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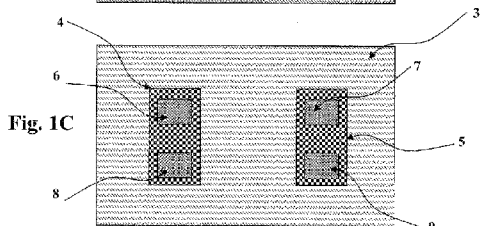
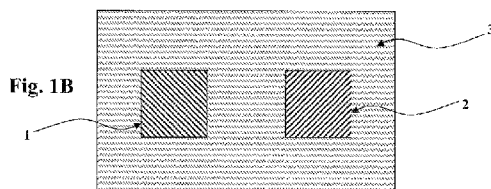
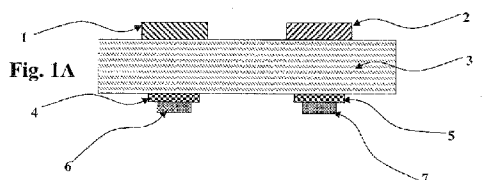
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[Continued on next page]

(54) Title: ELECTRIC-FIELD ENHANCED PERFORMANCE IN CATALYSIS AND SOLID-STATE DEVICES INVOLVING GASES



(57) Abstract: Electrode configurations for electric-field enhanced performance in catalysis and solid-state devices involving gases are provided. According to an embodiment, electric-field electrodes can be incorporated in devices such as gas sensors and fuel cells to shape an electric field provided with respect to sensing electrodes for the gas sensors and surfaces of the fuel cells. The shaped electric fields can alter surface dynamics, system thermodynamics, reaction kinetics, and adsorption/desorption processes. In one embodiment, ring-shaped electric-field electrodes can be provided around sensing electrodes of a planar gas sensor.

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## INTERNATIONAL SEARCH REPORT

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**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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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)

eKOMPASS (KIPO internal) "gas sensor &amp; electric field &amp; SOFC &amp; sensing electrode and similar tems "

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.   |
|-----------|--|---|
| X         | KR 10-2003-0055341 A(MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 02.JUL.2003<br><br>See the abstract, fig. 1~ 13, Paragraph [15] ~ Paragraph [222], whole claims | 1,2,4,6,7,11-16,<br>18-24,26-34,37,38<br>42-47,49-54,56,57<br>59,61,62,66-71,73-79,<br>81-89,92,93,97-102,<br>104-109 |
| Y         | See the whole document   | 3,5,8-10,17,25,35,36,<br>39-41,48,55,58,60,<br>63-65,72,80,90,91,<br>94-96,103,110                                    |
| Y         | KR 10-2004-0103928 A(AGAMA TRIX, INC.) 09.DEC.2004<br><br>See the abstract, fig. 2,3,5-19, Paragraph [10] ~ Paragraph [220], whole claims)                     | 5,8,17,25,35,36,60,63,<br>72,80,90,91   |
| A         | See the whole document   | 1-4,6,7,9-16,18-24,<br>26-34,37-59,61,62,<br>64-71,73-79,81-89,<br>92-110   |

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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.  |
| Y   | US 6,916,415 B2(WALDE)12.JUL.2005<br><br>See the whole document                    | 3,9,10,39-41,48,55,58<br>64,65,94-96,103,110                       |
| A   | See the whole document   | 1,2,4-8,11-38,42-47,49-54,<br>56,57,59-63,66-93,97-102,<br>104-109 |

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Information on patent family members

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**PCT/US2008/086693**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
| KR 10-2003-0055341 A                      | 02.07.2003          | CA 2436238 A1              | 13.06.2002          |
|   |                     | JP 2002-174618 A           | 21.06.2002          |
|   |                     | US 2004-0026268 A1         | 12.02.2004          |
|   |                     | WO 2002-046734 A1          | 13.06.2002          |
| KR 10-2004-0103928 A                      | 09.12.2004          | AU 2003-210957 A1          | 04.09.2003          |
|   |                     | AU 2003-210957 A1          | 10.02.2003          |
|   |                     | CA 2475375 A1              | 21.08.2003          |
|   |                     | EP 1474678 A2              | 10.11.2004          |
|   |                     | JP 2005-518527 A           | 23.06.2005          |
|   |                     | US 2005-0069892 A1         | 31.03.2005          |
|   |                     | WO 2003-069304 A3          | 21.08.2003          |
|   |                     | WO 2003-069304 A2          | 21.08.2003          |
| US 06916415 B2                            | 12.07.2005          | EP 1232390 A1              | 21.08.2002          |
|   |                     | JP 2003-515165 A           | 22.04.2003          |
|   |                     | KR 10-0801338 B1           | 29.01.2008          |
|   |                     | US 2002-0164815 A1         | 07.11.2002          |
|   |                     | WO 2001-038863 A1          | 31.05.2001          |