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H01L 29/786 (2006.01)	H01L 27/12 (2006.01)
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C09D 11/033 (2014.01)	C09D 11/037 (2014.01)
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H05K 3/12 (2006.01)	H05K 3/28 (2006.01)

(52) Cooperative Patent Classification (CPC):

**C09D 11/52; C08K 3/04; C08K 3/08; C09D 11/033;
C09D 11/037; C09D 11/10; C09D 11/101;
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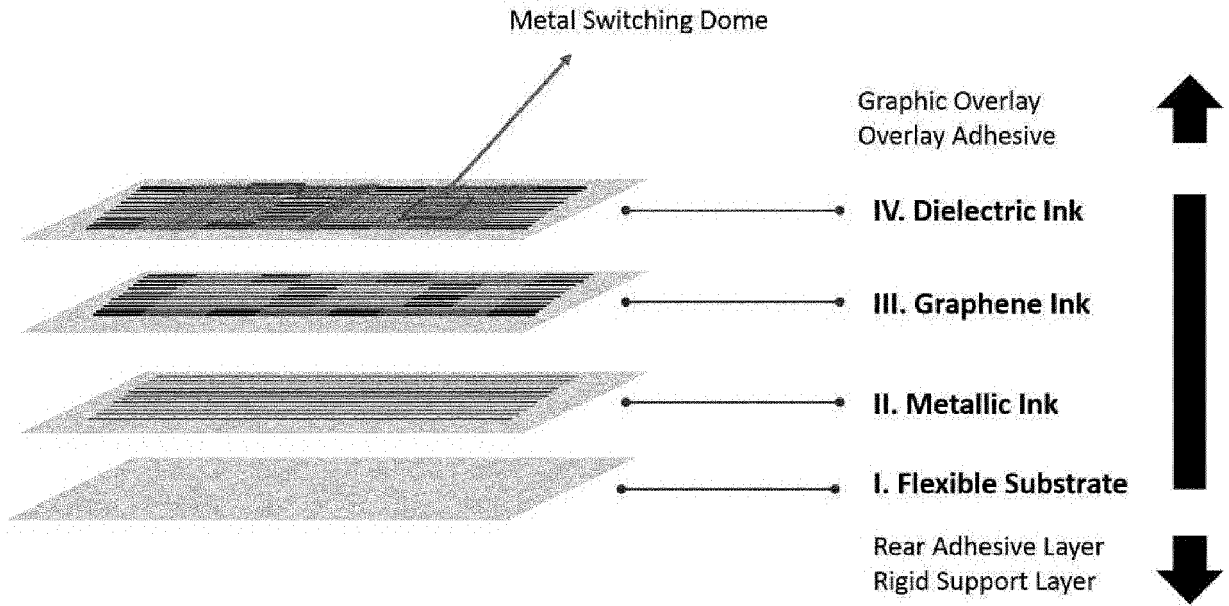
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(54) **GRAPHENE ENHANCED AND ENGINEERED MATERIALS FOR MEMBRANE TOUCH SWITCH AND OTHER FLEXIBLE ELECTRONIC STRUCTURES**

(57) A multilayered structure comprising: a flexible substrate; a layer comprising a metal ink; a layer comprising a graphene ink; and a layer comprising a dielectric ink.

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Figure 1





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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/127223 A1 (DORFMAN JAY ROBERT [US]) 27 May 2010 (2010-05-27) * claims; examples *	1-8	INV. B05D5/12 C08K3/04 C08K3/08
X	JP 2013 104019 A (MITSUBISHI PAPER MILLS LTD) 30 May 2013 (2013-05-30) * claims; examples *	1-8	C09D11/00 C09D11/03 C09D11/02 C09D11/10
X	US 2012/225198 A1 (SEONG JIE-HYUN [KR] ET AL) 6 September 2012 (2012-09-06) * claims; examples *	1-8	C09D11/101 H01L29/786 H01L27/12 C09D11/52
A	WO 2007/026366 A1 (PRINTAR LTD [IL]; HALAHMI IZHAR [IL] ET AL.) 8 March 2007 (2007-03-08) * claims; examples *	1-8	C09D11/324 C09D11/033 C09D11/037 C09D11/322
X	US 4 088 801 A (BOLON DONALD A ET AL) 9 May 1978 (1978-05-09) * claims 1-9; example 1 *	1,3-8	H05K1/09 H05K3/12
X	WO 2006/093398 A1 (INKTEC CO LTD [KR]; CHUNG KWANG-CHOON [KR] ET AL.) 8 September 2006 (2006-09-08) * claims 8,11; example 43 *	1,3-8	TECHNICAL FIELDS SEARCHED (IPC) C09D C08K B05D H01L
E	WO 2018/146616 A2 (NAT RES COUNCIL CANADA [CA]) 16 August 2018 (2018-08-16) * claims; examples *	1,3-8	
X	US 2010/000441 A1 (JANG BOR Z [US] ET AL) 7 January 2010 (2010-01-07) * paragraphs [0029], [0042], [0042]; claims 5,6,7; examples *	1,3-8	
-/--			
-The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 May 2024	Examiner Zeslawski, Wojciech
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 832 689 A1 (FUNDACIÓN IMDEA NANOCIENCIA [ES] ET AL.) 4 February 2015 (2015-02-04) * paragraphs [0043], [4447]; claims *	1,3-8	H05K3/28
X	KR 2015 0076632 A (DONGJIN SEMICHEM CO LTD [KR]) 7 July 2015 (2015-07-07) * paragraphs [0023], [0042] - [0047]; claims *	1,3-8	
			TECHNICAL FIELDS SEARCHED (IPC)
-The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 May 2024	Examiner Zeslawski, Wojciech
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

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Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

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No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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see sheet B

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All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

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As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

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Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

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None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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**LACK OF UNITY OF INVENTION
SHEET B**

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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1. claims: 2 (completely); 1, 3-8 (partially)

A metal ink based on metal fillers.

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2. claims: 1, 3-8 (all partially)

A metal ink based on organo-silver compounds.

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3. claims: 1, 3-8 (all partially)

A metal ink based on graphene.

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4. claims: 11 (completely); 9, 10, 13-15 (partially)

An UV curable dielectric ink.

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5. claims: 12 (completely); 9, 10, 13-15 (partially)

A thermal curable dielectric ink.

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6. claims: 9, 10, 13-15 (all partially)

A dielectric ink comprising a functional additive.

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7. claims: 9, 10, 13-15 (all partially)

A dye-containing dielectric ink

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8. claims: 9, 10, 13-15 (all partially)

A pigment-containing dielectric ink

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15-05-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010127223 A1	27-05-2010	CN 102224190 A	19-10-2011
		EP 2350176 A1	03-08-2011
		JP 5462274 B2	02-04-2014
		JP 2012509965 A	26-04-2012
		KR 20110088593 A	03-08-2011
		TW 201030768 A	16-08-2010
		US 2010127223 A1	27-05-2010
		WO 2010060024 A1	27-05-2010
JP 2013104019 A	30-05-2013	NONE	
US 2012225198 A1	06-09-2012	CN 102666747 A	12-09-2012
		JP 5388150 B2	15-01-2014
		JP 2013503433 A	31-01-2013
		KR 20110021681 A	04-03-2011
		TW 201137055 A	01-11-2011
		US 2012225198 A1	06-09-2012
WO 2007026366 A1	08-03-2007	CN 101283061 A	08-10-2008
		EP 1937785 A1	02-07-2008
		JP 2009506187 A	12-02-2009
		US 2009163615 A1	25-06-2009
		WO 2007026366 A1	08-03-2007
US 4088801 A	09-05-1978	CA 1096223 A	24-02-1981
		US 4088801 A	09-05-1978
WO 2006093398 A1	08-09-2006	EP 1853671 A1	14-11-2007
		ES 2424849 T3	09-10-2013
		JP 4964152 B2	27-06-2012
		JP 2008531810 A	14-08-2008
		PL 1853671 T3	31-01-2014
		US 2008206488 A1	28-08-2008
		US 2010247798 A1	30-09-2010
		WO 2006093398 A1	08-09-2006
WO 2018146616 A2	16-08-2018	CA 3052742 A1	16-08-2018
		CN 110382637 A	25-10-2019
		EP 3580284 A2	18-12-2019
		FI 3580284 T3	28-12-2023
		JP 7277383 B2	18-05-2023
		JP 2020510739 A	09-04-2020
		KR 20190108175 A	23-09-2019
		KR 20240005153 A	11-01-2024
		TW 201842088 A	01-12-2018
		US 2020017697 A1	16-01-2020

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55

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 24 15 3539

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The members are as contained in the European Patent Office EDP file on
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15-05-2024

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50

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		WO 2018146616 A2	16-08-2018

US 2010000441 A1	07-01-2010	US 2010000441 A1	07-01-2010
		US 2012007913 A1	12-01-2012
		US 2016360616 A1	08-12-2016
		US 2019380201 A1	12-12-2019

EP 2832689 A1	04-02-2015	EP 2832689 A1	04-02-2015
		WO 2015014862 A1	05-02-2015

KR 20150076632 A	07-07-2015	CN 104745007 A	01-07-2015
		KR 20150076632 A	07-07-2015

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