

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
8 April 2010 (08.04.2010)

PCT

(10) International Publication Number
WO 2010/040016 A3

(51) International Patent Classification:

C23C 18/16 (2006.01) *H01L 23/15* (2006.01)
C23C 18/42 (2006.01) *H01B 1/16* (2006.01)
C23C 18/54 (2006.01)

(21) International Application Number:

PCT/US2009/059311

(22) International Filing Date:

2 October 2009 (02.10.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/102,083 2 October 2008 (02.10.2008) US

(71) Applicant (for all designated States except US): **E. I. DU PONT DE NEMOURS AND COMPANY** [US/US]; 1007 Market Street, Wilmington, Delaware 19898 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **NAIR, Kumaran Manikantan** [US/US]; 2 Famers Lane, Head of the Harbor, New York 11780 (US). **SKURSKI, Michael A.** [US/US]; 1017 Manchester Drive, Cary, North Carolina 27511 (US). **VOULTOS, John, D.** [US/US]; 9144 Palm Bay Circle, Raleigh, North Carolina 27617 (US).

(74) Agents: **SIEGELL, Barbara, C.** et al.; E. I. du Pont de Nemours and Company, Legal Patent Records Center, 4417 Lancaster Pike, Wilmington, Delaware 19805 (US).

(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, 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, IS, JP, KE, KG, KM, 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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (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, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

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

29 July 2010

(54) Title: NICKEL-GOLD PLATEABLE THICK FILM SILVER PASTE, AND PLATING PROCESS FOR LOW TEMPERATURE CO FIRED CERAMIC DEVICES AND LTCC DEVICES MADE THEREFROM

(57) Abstract: Described are LTCC devices, with external silver containing electrical contacts, that are sequentially plated with a nickel containing metal and a gold containing metal.



WO 2010/040016 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/059311

A. CLASSIFICATION OF SUBJECT MATTER INV. C23C18/16 C23C18/42 C23C18/54 H01L23/15 H01B1/16 ADD.		
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) C23C H01L H01B		
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, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2005 061799 A1 (EPCOS AG [DE]) 5 July 2007 (2007-07-05) paragraph [0029] - paragraph [0031] claims 1,11	1,6
X	US 2005/003677 A1 (DEAN TIMOTHY B [US] ET AL) 6 January 2005 (2005-01-06) paragraph [0050] - paragraph [0052]; claims 1,5-7	5,6
A		1
X	US 2006/231801 A1 (CARROLL ALAN F [US] ET AL CARROLL ALAN FREDERICK [US] ET AL) 19 October 2006 (2006-10-19) paragraphs [0014], [0032], [0035], [0041], [0042], [0044], [0052]	2-4
A	US 2003/228968 A1 (USUI HIROSHI [JP] ET AL) 11 December 2003 (2003-12-11) paragraphs [0040], [0052] - [0062]	3,4
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 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	
8 June 2010	14/06/2010	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Le Hervet, Morgan	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/059311

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.:

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.

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, 5, 6

A process comprising plating silver-containing metal external electrical contacts of an LTCC device with nickel and gold successively. The related plating thicknesses and bath conditions.

2. claims: 2-4

A silver paste composition suitable for an LTCC device.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/059311

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102005061799 A1	05-07-2007	NONE	
US 2005003677 A1	06-01-2005	JP 2007524757 T KR 20060024448 A WO 2005006423 A1	30-08-2007 16-03-2006 20-01-2005
US 2006231801 A1	19-10-2006	AU 2006201558 A1 CN 101055896 A EP 1713092 A2 JP 2006332032 A KR 20060108545 A US 2009120483 A1	02-11-2006 17-10-2007 18-10-2006 07-12-2006 18-10-2006 14-05-2009
US 2003228968 A1	11-12-2003	CN 1483009 A EP 1443029 A1 WO 03040057 A1 TW 261050 B	17-03-2004 04-08-2004 15-05-2003 01-09-2006