Supplementary Information

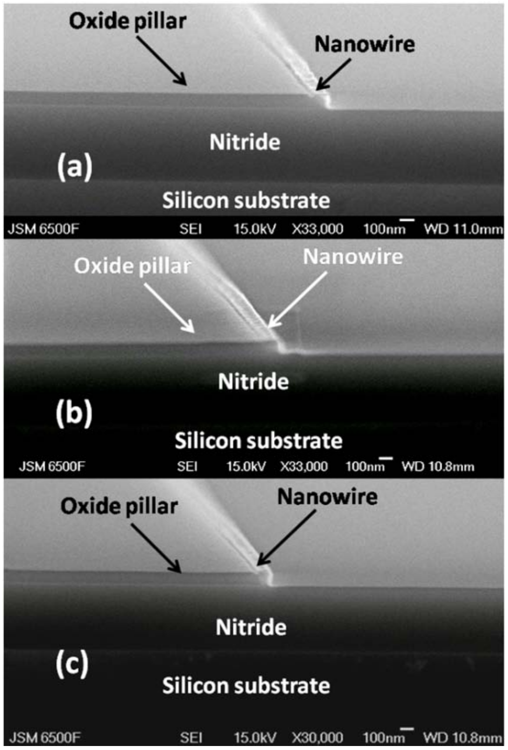

Figure S1: Cross sectional SEM images of nanowires that are captured from the test structures located at regions A, B and C of figure 2a.

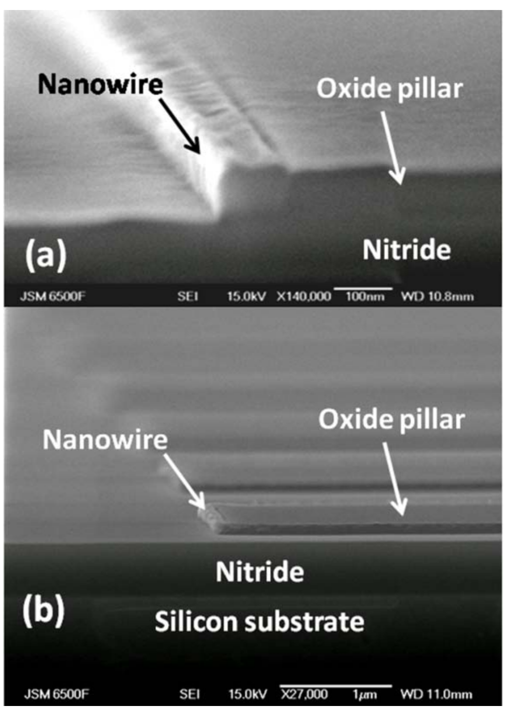

Figure S2: a) High magnification cross sectional SEM images of nanowires and b) a cross-sectional image of a NW where front view of the NW sidewall is captured.

A) Uniformity and reproducibility in width, shape and surface morphology of nanowires across the 6 inch wafer: To investigate the nanowire width, shape and surface morphology control across the wafer achieved by the spacer etch of a thin α-Si layer (100nm) using low density SF_6/ O_2 plasma based shallow RIE etch, figure S1 shows cross sectional SEM images of nanowires that are captured from the test structures located at regions A, B and C of figure 2a of the manuscript. During this investigation almost similar magnification is used and a same angle of vision is ensured to make a fair comparison. It is observed that the perfectly rectangular shape and reasonably smooth surface of polysilicon nanowire is well maintained in these three extreme locations of the wafer. The nanowire's width and height are calculated for these three locations using the scale of the SEM image. The nanowire width and height in locations A, B and C are found to be 96nm & 99nm, 98nm & 100nm and 94nm & 100nm respectively. In the magnifications of figure S1sidewall striations are hardly visible and hence a high magnification cross sectional SEM image of nanowire is presented in figure S2 (a). From figure S2 (a), nanowire width and height are found to be 100nm & 98nm. In this high magnification SEM image sidewall striation is again hardly visible. A crude calculation shows that sidewall striations are around 4.5nm which agrees with the results observed in the manuscript figure 3.

To further investigate sidewall of the NWs defined by low density SF_6/O_2 plasma based shallow etch, figure S2 (b) presents a cross-sectional image of a NW where front view of the NW sidewall is captured. This image obviously shows an improved NW sidewall striation in SF_6/O_2 based shallow etch process. It is also worth noting that NWs' improved anisotropy and surface topology is also well controlled at the corner of the prior fabricated oxide pillar which is usually vulnerable to dry etch. Figure S3 shows a Nomarski differential interference contrast (DIC) micrograph of NWs defined in the in SF_6/O_2 based shallow etch system after the oxide pillar has been completely etched by 20:1 buffered HF. The NWs are found to be reasonably continuous with an impressive arrangement of rectangular fashion in the nitride matrix implying excellent continuity and location control. These results unambiguously demonstrate that nanowire realized by spacer etch of thin film of α-Si layer using low density SF_6 and O_2 plasma provide impressive uniformity and reproducibility in nanowire dimension and surface morphology for a commercial grade mass manufacturable nano-sensors.

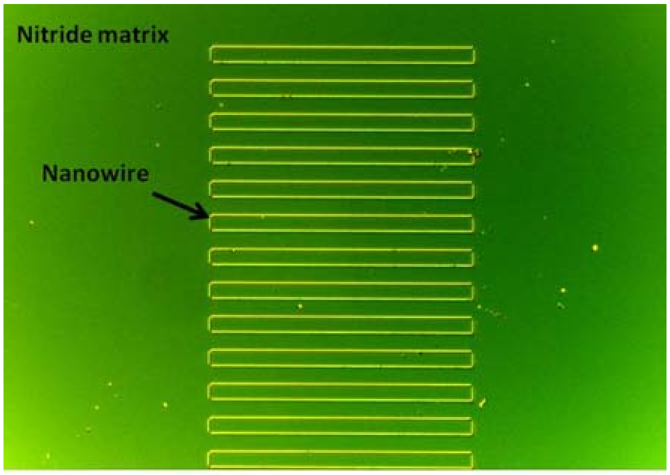

Figure S3: A Nomarski differential interference contrast (DIC) micrograph of NWs defined in the low density SF_6/O_2 plasma based shallow etch system after the oxide pillar has been completely etched by 20:1 buffered HF.

B) Polysilicon naowire sensor's response in different H_2 concentrations when gas exposure is done in vacuum ambient: Figure S4 demonstrates the nanowire's peak conductance change (%) with respect to vacuum as a function of H_2 gas concentrations for 58µm long, (95nm × 95nm) and (10nm × 10nm) polysilicon nanowires at different pressures. As discussed in the manuscript, the setting of 1% conductance change as a viable detection limit allows the nanosensor block of (95nm × 95nm) dimension detecting 315ppm and 180ppm of H_2 gases at pressures of 0.5 bar and 1 bar whereas polysilicon nanowire with (10nm × 10nm) dimension exhibit the ability to detect 240ppm and 130ppm of H_2 gases at pressures of 0.5 bar and 1 bar respectively. At H_2 gas pressure of 1.5 bar this sensitivity is quite phenomenological which is significantly lower than 100 ppm.

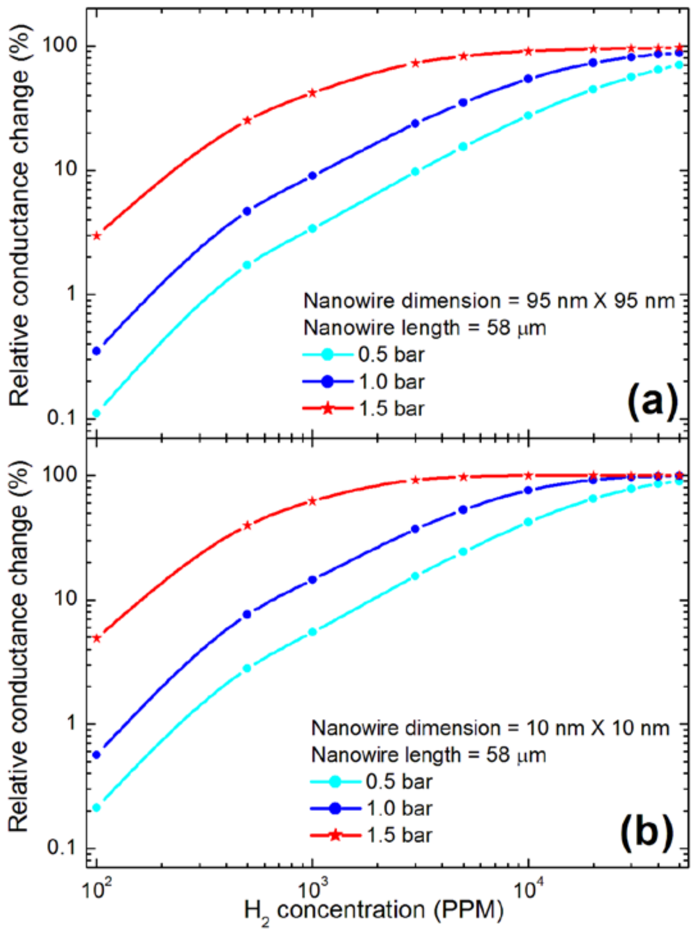

Figure S4: Polysilicon nanowire's peak conductance change (%) with respect to vacuum as a function of H_2 gas concentrations for a) 95nm × 95nm and b) 10nm × 10nm polysilicon nanowires at different pressures. The nano-sensor block has 58µm long nanowires and 30 nanowires connected in parallel.