the inventiveness of anything. Only the contrary is possible. On these issues *inter alia*, the EPC for good reason places the onus on the examining division; in order to justify a negative finding on inventive step the latter has to show a plausible path by which, starting from the prior art, the skilled person would arrive at the subject-matter of the invention. This path is not shown in the decision under appeal. In this respect the examining division made a mistake in law. As in the case of an error of judgement or a misinterpretation of a document, this does not however constitute a procedural violation.

3.9 The method of manufacturing a solid oxide fuel cell according to claim 1 is considered therefore to involve an inventive step in the sense of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description: pages 1, 2, 2a, 3 to 13 faxed 10 May 2007.

Claims: 1 faxed 10 May 2007 and amended by phone on 21 May 2007;
2 to 9 faxed 10 May 2007.

Drawings: sheets 1, 3 to 7 as originally filed;
sheet 2 faxed 10 May 2007.

Registrar Chair

S. Sánchez Chiquero R. G. O'Connell