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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: BIOACTIVE POROUS BONE GRAFT IMPLANTS

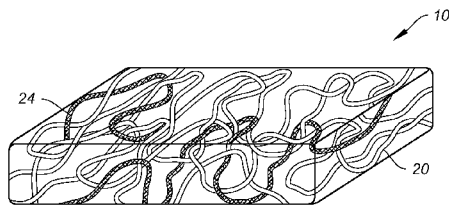


FIG. 1A

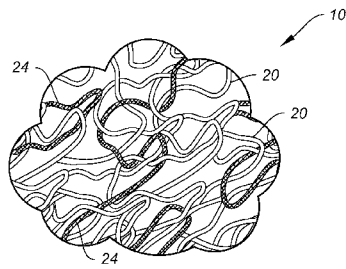


FIG. 1B

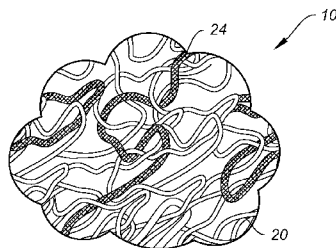


FIG. 1C

(57) Abstract: Bioactive porous bone graft implants in various forms suitable for bone tissue regeneration and/or repair, as well as methods of use, are provided. The implants are formed of bioactive glass and have an engineered porosity. The implants may take the form of a putty, foam, fibrous cluster, fibrous matrix, granular matrix, or combinations thereof and allow for enhanced clinical results as well as ease of handling.



**(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).

**Declarations under Rule 4.17:**

— *of inventorship (Rule 4.17(iv))*

**Published:**

— *with international search report (Art. 21(3))*

**(88) Date of publication of the international search report:**

12 February 2015

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/26951

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61L 27/10 (2010.01)  
CPC - A61F 2002/2835

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)  
IPC(8) - A61L 27/10 (2010.01)  
CPC - A61F 2002/2835

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
623/23.51, 23.57, 23.61; 623/23.51-23.63  
(Search term limited; see below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
PubWest (PGPB, USPT, EPAB, JPAB); Google; PatBase (All);  
Search Terms: Glass, bioactive, fiber, fibrous, granule, coating, silic\*, S70C30, S70 C30, 45S5, 45 S5, S53P4, S53 P4, 58S, 1393, 13-93, porous, pore site, diameter, radius, micron, micrometer, mum, nanometer, nm, first, second, component, graft, inject, bone, osseo

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0217388 A1 (GREENSPAN et al.) 08 September 2011 (08.09.2011) Entire document, especially Abstract, para[0017]- para[0026], para[0036]	1-5, 11, 13, 15-19
-		6-10, 12, 14
Y	US 2003/0120348 A1 (BROSNAHAN et al.) 26 June 2003 (26.06.2003) Entire document, especially Abstract and para[0029]- para[0030].	6
Y	US 2006/0093645 A1 (JANAS et al.) 04 May 2006 (04.05.2006) Entire document, especially Abstract, para[0031] and para[0041].	7
Y	US 2010/0278902 A1 (JALLOT et al.) 04 November 2010 (04.11.2010) Entire document, especially Abstract and para[0026].	8
Y	US 2009/0306673 A1 (BUMA et al.) 10 December 2009 (10.12.2009) Entire document, especially Abstract, para[0049]- para[0051].	9-10
Y	Early dissolution of a morsellised impacted silicate-free bioactive glass in metaphyseal defects to (GRIFFON et al.) 2001. J Biomed Mater Res. 2001;58(6):638-44. Accessed from the web <url: http://www.ncbi.nlm.nih.gov/pubmed/11745515> Accessed 9/3/2014.	12
Y	US 6,051,247 A (HENCH et al.) 18 April 2000 (18.04.2000) Entire document, especially Abstract, col 6, ln 45-65 and col 1, ln 21-61.	14
A	US 6,344,496 B1 (NIEDERAUER et al.) 05 February 2002 (05.02.2002) Entire document.	1-19
A	US 6,171,986 B1 (ZHONG et al.) 09 January 2001 (09.01.2001) Entire document.	1-19

Further documents are listed in the continuation of Box C.

\* 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

03 September 2014 (03.09.2014)

Date of mailing of the international search report

26 NOV 2014

Name and mailing address of the ISA/US

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PCT Helpdesk: 571-272-4300  
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/26951

**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:  
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-19, drawn to a composite bone graft comprising a bioactive glass and a second component comprising a bioactive material, wherein the composite implant comprises a pore size distribution including pores characterized by pore diameters ranging from about 100 nanometers to about 1 millimeter.

Group II: Claims 20-22, drawn to a composite bone graft conformable putty having a first component comprising a bioactive glass and in the form of porous granules, and a second component comprising a carrier material

— see extra 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 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.:  
1-19

**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/US 14/26951

— Continuation of Box III: Observations where unity of invention is lacking (Continuation of item 3 of first sheet) —

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-19, drawn to a composite bone graft comprising a bioactive glass and a second component comprising a bioactive material, wherein the composite implant comprises a pore size distribution including pores characterized by pore diameters ranging from about 100 nanometers to about 1 millimeter.

Group II: Claims 20-22, drawn to a composite bone graft conformable putty having a first component comprising a bioactive glass and in the form of porous granules, and a second component comprising a carrier material

The inventions listed as Groups I - II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups I-II share the common features of a composite with a first material comprising a bioactive glass and wherein each of the components has a different resorption capacity than the other component. However, said features are known in the art to US 2011/0217388 A1 to Greenspan et al. (hereinafter: Greenspan). Greenspan describes a bone graft implant (Abstract) with a first material comprising a bioactive glass (para[0017]) and wherein each of the components has a different resorption capacity than the other component (para[0016]-[0018]: note different materials have different resorption capacity).

Consequently, the special technical feature of Group I is a composite comprising a second component comprising a bioactive material, wherein the composite implant comprises a pore size distribution including pores characterized by pore diameters ranging from about 100 nanometers to about 1 millimeter, which is not present in group II which has the special technical features of a composite comprising a conformable putty having a first component in the form of porous granules, and a second component comprising a carrier material. Neither of these special technical features is shared by the other group. Accordingly, unity of invention is lacking under PCT Rule 13.1.