



(86) Date de dépôt PCT/PCT Filing Date: 2000/12/08  
(87) Date publication PCT/PCT Publication Date: 2001/07/12  
(85) Entrée phase nationale/National Entry: 2001/08/31  
(86) N° demande PCT/PCT Application No.: DE 2000/004393  
(87) N° publication PCT/PCT Publication No.: 2001/050198  
(30) Priorité/Priority: 1999/12/31 (199 64 099.8) DE

(51) Cl.Int.<sup>7</sup>/Int.Cl.<sup>7</sup> G03F 7/26, B81C 1/00

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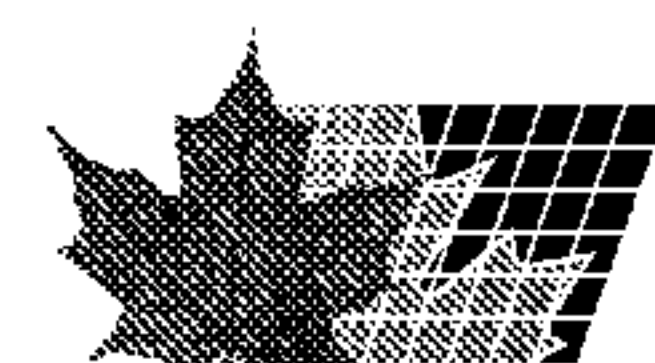
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(54) Titre : PROCEDE DE FABRICATION DE STRUCTURES CONDUCTRICES ET DE LIAISON DISPOSEES DE  
MANIERE TRIDIMENSIONNELLE, DESTINEES A DES FLUX VOLUMIQUES ET ENERGETIQUES  
(54) Title: METHOD FOR PRODUCTION OF THREE-Dimensionally ARRANGED CONDUCTING AND  
CONNECTING STRUCTURES FOR VOLUMETRIC AND ENERGY FLOWS

(57) **Abrégé/Abstract:**

The invention relates to a method for production of three-dimensionally arranged conducting and connecting structures for volumetric and energy flows. Various light-setting materials are used for the production of the layers. Upon exchanging the materials, those layer regions in which no setting occurred during the preceding setting process, are also filled with new material, such that, in the subsequent setting process, not only is the upper layer linked to the one lying directly beneath it, but also material of the upper layer is connected to the material of a layer lying below the penultimate layer. It is thus possible, within the layer sequence, to connect a structure with varying properties from layer to layer.



(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES  
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG(19) Weltorganisation für geistiges Eigentum  
Internationales Büro(43) Internationales Veröffentlichungsdatum  
12. Juli 2001 (12.07.2001)

PCT

(10) Internationale Veröffentlichungsnummer  
**WO 01/50198 A2**(51) Internationale Patentklassifikation<sup>7</sup>: G03F(74) Anwalt: RÖTHER, Peter; Vor dem Tore 16a, 47279  
Duisburg (DE).

(21) Internationales Aktenzeichen: PCT/DE00/04393

(81) Bestimmungsstaaten (*national*): AU, CA, CN, ID, IN, IS,  
JP, KR, NO, RU, SG, US.(22) Internationales Anmeldedatum:  
8. Dezember 2000 (08.12.2000)(84) Bestimmungsstaaten (*regional*): europäisches Patent (AT,  
BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,  
NL, PT, SE, TR).

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

Veröffentlicht:

(30) Angaben zur Priorität:  
199 64 099.8 31. Dezember 1999 (31.12.1999) DE— Ohne internationalen Recherchenbericht und erneut zu  
veröffentlichen nach Erhalt des Berichts.

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47239 Duisburg (DE).Zur Erklärung der Zweibuchstaben-Codes, und der anderen  
Abkürzungen wird auf die Erklärungen ("Guidance Notes on  
Codes and Abbreviations") am Anfang jeder regulären Ausgabe  
der PCT-Gazette verwiesen.(54) Title: METHOD FOR PRODUCTION OF THREE-Dimensionally ARRANGED CONDUCTING AND CONNECTING  
STRUCTURES FOR VOLUMETRIC AND ENERGY FLOWS(54) Bezeichnung: VERFAHREN ZUR HERSTELLUNG DREIDIMENSIONAL ANGEORDNETER LEIT- UND VERBIN-  
DUNGSSTRUKTUREN FÜR VOLUMEN- UND ENERGIESTRÖME

(57) Abstract: The invention relates to a method for production of three-dimensionally arranged conducting and connecting structures for volumetric and energy flows. Various light-setting materials are used for the production of the layers. Upon exchanging the materials, those layer regions in which no setting occurred during the preceding setting process, are also filled with new material, such that, in the subsequent setting process, not only is the upper layer linked to the one lying directly beneath it, but also material of the upper layer is connected to the material of a layer lying below the penultimate layer. It is thus possible, within the layer sequence, to connect a structure with varying properties from layer to layer.

(57) Zusammenfassung: Die Erfindung betrifft ein Verfahren zur Herstellung dreidimensional angeordneter Leit- und Verbindungsstrukturen für Volumen- und Energieströme. Dabei werden zur Erzeugung der Schichten unterschiedliche lichtaushärtende Materialien verwendet. Beim Austausch der Materialien werden auch die Schichtenbereiche mit neuem Material gefüllt, in denen bei der vorhergehenden Aushärtung keine Aushärtung stattfand, so dass bei der darauffolgenden Aushärtung nicht nur die oberste Schicht mit der darunterliegenden verbunden wird, sondern auch Material der obersten Schicht mit dem Material einer unterhalb der vorletzten Schicht liegenden Schicht verbunden wird. Damit ist es möglich, innerhalb der Schichtenfolge eine Struktur mit anderen Eigenschaften von Lage zu Lage miteinander zu verbinden.

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**Method for Production of Three-dimensionally Arranged Conducting and  
Connecting Structures for Volumetric and Energy Flows**

The present invention relates to a method for producing three-dimensionally arranged conducting and connecting structures for volumetric and energy flows. The volumetric flows can be gaseous, liquid, or solid, or can consist of a mixture of these aggregate states. The energy flows can be acoustic, electrical, magnetic, or electromagnetic.

As a rule, such volumetric and energy flows are realized today by many different technologies. The most frequently used transport paths in microsystem technology are strip conductors and bonding wires. In addition to wave guides, glass fibres are also used to transport electromagnetic energy. Volumetric flows are realized through channels, tubes, and pipelines. As miniaturization increases, it is becoming increasingly difficult to combine these conducting and connecting elements.

The present invention achieves this objective by using a structured and layered design. Layered-structure methods are familiar from microtechnology. DE-PS 44 20 996 describes a method in which a small quantity of light-hardened plastic is held by surface tension between two parallel plates, at least one of which is transparent to electromagnetic waves. The surface of the liquid plastic beneath the plate that is transparent to electromagnetic waves is hardened, for example, by a laser beam that is guided over the surface according to a three-dimensional model of the

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structure that is to be generated, said model being stored in a computer. The laser light hardens the liquid plastic layer by layer, according to the three-dimensional model, the space between the plates being increased by the thickness of one layer on each occasion, so that fresh plastic can flow into the resulting space between the hardened layer and the plate, and do this simply as a result of its surface tension. In this way it is possible to generate structures in the micrometer range very precisely.

The present invention exploits this technology.

When this is done, different light-hardened materials are used to form the layers. These materials can have various physical, chemical, and biological properties; for example they can be electrically conductive or electrically insulating, and they can have different optical refractive indices. When the material is replaced, the layer segments in which no hardening took place during the previous hardening process are also filled with new material, so that during subsequent hardening, not only is the uppermost layer joined to the one beneath it, but the material of the uppermost layer is joined to the material of a layer that is beneath the penultimate layer. Thus, it is possible within the sequence of layers, to join a structure with material characteristics that vary from layer to layer. These unhardened areas, which remain as channels after hardening and flushing, are available for volumetric transport. In the same way, these channels can be used as waveguides for high frequencies if the walls of the channels are produced from material having appropriate properties.

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In addition, light-conducting structures can be generated by using materials with different refractive indices. These light-conducting structures can be used in conjunction with phototransistors (key phrase: light switches light) to form optical integrated circuits.

In this way, it is also possible to interconnect conventional integrated circuits, for an integrated circuit has been integrated into a cavity beneath the last surface, so a channel can be generated with conductive material by way of the connectors (pads) and this can be routed to an additional integrated circuit or to a plug-type connector that has been manufactured in this way.

**WO 01/50198****PCT/DE00/04393****Patent Claims**

1. Method for producing three-dimensionally arranged conducting and connecting structures for volumetric and energy flows. When this is done, different light-hardened materials are used to form the layers. When the material is replaced, the layer segments in which no hardening took place during the previous hardening process are filled with new material, so that during subsequent hardening, not only is the uppermost layer joined to the one beneath it, but the material of the uppermost layer is joined to the material of a layer that is beneath the penultimate layer. Thus, it is possible within the sequence of layers, to join a structure with material characteristics that vary from layer to layer.
2. Method as defined in Claim 1, characterized by the following process steps:
  - a) a structured layer is generated by the structured consolidation of a liquid, light-hardened material with selected physical, chemical, or biological properties;
  - b) the structured layer is cleansed of unhardened material by a flushing process and then filled with liquid, light-hardened material with other physical, chemical, or biological properties, and covered over with a defined layer thickness as set out in DE-PS 44 20 996;
  - c) areas of the first layer and the new layer are hardened so as to be structured, by structured consolidation;

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- d) the structured layers are cleansed of unhardened material from the last structuring by a flushing process, and then filled with liquid, light-hardened material with other physical, chemical, and biological properties, and covered over with a defined layer thickness as set out in DE-PS 44 20 996;
- e) areas of the second layer and the new layer are hardened by structured consolidation so as to be structured, when connection of materials with identical physical, chemical, or biological properties, or insulation of these, is generated;
- f) the structured layer is cleansed of unhardened material from the last structuring by a flushing process;
- g) areas not filled with material are fitted with electronic, mechanical, optical, or chemical components, according to the system that is to be assembled;
- h) the structured layers and the components are filled with liquid, light-hardened material having other physical, chemical, and biological properties, and covered over with a defined layer thickness as set out in DE-PS 44 20 996;
- i) areas of the penultimate layer and the new layer are hardened by structured consolidation so as to be structured, when the connection of materials and

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components with identical physical, chemical, or biological properties , or insulation of these, is generated.

3. Method as defined in Claim 2, characterized in that a plurality of electronic, mechanical, chemical, or biological/electrical components are interconnected.
4. Method as defined in Claim 3, characterized in that the connections between the components and the environment of the system can be used for volumetric and energy flows.

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