Havemann anticipates claims 1-12 of U.S. Patent No. 6,784,552, Nulty et al.
(“the ’552 Patent”) under 35 U.S.C. § 102

Prior Art Cited in this Chart:
U.S. Patent No. 5,482,894, Havemann (“Havemann”)

Claim Language	**Havemann**
Claim 1	
A structure, comprising:	“The present invention relates to a method of producing and a structure for self-aligned contacts on semiconductor devices.” **Col. 2, lines 10-11.**
a conductive layer disposed over a substrate;	“Conformal dielectric 30 deposited on the sidewalls of conductors 26 may also be thinned at this point (e.g., if layer 30 is used in a known manner to align ion implantation to substrate 20, layer 30 may require thinning after implantation to reduce the aspect ratio of insulated gap 29). **Col. 5, lines 10-14.** **Figure 2D** FIG. 2D
a first insulating layer on the conductive layer;	“FIG. 1B shows the structure after patterning and etching by known methods to form two conductors 26, including insulating conductor caps 28, separated by a gap 24 with a relatively high aspect ratio (1.4:1 aspect ratio shown).” **Col. 3, lines 62-65.** **Figure 2D** FIG. 2D
a contact region in said	“Preferably, a short anisotropic etch of the conformal layer follows

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Claim Language	Havemann
first insulating layer;	these steps if contact is to be made to the substrate in the gap (which may then be followed by a deposition of conducting material in the gap to form an electrical contact to the substrate." **Col. 2, lines 62-66**. "Finally, as illustrated in FIG. 11, contact plug 40, formed of a conducting material (e.g. a composite comprised of a refractory metal underlayer with a tungsten overlayer) may be deposited in cap window 39 and contact window 41 (which includes the portion of insulated gap 29 underlying window 39) to form a contact to the substrate at gap bottom 43." **Col. 4, line 63 – Col. 5, line 1.** **Figure 2D**

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<table>
<tr><th>Claim Language</th><th>Havemann</th></tr>
<tr><td>at least one insulating spacer in the contact region adjacent to the first insulating layer; and</td><td>
<table>
<tr><th>Drawing Element</th><th>Preferred or Specific Examples</th><th>Generic Term</th><th>Other Alternate Examples</th></tr>
<tr><td>20</td><td>Single-crystal silicon</td><td>Substrate</td><td></td></tr>
<tr><td>22</td><td>Thermally-grown oxide (SiO_2)</td><td>Gate oxide</td><td>Silicon nitride</td></tr>
<tr><td>26</td><td>Polysilicon w/ refractory metal silicide overlayer</td><td>Conductors</td><td>Aluminum, copper, tungsten, platinum, titanium</td></tr>
<tr><td>28</td><td>Thermally-grown oxide</td><td>Insulating conductor cap</td><td>CVD oxide, silicon nitride, doped oxides, silicon oxynitride</td></tr>
<tr><td>30</td><td>Thermally-grown oxide</td><td>Conformal dielectric layer</td><td>CVD oxide, silicon nitride, silicon oxynitride</td></tr>
<tr><td>32</td><td>Allied Signal 515 Series SOG</td><td>Organic-containing dielectric layer</td><td>Amorphous Teflon, parylene, polyimide</td></tr>
<tr><td>34</td><td>CVD silicon dioxide</td><td>Inorganic cap layer</td><td>Inorganic SOG, silicon nitride, doped oxides, silicon oxynitride</td></tr>
<tr><td>36</td><td></td><td>Photoresist</td><td></td></tr>
<tr><td>40</td><td>Tungsten w/ refractory metal underlayer</td><td>Contact plug</td><td>Aluminum, polysilicon, copper, titanium, tantalum, titanium nitride, refractory metal silicides</td></tr>
<tr><td>42</td><td>Silicon nitride</td><td>Conformal dielectric overlayer</td><td>Thermal oxide, CVD oxide</td></tr>
</table>
Col. 6, line 6.

Figure 2D

FIG. 2D
</td></tr>
<tr><td>an etch stop material over said first insulating layer and adjacent to the insulating spacer, the etch stop material being a</td><td>“Additional material may subsequently be deposited as a conformal dielectric overlayer 42, e.g., using thermal oxide or silicon nitride (see FIG. 2C).”
Col. 5, lines 16-18.</td></tr>
</table>

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Claim Language	Havemann
different material from the insulating spacer,	"If conformal layer 30 and overlayer 42 differ in materials (e.g. thermal oxide and nitride), relatively selectively between the two materials may also be exploited to design a structure wherein conductor caps 28 are extremely thin." **Col. 5, lines 27-31.** **Figure 2D** FIG. 2D
wherein a side of the insulating spacer has an angle relative to the substrate surface that is either a right angle or an acute angle of more than 85°.	"Cap window 39 supplies a pattern for etching a contact window through organic-containing layer 32 by a suitable anisotropic (substantially in one direction, usually vertical) etch." **Col. 4, lines 37-40.** "At some geometry, this method becomes ineffective for reliably forming such self-aligned contacts; the limited selectivity between dielectric layers and limited etch anisotropy (ability to etch in one direction only, e.g. vertically) make such a process difficult for high aspect ratio gaps." **Col. 2, lines 1-6.** **Figure 2D** FIG. 2D
Claim 2	

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Claim Language	Havemann
The semiconductor apparatus of claim 1 wherein said etch stop material comprises silicon nitride.	"The selective etch process is designed to remove material from the second dielectric layer faster than it removes material from the first dielectric layer. Silicon nitride and silicon dioxide (of different varieties) are used for the dielectric layers; relative etch selectivity for the best of such dielectric combinations is on the order of 10:1." **Col. 1, 55-60.**
Claim 3	
The semiconductor apparatus of claim 1 wherein said etch stop material comprises silicon dioxide.	"The selective etch process is designed to remove material from the second dielectric layer faster than it removes material from the first dielectric layer. Silicon nitride and silicon dioxide (of different varieties) are used for the dielectric layers; relative etch selectivity for the best of such dielectric combinations is on the order of 10:1." **Col. 1, 55-60.** "Additional material may subsequently be deposited as a conformal dielectric overlayer 42, e.g., using thermal oxide or silicon nitride (see FIG. 2C). This layer provides a minimal protection for substrate 20 during the O_2 plasma etch to remove organic-containing material from insulated gap 29." **Col. 5, lines 15-20.**

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