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(51) International Patent Classification ⁷ : C01B 37/02, H01L 21/316	A1	(11) International Publication Number: WO 00/39028 (43) International Publication Date: 6 July 2000 (06.07.00)																																	
(21) International Application Number: PCT/US99/30655 (22) International Filing Date: 23 December 1999 (23.12.99) (30) Priority Data: <table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">09/220,882</td> <td style="width: 40%;">23 December 1998 (23.12.98)</td> <td style="width: 30%;">US</td> </tr> <tr> <td>09/222,569</td> <td>28 December 1998 (28.12.98)</td> <td>US</td> </tr> <tr> <td>09/335,210</td> <td>17 June 1999 (17.06.99)</td> <td>US</td> </tr> <tr> <td>09/361,499</td> <td>23 July 1999 (23.07.99)</td> <td>US</td> </tr> <tr> <td>09/413,062</td> <td>4 October 1999 (04.10.99)</td> <td>US</td> </tr> </table> (71) Applicant (for all designated States except US): BATTELLE MEMORIAL INSTITUTE [US/US]; Pacific Northwest Division, P.O. Box 999, Richland, WA 99352 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): DOMANSKY, Karel [CZ/US]; 1850 Stevens Drive, Richland, WA 99352 (US). FRYXELL, Glen, E. [US/US]; 8907 West Entiat Avenue, Kennewick, WA 99336 (US). LIU, Jun [CN/US]; 5656 Collins Road, West Richland, WA 99353 (US). KOHLER, Nathan, J. [US/US]; 403 Shoreline Court, Richland, WA 99352 (US). BASKARAN, Suresh [IN/US]; 1002 N. Pittsburgh, Kennewick, WA 99336 (US). LI, Xiaohong [CN/US]; 2884 Troon Court, Richland, WA 99352 (US). THEVUTHASAN, Suntharampillai [LK/US]; 901 South			09/220,882	23 December 1998 (23.12.98)	US	09/222,569	28 December 1998 (28.12.98)	US	09/335,210	17 June 1999 (17.06.99)	US	09/361,499	23 July 1999 (23.07.99)	US	09/413,062	4 October 1999 (04.10.99)	US																		
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Buchanan Street, Kennewick, WA 99336 (US). COYLE, Christopher, A. [US/US]; 708 Van Giesen Street, Richland, WA 99352 (US). BIRNBAUM, Jerome, C. [US/US]; 109 Center Blvd., Richland, WA 99352 (US). (74) Agents: STEWART, James, G. et al.; Marger Johnson & McCollom, 1030 SW Morrison St., Portland, OR 97205 (US). (81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.																																			
(54) Title: MESOPOROUS SILICA FILM FROM A SOLUTION CONTAINING A SURFACTANT AND METHODS OF MAKING SAME (57) Abstract The present invention is a mesoporous silica film having a low dielectric constant and method of making having the steps of combining a surfactant in a silica precursor solution, spin-coating a film from this solution mixture, forming a partially hydroxylated mesoporous film, and dehydroxylating the hydroxylated film to obtain the mesoporous film. It is advantageous that the small polyoxyethylene ether surfactants used in spin-coated films as described in the present invention will result in fine pores smaller on average than about 20 nm. The resulting mesoporous film has a dielectric constant less than 3, which is stable in moist air with a specific humidity. The present invention provides a method for superior control of film thickness and thickness uniformity over a coated wafer, and films with low dielectric constant. The present invention is a method of dehydroxylating a silica surface that is hydroxylated having the steps of exposing the silica surface separately to a silicon organic compound and a dehydroxylating gas. Exposure to the silicon organic compound can be in liquid, gas or solution phase, and exposure to a dehydroxylating gas is typically at elevated temperatures. In one embodiment, the improvement of the dehydroxylation procedure is the repetition of the soaking and dehydroxylating gas exposure. In another embodiment, the improvement is the use of an inert gas that is substantially free of hydrogen. In yet another embodiment, the present invention is the combination of the two-step dehydroxylation method with a surfactant templating method of making a mesoporous film.																																			
NRA porosity - C_xEO₁₀ series <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <caption>Approximate data points from the graph</caption> <thead> <tr> <th>Surfactant/TEOS mole ratio</th> <th>NRA porosity (%)</th> <th>Series</th> </tr> </thead> <tbody> <tr><td>0.1</td><td>38</td><td>C₁₈EO₁₀ (XL-91)</td></tr> <tr><td>0.1</td><td>47</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.15</td><td>32</td><td>C₁₆EO₁₀ (XL-90)</td></tr> <tr><td>0.15</td><td>40</td><td>C₁₂EO₁₀ (XL-92)</td></tr> <tr><td>0.15</td><td>43</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.2</td><td>55</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.25</td><td>53</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.3</td><td>51</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.4</td><td>50</td><td>C₁₆EO₁₀ (XL-132)</td></tr> <tr><td>0.5</td><td>45</td><td>C₁₆EO₁₀ (XL-132)</td></tr> </tbody> </table>			Surfactant/TEOS mole ratio	NRA porosity (%)	Series	0.1	38	C ₁₈ EO ₁₀ (XL-91)	0.1	47	C ₁₆ EO ₁₀ (XL-132)	0.15	32	C ₁₆ EO ₁₀ (XL-90)	0.15	40	C ₁₂ EO ₁₀ (XL-92)	0.15	43	C ₁₆ EO ₁₀ (XL-132)	0.2	55	C ₁₆ EO ₁₀ (XL-132)	0.25	53	C ₁₆ EO ₁₀ (XL-132)	0.3	51	C ₁₆ EO ₁₀ (XL-132)	0.4	50	C ₁₆ EO ₁₀ (XL-132)	0.5	45	C ₁₆ EO ₁₀ (XL-132)
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