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Bezeichnung der Erfindung: Fibre optic sensor with bonded dye

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : G01N 21/75, G02B 5/16

**ENTSCHEIDUNG / DECISION**  
vom / of / du 4 February 1988

Anmelder / Applicant / Demandeur : Imperial Chemical Industries PLC

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPO / EPC / CBE

Art.56

Kennwort / Keyword / Mot clé : "Inventive step (yes)"

Leitsatz / Headnote / Sommaire

Europäisches  
Patentamt

Beschwerdekammern

European Patent  
Office

Boards of Appeal

Office européen  
des brevets

Chambres de recours



Case Number : T 164/87

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.1  
of 4 February 1988

**Appellant :** Imperial Chemical Industries PLC  
Imperial Chemical House  
Millbank  
GB-London SW1P 3JF

**Representative :** Hall, David Brian  
Imperial Chemical Industries PLC  
Legal Department: Patents  
PO Box 6  
Welwyn Garden City  
Herts, AL7 1HD  
GB

**Decision under appeal :** Decision of Examining Division 061  
of the European Patent Office  
dated 4 December 1986 refusing  
European patent application  
No. 82 303 803.9 pursuant to  
Article 97(1) EPC

**Composition of the Board :**

**Chairman :** K. Lederer

**Members :** E. Turrini

C. Payraudeau

## Summary of Facts and Submissions

- I. European patent application No. 82 303 803.9 (publication No. 0 072 627), was refused by decision of the Examining Division. That decision was based on Claim 1, filed on 16 August 1986.
- II. The reasons given for the refusal were that the subject-matter of Claim 1 did not involve an inventive step having regard to the prior art documents Nature, Vol. 257, 23 October 1975, pages 666 and 667, London, GB, E.E. Hardy et al. "Coated optical guides for spectrophotometry of chemical reactions" (D2), US-A-4 050 895 (D3) and US-A-3 904 373 (D4).
- III. The Appellant filed a notice of appeal together with the appeal fee. He also filed in due time a statement of grounds of appeal accompanied by an auxiliary set of claims.
- IV. Following a communication on behalf of the Board of Appeal, the Appellant filed on 21 December 1987 a letter requesting that the decision of the Examining Division be set aside and a European patent granted on the basis of an annexed set of Claims 1 to 9 with amendments proposed to new Claim 5 in a telex of 14 December 1987. As auxiliary request, the Appellant asked for the grant of a European patent with the unamended annexed set of Claims 1 to 9.
- V. Current Claim 1 reads as follows:

"An optical sensor for detecting changes in a chemical or physical parameter, comprising optical sensing means (4, 5, 6, 8; 11; 21) in form of a cylindrical waveguide and including a chromophore material (8; 18; 26) which is

variable in colour in response to the chemical or physical parameter, characterised in that the optical sensor comprises optical fibre means (1; 12; 13; 23) including a core (2; 14; 22) and a cladding (3; 15; 24) for launching light into and collecting light from the optical sensing means (4, 5, 6, 8, 11; 21), and in that the optical sensing means includes a porous material (4; 17; 21) to the surface of at least a part of which the chromophore material (8; 18; 26) is chemically bonded."

Claims 2 to 9 of the main and auxiliary requests are dependent from current Claim 1.

VI. The Appellant argues essentially as follows:

Documents D2 and D3 describe an optical sensor for detecting changes in a chemical or physical parameter, which sensor comprises optical sensing means including a lightguide covered by a chromophore material. Document D2 emphasises the fact that the direct application of the chromophore material to the core of the lightguide gives problems in coating adhesion. Document D3 and document D2 itself suggest a solution to these kinds of problems by holding the chromophore material in a polymer coating matrix and state that this technique was successfully applied. The skilled man would therefore seek merely to improve on such results, extending further in the direction indicated in D2 or D3 that had already proved to be successful. The utilisation of other teachings pointing away from such direction, e.g. the application of the teaching consisting in chemically bonding the chromophore material to the surface of the core of the lightguide would require hindsight. Moreover, the feature concerning the utilisation of porous material is not disclosed in combination with sensors including waveguides. Said feature would not be applied in such a case due to the fact that a

porous material would be expected to hinder the propagation of light through the waveguide.

Thus, although the individual elements of the invention are known per se, the skilled man would not obtain the invention from the disclosures of the cited documents without hindsight.

### Reasons for the Decision

1. The appeal is admissible.
2. Main request.
  - 2.1. There is no objection to the present application on formal grounds, since it is, in agreement with Article 123(2) EPC, adequately supported by the specification as originally filed.
  - 2.2. More specifically, present Claim 1 includes the features of original Claims 1, 2 and 10. The remaining feature of present Claim 1 that the optical fibre means is formed by a core and a cladding, is supported by the original drawings and the original description, pages 6 and 7, whereby the optical fibre of each embodiment is defined as comprising a core and a cladding.
  - 2.3. Novelty.
    - 2.3.1. Document D2 relates to an optical sensor for detecting changes in a chemical parameter (page 666, left column, first paragraph), comprising optical sensing means in the form of a cylindrical waveguide (Figure 1, "waveguide") and including a chromophore material which is variable in

colour in response to the chemical parameter (page 666, left column, line 8).

The above-mentioned features of the optical sensor according to document D2 correspond to the subject-matter of the preamble of Claim 1.

However, the optical sensor of D2 does not comprise any feature of the characterising portion of Claim 1. In particular, said sensor does not include optical fibre means for launching light into and collecting light from the optical sensing means (Figure 2). Moreover, the features concerning the porous material of the optical sensing means and the chemical bonding of the chromophore material to the surface of the optical sensing means are not mentioned.

- 2.3.2. Document D3, very similar to document D2, also describes an optical sensor including all the features of the preamble of Claim 1 (D3: Figure 1; description "Summary of the invention") but not the features of the characterising part of Claim 1 (D3: Figure 3).

It has to be noted that the expression "the first material ... chemically ... reacting with ... the second material" (D3: column 2, lines 33 to 36) does not necessarily mean that the chromophore material is chemically bonded to the surface of the optical sensing means.

- 2.3.3. Document D4 (column 1, lines 1 to 27; column 2, lines 12 to 21; column 3, lines 4 to 23) refers to an optical sensor for detecting changes in a chemical parameter comprising optical sensing means, including a porous material (column 3, lines 17 and 18) at the surface of which a chromophore material is chemically bonded.

Contrary to the subject-matter of Claim 1, the optical sensing means according to document D4 comprises stirring rods or the like which do not have the function of a waveguide and an optical fibre means for launching light into and collecting light from the optical sensing means, is not present.

- 2.3.4. The other cited prior art documents are not more relevant.
- 2.3.5. For the above reasons the subject-matter of Claim 1 is deemed to be novel within the meaning of Article 54 EPC.

#### 2.4. Inventive step.

- 2.4.1. Claim 1 is based, as before outlined, on D2 or D3, which are, in the Board's opinion, the nearest prior art. Starting from the disclosure of D2 or D3, a first problem to be solved is to improve the bonding action between the chromophore material and the cylindrical waveguide, while at the same time, as a second problem to be solved, improving the overall sensitivity of the optical sensor.
- 2.4.2. The two problems are solved by the features of the characterising portion of Claim 1.
- 2.4.3. As far as the solution of the first problem is concerned, a man skilled in the art would look for other solutions in the same technical field which could provide a better bond. Document D4, which also refers to an optical sensor for detecting changes in a chemical parameter, would suggest to him to bond the chromophore material chemically (by means of an intermediate silane coupling agent) to the cylindrical waveguide of the optical sensing means according to document D2 or D3, obtaining thus a strong linkage. Indeed, although the optical

sensing means of D4 does not include a waveguide, the skilled man would not see any drawback in applying the chemical bonding in the case of a waveguide, because he would recognise that a chromophore applied, e.g. on the surface of the waveguide without the utilisation of a polymer coating, functions correctly as far as the light transmission through the waveguide is concerned (document D2, page 666, left column, second paragraph). He would therefore make this trial and he would appreciate the favourable results.

Thus, the Board of Appeal shares the opinion of the Examining Division in the impugned decision, that the satisfactory results outlined in D2 or D3 in solving the bonding problem by utilising polymer bonding agents, would not deter the skilled man from seeking other solutions, if the latter are not in contradiction with the former solutions. Indeed, the solution suggested by D4 of chemically bonding the chromophore material is not in conflict with the solution proposed by D2 or D3.

- 2.4.4. As far as the solution of the second problem is concerned, the skilled man would, without the need of inventive ingenuity, use optical fibre means for launching light into and collecting light from the optical sensing means in the form of a waveguide, this being a common working option in the opto-electric field to reduce light losses. He would also take into account the teaching of document D4 and in particular he would consider the utilisation of porous glass in form of rods (document D4, column 3, lines 17 and 18), because the surface to which the chromophore is bonded increases with the porosity of the rods leading to an increase of the sensor sensitivity. However, the skilled man would be discouraged from applying such a feature to a cylindrical

waveguide, due to the fact that the latter relies on internal reflection at its surface to propagate the light through the waveguide itself and he would therefore expect that the light would be scattered by the porous material, in particular by the porous surface of the waveguide and that consequently the waveguide would be rendered unsuitable to guide the light through it.

The other cited documents do not help to solve the second problem mentioned.

Contrary to every expectation, the waveguide of the sensor according to Claim 1 exhibits effective waveguidance and the overall sensitivity of the sensor is greatly enhanced with respect to a sensor which does not utilise porous material.

2.4.5. Thus, the subject-matter of Claim 1 is considered to involve an inventive step within the meaning of Article 56 EPC and Claim 1 is, therefore, admissible under Article 52(1) EPC.

2.4.6. Since Claims 2 to 9 relate to particular embodiments of the optical sensor according to Claim 1, their allowability follows from that of Claim 1.

3. Auxiliary request.

Since the main request is allowable, there is no need to consider the auxiliary request which, in any case, only differs from the main request by the wording of Claim 5, which is less clear than that of Claim 5 of the main request.

**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 grant a European patent on the basis of the following documents:
  - 2.1. Description: page 5 as originally filed;  
pages 2 and 6 filed on 21 May 1986;  
pages 1, 1a, 3, 4 and 7 filed on 21 December 1987.
  - 2.2. Claims: Claims 1 to 9 filed on 21 December 1987 with the following amendments requested by the Applicant in the telex dated 14 December 1987 and enclosed with the letter filed on 21 December 1987:  
  
in Claim 5, after "terminal" insert "portion",  
after "throughout" insert "and" and after  
"fibre means" insert ", "
  - 2.3. Drawing: Sheet 1/1 filed on 21 December 1987.

The Registrar:

The Chairman:

F.Klein

K.Lederer