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(71) Applicant: **BASF SE** [DE/DE]; Carl-Bosch-Strasse 38, 67056 Ludwigshafen am Rhein (DE).

(72) Inventors: **ARNOLD, Marco**; Carl-Bosch-Strasse 38, 67056 Ludwigshafen (DE). **WEI, Chiao Chien**; No. 33, Chin Chien 1st Road, Taoyuan 32853 (TW). **HUANG, Tzu Tsang**; No. 31, Chin Chien 2nd Road, Taoyuan 32853 (TW). **LIN, Shih Ming**; No. 33, Chin Chien 1st Road, Taoyuan 32853 (TW). **KUO, Cheng Chen**; No. 31, Chin Chien 2nd Road, Taoyuan 32853 (TW). **CHOU, Shih Wei**; No. 33, Chin Chien 1st Road, Taoyuan 32853 (TW). **CHU, Chieh**; No. 33, Chin Chien 1st Road, Taoyuan 32853 (TW).

(74) Agent: **BASF IP ASSOCIATION**; BASF SE, G-FLP - C006, 67056 Ludwigshafen (DE).

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(54) Title: COMPOSITION FOR COBALT OR COBALT ALLOY ELECTROPLATING

(57) Abstract: A cobalt electroplating composition comprising: (a) cobalt ions, (b) an ammonium compound of formula $(NR^1R^2R^3H^+)_nX^{n-}$ wherein R^1, R^2, R^3 are independently selected from H and linear or branched C_1 to C_6 alkyl, X is selected from an n valent inorganic or organic counter ion, n is an integer selected from 1, 2 or 3.



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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. C25D3/12 C25D3/16 C25D7/12
ADD. H01L21/768 H01L21/288

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)
C25D H01L

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.
X	SOTO A B ET AL: "Electrochemical nucleation of cobalt onto glassy carbon electrode from ammonium chloride solutions", ELECTROCHIMICA ACTA, ELSEVIER SCIENCE PUBLISHERS, BARKING, GB, vol. 41, no. 16, January 1996 (1996-01), pages 2647-2655, XP004019951, ISSN: 0013-4686, DOI: 10.1016/0013-4686(96)00088-6	1-5,11
Y	Section Experimental ----- -/--	7,12,13



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

11 September 2019

Date of mailing of the international search report

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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/EP2019/058617

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MADAI GRANADOS NERI ET AL: "Cobalt Electrodeposition Process from Electrolytic Baths based on CoSO", ECS TRANSACTIONS, January 2009 (2009-01), pages 375-383, XP055508273, US	1-4,11
Y	ISSN: 1938-5862, DOI: 10.1149/1.3268405 Section experimental conditions	7,12,13
X	GB 2 100 752 A (OCCIDENTAL CHEM CO [US]) 6 January 1983 (1983-01-06) page 1, line 89 - page 2, line 16	1-4
X	US 3 951 760 A (FUEKI SHIMETOMO ET AL) 20 April 1976 (1976-04-20) column 2, line 4 - column 3, line 9	1-6,11
X	JACOB EWING ET AL: "High-current-density electrodeposition using pulsed and constant currents to produce thick CoPt magnetic films on silicon substrates", AIP ADVANCES, AMERICAN INSTITUTE OF PHYSICS, 2 HUNTINGTON QUADRANGLE, MELVILLE, NY 11747, vol. 8, no. 5, 20 December 2017 (2017-12-20), XP012225036, DOI: 10.1063/1.5007272	1-3,6,11
Y	Section II. METHODS	7,12,13
Y	US 4 016 051 A (GELDZAHLE CHARLES ET AL) 5 April 1977 (1977-04-05) column 1, line 43 - column 3, line 45; tables 1,2	7,10,11
Y	GB 1 336 146 A (CANNING & CO LTD W) 7 November 1973 (1973-11-07) examples II, III	7,10,11
Y	WO 2018/015168 A1 (BASF SE [DE]) 25 January 2018 (2018-01-25) page 3, line 20 - page 7, line 18	7,10,12, 13
A	WO 2017/004424 A1 (ENTHONE [US]) 5 January 2017 (2017-01-05) cited in the application page 3, line 18 - page 4, line 17 page 6, line 23 - page 8, line 20	12,13
A	US 2016/273117 A1 (DOUBINA NATALIA V [US] ET AL) 22 September 2016 (2016-09-22) the whole document	12,13
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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BUCKALEW BRYAN ET AL: "Electrodeposited cobalt for advanced packaging applications", 2017 IEEE ELECTRON DEVICES TECHNOLOGY AND MANUFACTURING CONFERENCE (EDTM), IEEE, 28 February 2017 (2017-02-28), pages 51-52, XP033106049, DOI: 10.1109/EDTM.2017.7947517 the whole document -----	12

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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.:

2-7, 10(completely); 1, 11-13(partially)

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: 2-7, 10(completely); 1, 11-13(partially)

A composition comprising cobalt ions and an ammonium compound according to the claimed formula, and further comprising a suppressing agent of formula S1. The use of such a composition. A process for depositing cobalt on a semiconductor substrate by means of such a composition.

2. claims: 8, 9(completely); 1, 11-13(partially)

A composition comprising cobalt ions and an ammonium compound according to the claimed formula, and further comprising a leveling agent according to one of the claimed formulas. The use of such a composition. A process for depositing cobalt on a semiconductor substrate by means of such a composition.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/058617

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