

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
6 March 2003 (06.03.2003)

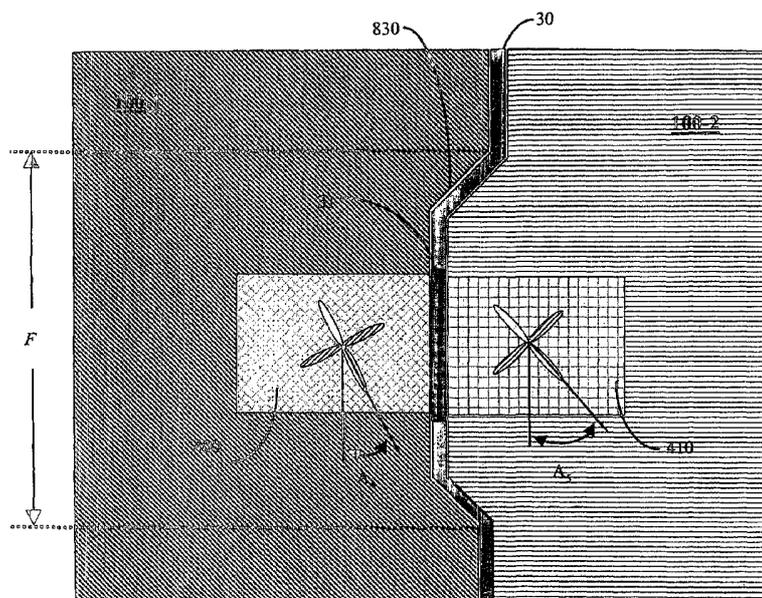
PCT

(10) International Publication Number  
WO 2003/019685 A3

- (51) International Patent Classification<sup>7</sup>: H01L 39/24, 39/22
- (74) Agent: FASKEN MARTINEAU DUMOULIN LLP; Box 20, Suit 4200, Toronto- Dominion Centre, Toronto Dominion Bank Tower, Toronto, M5K 1N6 (CA).
- (21) International Application Number: PCT/CA2002/001326
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.
- (22) International Filing Date: 28 August 2002 (28.08.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/316,378 30 August 2001 (30.08.2001) US
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant: D-WAVE SYSTEMS, INC [CA/CA]; 320-1985 West Broadway, Vancouver, British Columbia, V6J 4Y3 (CA).
- (72) Inventors: IL'ICHEV, Evgeni; Anna-Siemsen-Strasse 57, 07743 Jena, (DE). IJSSELSTELJN, Robbert, P.J.; Hinter der Kirche 1, 07743 Jena, (DE). STEININGER, Miles, F.H.; 2234 Mathers Avenue, West Vancouver, British Columbia, V7V 2H5 (CA).
- Published:  
— with international search report

[Continued on next page]

(54) Title: OXYGEN DOPING OF JOSEPHSON JUNCTIONS



(57) Abstract: A method of forming a grain boundary Josephson junction includes forming a superconducting layer on a substrate, patterning the superconducting layer to form the grain boundary Josephson junction, and annealing the substrate and superconducting layer in oxygen in order to increase the critical current density of the junction. The method is applicable to various types of junctions, including DD, DND, and SND junctions formed on various types of substrates, including bi-crystal substrates and single crystal substrates. The annealing is reversible. Oxygen can be removed from the junction, thereby decreasing the critical current density of the junction. In some instances, after patterning, the superconducting layer has a dimension smaller than a length of a facet in the superconducting layer.

WO 2003/019685 A3



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**(88) Date of publication of the international search report:**  
29 January 2004

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 02/01326

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 H01L39/24 H01L39/22

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 7 H01L B32B H03B H03D

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 practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HUANG M Q ET AL: "A new preparation technique for YBa <sub>2</sub> Cu <sub>3</sub> O <sub>7</sub> bicrystal junctions" PHYSICA C, NORTH-HOLLAND PUBLISHING, AMSTERDAM, NL, vol. 292, no. 3-4, 20 December 1997 (1997-12-20), pages 177-182, XP004109452 ISSN: 0921-4534 page 177, paragraphs 1., INTRODUCTION -page 178, paragraphs 2., EXPERIMENTAL --- -/--	1, 2, 4, 6, 11-13, 22, 23, 26, 31-33

Further documents are listed in the continuation of box C.

Patent family members are listed in 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 document 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

Date of mailing of the international search report

17 November 2003

27/11/2003

Name and mailing address of the ISA  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer  
  
 van Toledo, W

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 02/01326

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	TOKUNAGA S ET AL: "SiO <sub>2</sub> passivation film effects on YBCO junctions" PHYSICA C, NORTH-HOLLAND PUBLISHING, AMSTERDAM, NL, vol. 306, no. 1-2, 10 September 1998 (1998-09-10), pages 107-113, XP004145062 ISSN: 0921-4534 page 107 -page 109 ----	1,5, 11-13, 18-22, 28, 31-33, 37,38
X	DAALMANS G M: "HTS DC SQUIDS for practical applications" APPLIED SUPERCONDUCTIVITY, PERGAMON PRESS, EXETER, GB, vol. 3, no. 7, 1 July 1995 (1995-07-01), pages 399-423, XP004007067 ISSN: 0964-1807 page 416 -page 417 ----	1,2,6, 11-13, 22,23, 26,31-33
X	US 5 339 457 A (KAWASAKI TAKEHIKO ET AL) 16 August 1994 (1994-08-16) column 11, line 44 -column 13, line 36; figures 4A-D ----	1,11-15, 22,31-35
X	US 5 358 928 A (GINLEY DAVID S ET AL) 25 October 1994 (1994-10-25)  the whole document ----	1,11,12, 18,20, 22,31, 32,37,39
X	EP 0 329 603 A (IBM) 23 August 1989 (1989-08-23)  column 6, line 18 -column 9, line 11 ----	1,6, 11-13, 22,26, 31-33
A	EP 0 756 335 A (INT SUPERCONDUCTIVITY TECH) 29 January 1997 (1997-01-29) column 10, line 37 -column 11, line 53; figures 2-4 ----	1-39
A	US 6 242 387 B1 (ALLEN LAURA H ET AL) 5 June 2001 (2001-06-05) the whole document -----	1-39

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 02/01326

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5339457	A	16-08-1994	DE 68926947 D1	19-09-1996
			DE 68926947 T2	30-01-1997
			EP 0372951 A2	13-06-1990
			JP 2902017 B2	07-06-1999
			JP 3204982 A	06-09-1991
			CA 2004555 A1	09-06-1990
US 5358928	A	25-10-1994	NONE	
EP 0329603	A	23-08-1989	US 5162298 A	10-11-1992
			DE 68901980 D1	13-08-1992
			DE 68901980 T2	25-02-1993
			EP 0329603 A2	23-08-1989
			JP 1218077 A	31-08-1989
			JP 2109479 C	21-11-1996
			JP 8028536 B	21-03-1996
			US 5278140 A	11-01-1994
EP 0756335	A	29-01-1997	JP 9036449 A	07-02-1997
			DE 69607700 D1	18-05-2000
			DE 69607700 T2	07-09-2000
			EP 0756335 A1	29-01-1997
US 6242387	B1	05-06-2001	US 5889289 A	30-03-1999