Fractal nano resonator

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Abstract
In this research work, we present the study of the different modes of the mechanical response of a doubly
clamped silicon fractal-shaped nanomechanical resonator. The device is fabricated by a resistless process based on
focused ion beam (FIB) local gallium implantation, selective silicon etching using a solution of tetramethylammonium
hydroxide (TMAH), and an annealing process in a boron rich atmosphere; see [1]. The Si fractal structure has thickness of 40 nm and width of 12µm approximately. The double-clamped Si structure is electrostatically actuated having capacitive or optical readout [2]. Moreover, a COMSOL model of the device has been built for the theoretical prediction of the broadband spectrum of the mechanical response. The objectives of our project are to prove the concept of electrostatically driven 2D Si-based fractal-shaped nanoresonators and to be able to simulate the mechanical response of the proposed structures. Such ability would give us the freedom of choosing the most appropriate geometry from a wide range of fractal shapes [3] in order to achieve a predefined task. The resulted broadband spectrum of the mechanical response is applicable for mass sensors, RF filters [4], while the shape and dimensions are also suitable for mid infra-red plasmonic [5] and photovoltaic [6] purposes.

References:
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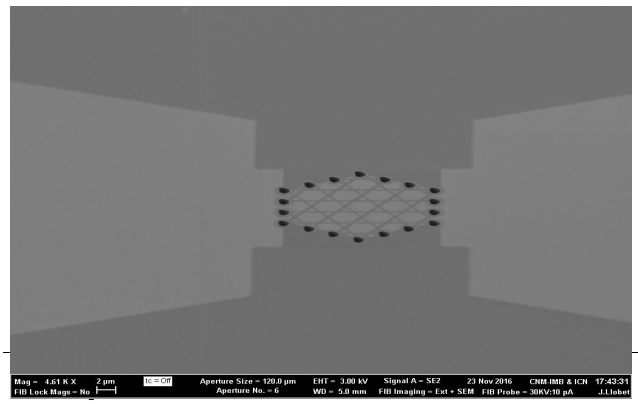

Figure 1: SEM image of the double clamped fractal structure at the gallium implantation step

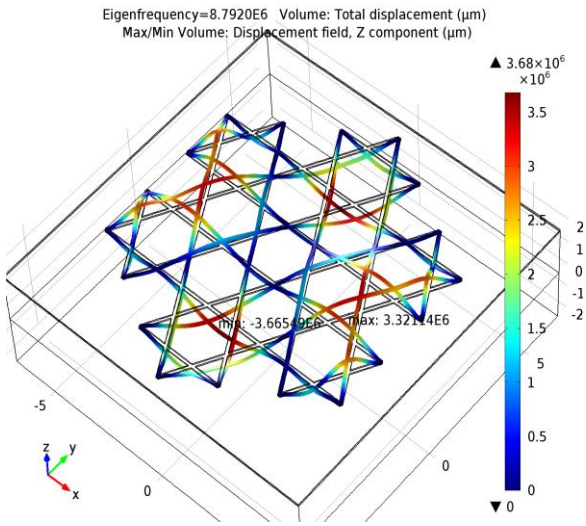

Figure 2: Modal shape of the response at 8.79 [MHz], simulated by COMSOL