Supporting Information

Scalable manufacturing of single nanowire devices using crack-defined shadow mask lithography

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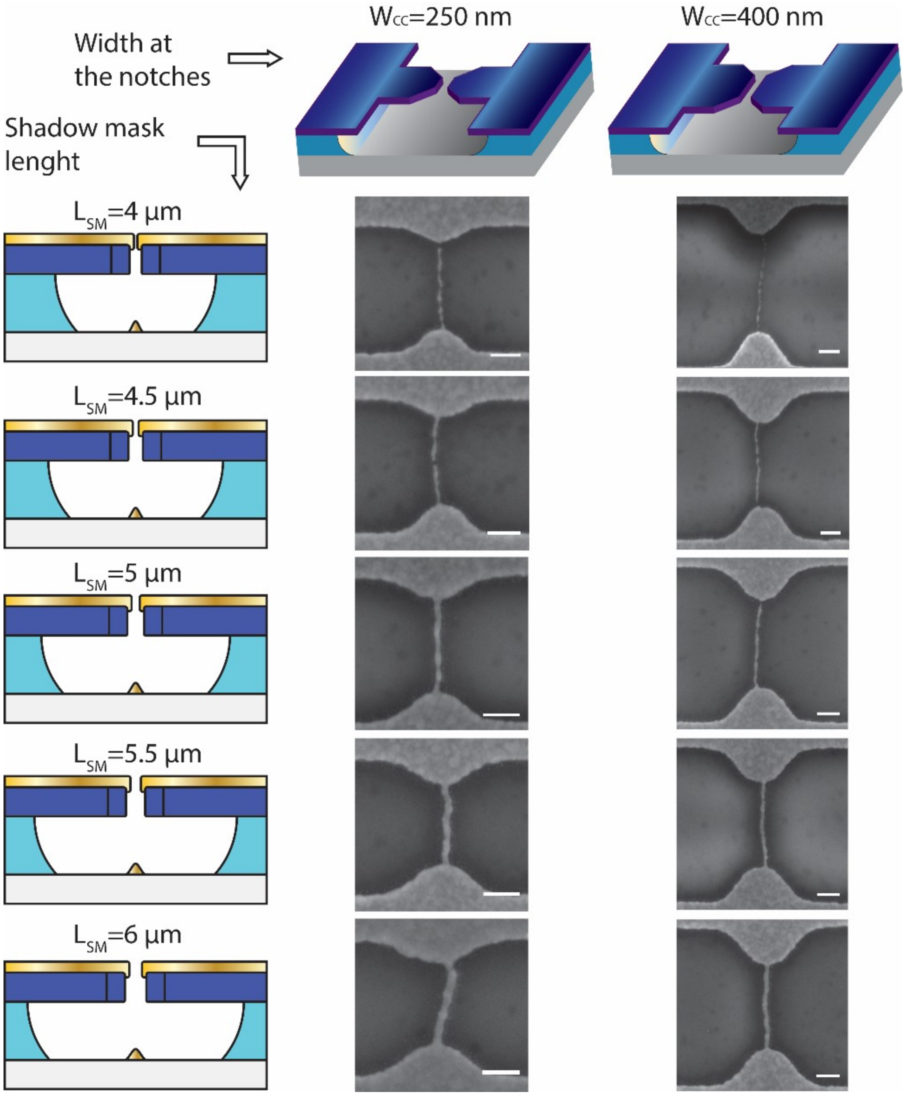

Figure S1. Set of NW designs. Each SEM picture corresponds to a combination of designed width of the notched constriction W_{CC} and length of the suspended shadow mask L_{SM}. Two different notch constriction width were tested, with resulting width at the notch site of 250 nm (second column) and 400 nm (third column). The notches are less sharp in the narrow design than in the wide one. This difference is due to proximity effects during EBL exposure of the notched beam structures. Nevertheless, the yield of cracking in the TiN layer and formation of NW after the PVD step is not affected. It is possible to notice that a different length of a beam structure corresponds to a different W_{NW}. In general, the yield of NW formation is lower for shorter beam structures, as the resulting smaller nanogaps are more prone to be completely or partially sealed before a continuous NW is formed. Scale bars, 100 nm.

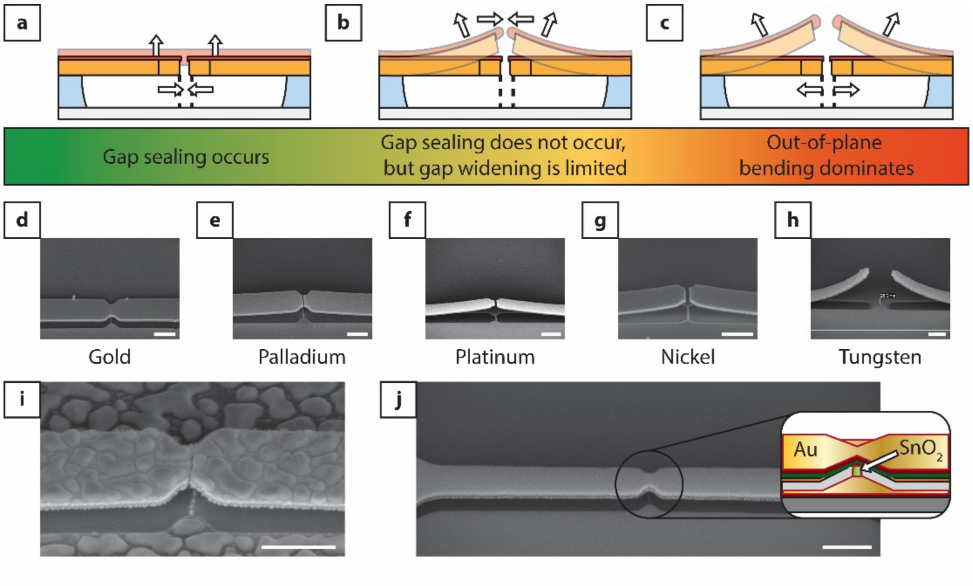

Figure S2. Material flexibility and limitations of our shadow masking technique. a) Schematic representation of the gap narrowing and nanogap closure. The red transparency indicates the increasing thickness of deposited material. b) Schematic representation of the counteracting effects of gap narrowing and cantilever bending, which result in a substantial preservation of W_{NG}. c) Schematic representation of the bending effect. The yellow transparencies in b) and c) illustrate the out-of-plane bending of the shadow mask during deposition. d), e), f), g), and h) SEM images (side-view) of NWs with long cantilevers on top. The materials are respectively gold, palladium, platinum, nickel and tungsten, and they are ordered by increasing out-of-plane bending. i) SEM image (side-view) of tin NWs. Tin is wetting the chromium adhesion layer, but no continuous film or NW is formed. This problem can be solved by changing the surface energy of the substrate via surface modification or with post-deposition annealing. j) SEM image (side-view) of SnO_2 NWs with side schematic image. SnO_2 was deposited until the nanogap in the shadow mask was sealed, and then a Au layer for electrical contact was deposited on top. Scale bars, 500 nm for all the pictures.

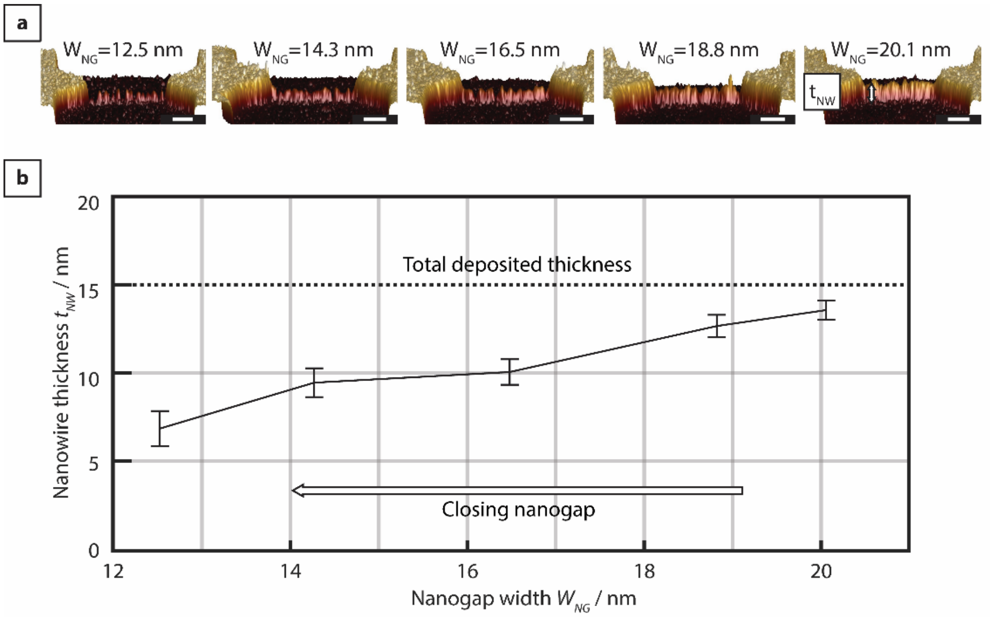

Figure S3. Effect of gap narrowing and closure on the thickness of the NWs. a) Series of AFM images of formed Au NWs, where it is possible to notice that a decreasing W_{NG} is associated to a decreasing NW thickness t_{NW}. In fact, a narrower nanogap tends to be sealed earlier in the deposition process, leading to an increasingly thinner NW. The sub-10 nm thickness range for conductive NW is very difficult to target, since there is a high probably of the deposited cluster being too thin to coalesce and form a continuous NW. Scale bars, 100 nm for all images. b) Increased nanogap closing effect on t_{NW}. As previously explained, the NW thickness tends to the total deposited values for wide nanogaps, while narrow nanogaps generate thinner NWs with an increasing probability to get a non-conductive structure. Each data point corresponds to the average of the measurements of five devices, and the error bar corresponds to the standard deviation.