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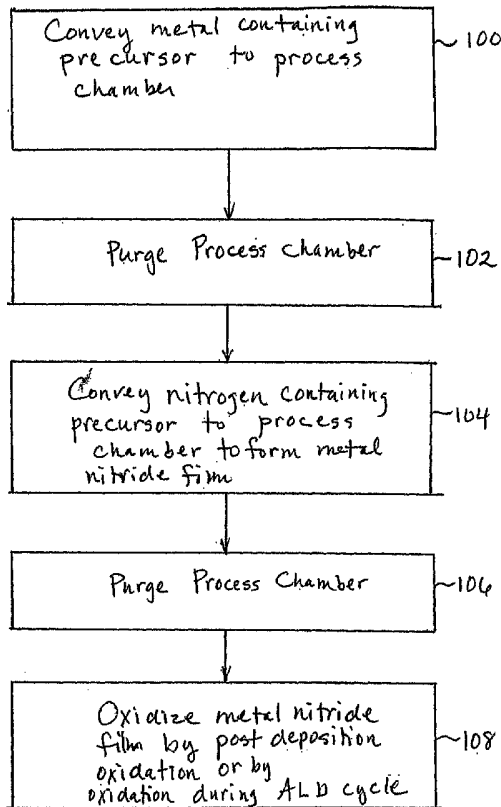
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[Continued on next page]

(54) Title: NITRIDATION OF HIGH-K DIELECTRIC FILMS



(57) Abstract: The present invention promotes incorporation of nitrogen (e.g., nitridation) into high-k dielectric films using a low temperature process. Further, the present invention provides an in-situ method; that is formation of the high-k dielectric film and nitridation of the film are carried out in the same process chamber during deposition of the film, as opposed to the conventional post processing techniques. In another aspect, a method for depositing a multi-layer material for use as a gate dielectric layer in semiconductor devices is provided.

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European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(7) : H01L 21/4763 US CL : 438/591 According to International Patent Classification (IPC) or to both national classification and IPC</p>																										
<p>B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 438/591</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>																										
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category *</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X,P</td> <td>US 2004/0198069 (Metzner et al) 7 October 2004 (07.10.2004), Fig. 1, Page 2-6.</td> <td>1-5, 7, 9, 12-15, 18, 20 and 23</td> </tr> <tr> <td>Y</td> <td>US 6,399,208 (Baum et al) 04 June 2002 (04.06.2002), Columns 4 and 7</td> <td>6, 17 and 34</td> </tr> <tr> <td>Y</td> <td>US 2005/0175789 (Helms Jr. et al) 23 June 2003 (23.06.2003), Page 4, Paragraph 31</td> <td>8, 19 and 43</td> </tr> <tr> <td>Y</td> <td>US 6,803,272 (Halliyal et al) 22 Aug. 2003 (22.08.2003), Column 14</td> <td>24</td> </tr> <tr> <td>Y</td> <td>US 2003/0108674 (Chung et al) 12 Jun 2003 (12.06.2003), Fig. 1B, Page 3, Paragraph 42</td> <td>25-26</td> </tr> <tr> <td>Y,P</td> <td>US 6,764,898 (En et al) 20 Jul 2004 (20.07.2004), Fig. 2, Column 7-8</td> <td>27, 29, 31-33 and 41</td> </tr> <tr> <td>Y</td> <td>US 2003/0113972 (Hayashi et al) 19 Jun 2003 (19.06.2003), Page 4-5, Paragraph 54-55 and 66</td> <td>39 and 40</td> </tr> </tbody> </table>			Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X,P	US 2004/0198069 (Metzner et al) 7 October 2004 (07.10.2004), Fig. 1, Page 2-6.	1-5, 7, 9, 12-15, 18, 20 and 23	Y	US 6,399,208 (Baum et al) 04 June 2002 (04.06.2002), Columns 4 and 7	6, 17 and 34	Y	US 2005/0175789 (Helms Jr. et al) 23 June 2003 (23.06.2003), Page 4, Paragraph 31	8, 19 and 43	Y	US 6,803,272 (Halliyal et al) 22 Aug. 2003 (22.08.2003), Column 14	24	Y	US 2003/0108674 (Chung et al) 12 Jun 2003 (12.06.2003), Fig. 1B, Page 3, Paragraph 42	25-26	Y,P	US 6,764,898 (En et al) 20 Jul 2004 (20.07.2004), Fig. 2, Column 7-8	27, 29, 31-33 and 41	Y	US 2003/0113972 (Hayashi et al) 19 Jun 2003 (19.06.2003), Page 4-5, Paragraph 54-55 and 66	39 and 40
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<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201</p>		<p>Authorized officer <i>Jylian Dele For</i> Carl Whitehead Telephone No. (703) 872-7222</p>																								