Mechanical engineering by nanostructuration in suspended 2D materials

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2D membranes are extremely sensitive to immediate environment like mass, force and charge, in addition to a unique crystalline structure and electronic band structure. The efficiency of an applied stress to modify the properties of 2D materials is at the origin of various applicative proposals in nanomechanic or optoelectronic. This possibility would define the phononic in 2D materials. However a clear and systematic methodology to control the strain at a nanometric scale is still lacking in 2D suspended membranes. Under the statement that the mechanic in a system is strongly related to its own geometry, we have overlapped this problem by nanostructuring suspended materials like bilayer of epitaxial graphene or MoS2 membranes on a large scale of samples. To measure strain and vibrations, μ-Raman spectroscopy, mapping and optomechanical measurements were achieved with mechanical measurements at the nanoscale. Our engineering of 2D materials geometry has permit to release, concentrate and modulate strain on nanoconstrictions with a gain > 20 and to enhance the mechanical quality factor of a suspended 2D membrane at ambient.

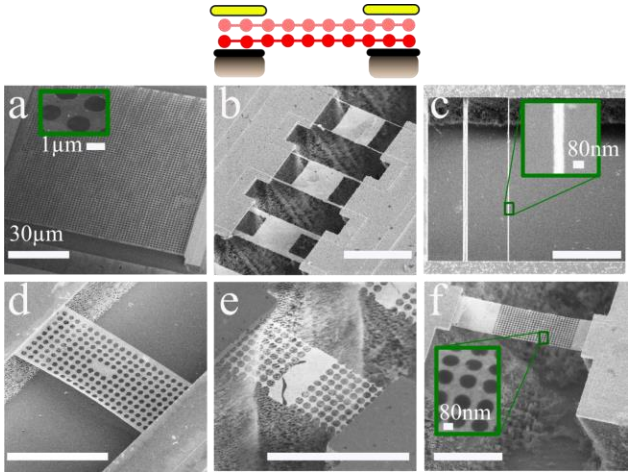

Figure 1: SEM images of suspended graphene nanostructures with different geometries from 20nm up to 300μm.

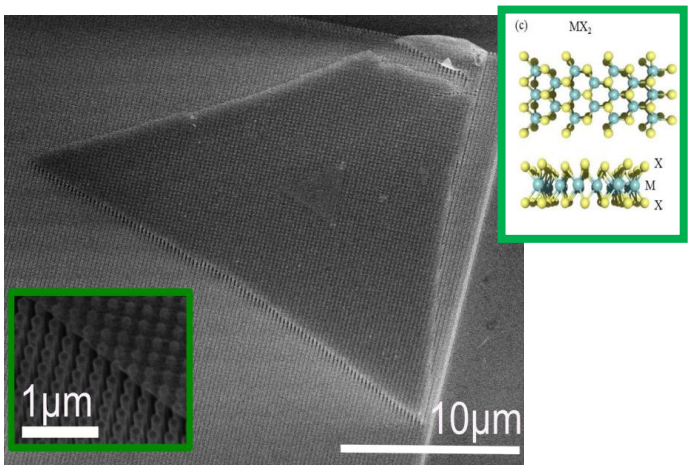

Figure 2: SEM images of suspended monolayer Mos2 on SiO_2 pillars array

References

[1] Henck, H et al. *APL*, (109), 113103. (2016)
[2] Ben Aziza Z. et al. *Carbon*, (2016)