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Focused ion beam implantation as a tool for the fabrication of nanoelectromechanical devices

We are presenting the fabrication of nanometric resonators, from a new approach, based on ion implantation by a focused ion beam (FIB). This new method allows the fabrication of functional suspended nanodevices, from the electrical and mechanical point of view, without using any resist.[1] This method is i) fast and simple, where only three steps are needed; ii) high resolution, it is demonstrated the fabrication of 4 um length and 10 nm diameter suspended devices (fig 1a); iii) flexible, it is feasible the definition of structures of different shape (fig 1b); iv) reproducible (fig 1c) and v) CMOS compatible.

The principal results can be classified as:

a) Investigation of the effect of gallium ion implantation onto silicon from the process and nanoelectromechanical material properties point of view.[1,2]

b) Development and optimization of the fabrication process, especially controlling the dimensions and the combination with other fabrication processes. That method permits to obtain customized devices. It is a versatile prototyping method that allows the fabrication of small batches of devices of nanometric dimensions that can be employed for the scientific and academic experimentation.[2]

c) Investigation of the electronical, mechanical and electromechanical properties [3] of the devices, specifically suspended silicon nanowires (SiNWs) that can be employed as high frequency mechanical resonators or single hole transistors (SHoTs). We investigated and fabricated ultra-thin field effect transistors (10 ~ 15 nm) and suspended transistors (fig 1d) that exhibits Coulomb blockade electrical characteristics at low temperature thanks to the nanocrystals that are grown during the high temperature fabrication step.[4]

References

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Figures

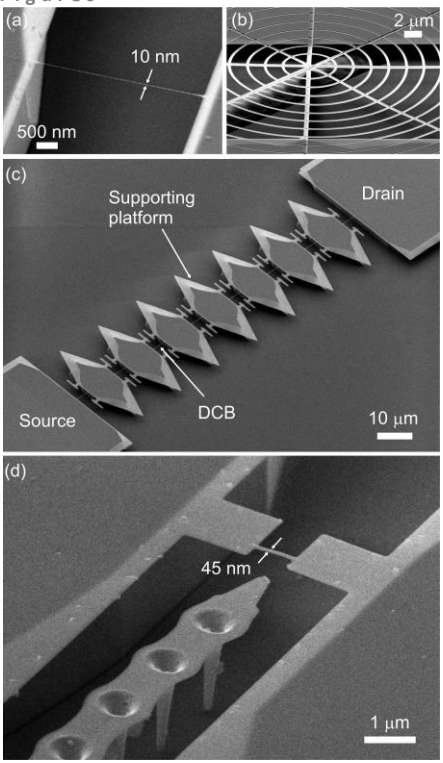

Figure 1: 45 degree SEM tilted images of different silicon suspended devices fabricated by the approach presented. (a) SEM image of a 4.3 um length and 10 nm diameter suspended SiNW. (b) SEM image of a suspended Si spider-web that consists on concentrically circular wires supported by straight wires. (c) Array of eight suspended Si doubly clamped beams (DCBs) configured in series and supported by the source and drain electrodes and seven supporting platforms. (d) Suspended SHoT.