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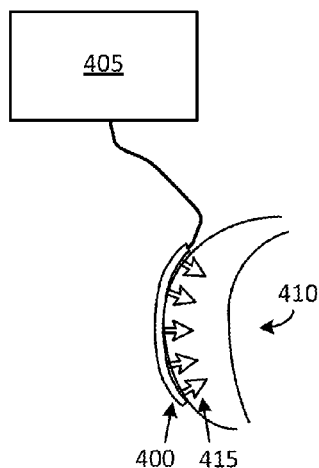
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[Continued on next page]

(54) Title: 3D MICROELECTRODE DEVICE FOR LIVE TISSUE APPLICATIONS



(57) Abstract: A 3D microelectrode device includes a flexible substrate containing poly-dimethyl siloxane (PDMS). The device may be fabricated in a miniature form factor suitable for attachment to a small organ such as a lateral gastrocnemius muscle of a live rat. In addition to providing a miniaturized, conformable attachment, the device provides an anchoring action via one or more microelectrodes, each having an insertable tip particularly shaped to provide the anchoring action. Furthermore, a base portion of each of the microelectrodes is embedded inside conductive poly-dimethyl siloxane (cPDMS). The cPDMS is contained in a pad that is coupled to a conductive track embedded in the flexible substrate. Embedding of the base portion inside the cPDMS material not only allows the microelectrode to bend in various directions, but also provides good electrical conductivity while eliminating the need for attachment processes using solder or epoxy adhesives.

FIG. 4



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. A61N1/05 H05K1/09
ADD. A61B5/04 H05K1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61N H05K A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	P WEI ET AL: "Stretchable microelectrode array using room-temperature liquid alloy interconnects", JOURNAL OF MICROMECHANICS AND MICROENGINEERING, vol. 21, no. 5, 1 May 2011 (2011-05-01), page 054015, XP055005020, ISSN: 0960-1317, DOI: 10.1088/0960-1317/21/5/054015 page 2, column 2; figures 1,3a,3b,4 page 3, column 2; figure 5 page 6, column 1 page 4, column 1 - column 2 ----- -/--	1-28



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/046104

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-28

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/046104

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/157714 A1 (ETH ZUERICH ETH TRANSFER [CH]; UNIV ZUERICH [CH]; VOEROES JANOS [CH];) 22 December 2011 (2011-12-22) cited in the application page 8, lines 10-12 page 21, lines 15-20 page 13, lines 17-19 page 14, lines 25-29 page 19, lines 5-7 -----	1-28
Y	KR 101 054 864 B1 (SNU R& DB FOUNDATION [KR]) 5 August 2011 (2011-08-05) figure 1 -----	2-5,16
Y	STÄ CR PHANIE P LACOUR ET AL: "Flexible and stretchable micro-electrodes for in vitro and in vivo neural interfaces", MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING, SPRINGER, BERLIN, DE, vol. 48, no. 10, 10 June 2010 (2010-06-10), pages 945-954, XP019835546, ISSN: 1741-0444 page 3, column 1, paragraph 4; figure 2b -----	24
A	US 2006/074460 A1 (MAGHRIBI MARIAM N [US] ET AL) 6 April 2006 (2006-04-06) the whole document -----	1-28
A	US 2011/254171 A1 (GUO LIANG [US] ET AL) 20 October 2011 (2011-10-20) the whole document -----	1-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/046104

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011157714 A1	22-12-2011	EP 2582289 A1	24-04-2013
		US 2013303873 A1	14-11-2013
		WO 2011157714 A1	22-12-2011

KR 101054864 B1	05-08-2011	NONE	

US 2006074460 A1	06-04-2006	NONE	

US 2011254171 A1	20-10-2011	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-28

Device comprising a flexible substrate, a track embedded in the substrate and comprising conductive poly-dimethyl siloxane material and a microelectrode comprising a base portion, a longitudinal portion and an insertable tip and a method of manufacturing a 3D microelectrode device comprising conductive poly-dimethyl siloxane material

2. claims: 29-33

Method of manufacturing a microelectrode apparatus comprising the steps of treating a microelectrode device and an extender assembly to an oxygen plasma cycle, overlapping a portion of the microelectrode device with a portion of the extender and using a laminating apparatus to create a chemical and mechanical bonding between the microelectrode device and the extender, wherein the portion of the microelectrode device comprises conductive poly-dimethyl siloxane pad
