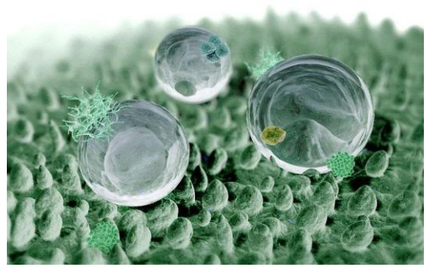
Suspended Hydrophobic Silicon Membrane (SHSM)

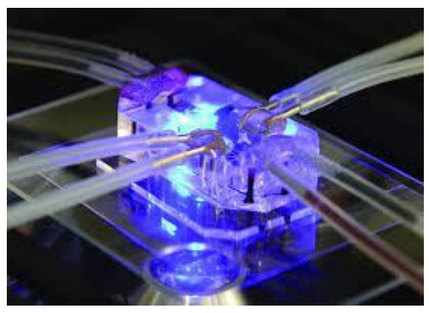
Abstract

The Silicon Hydrophobic Suspended Membrane (SHSM) project aims to develop a novel technology for selective gas filtration by exploiting the hydrophobic properties of water, enabling osmosis to be achieved on a nanoscale.

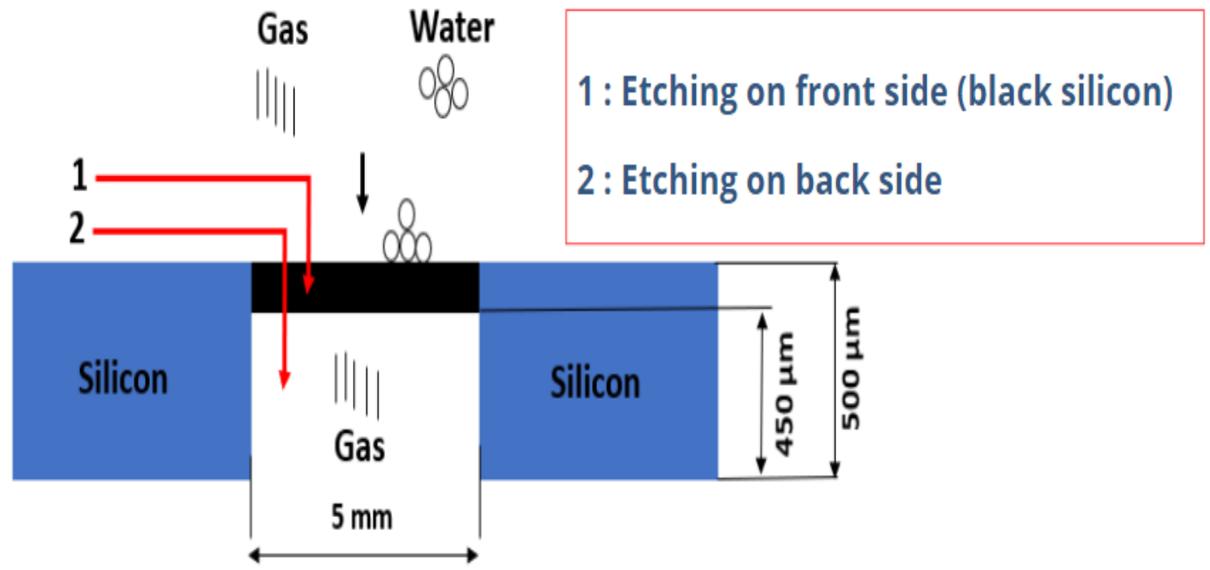
This approach is inspired by the lotus effect observed at the nanoscale, and we are implementing this feature through a phenomenon observed in cryogenic plasma etching known as Columnar Microstructures.

In summary, the MHSS aims to design a hydrophobic silicon membrane incorporating nanostructured features. This innovation offers promising application prospects, particularly in the fields of Micro-Electro-Mechanical Systems (MEMS), microfluidic systems and photovoltaic systems, paving the way for significant advances in these specific technological fields.





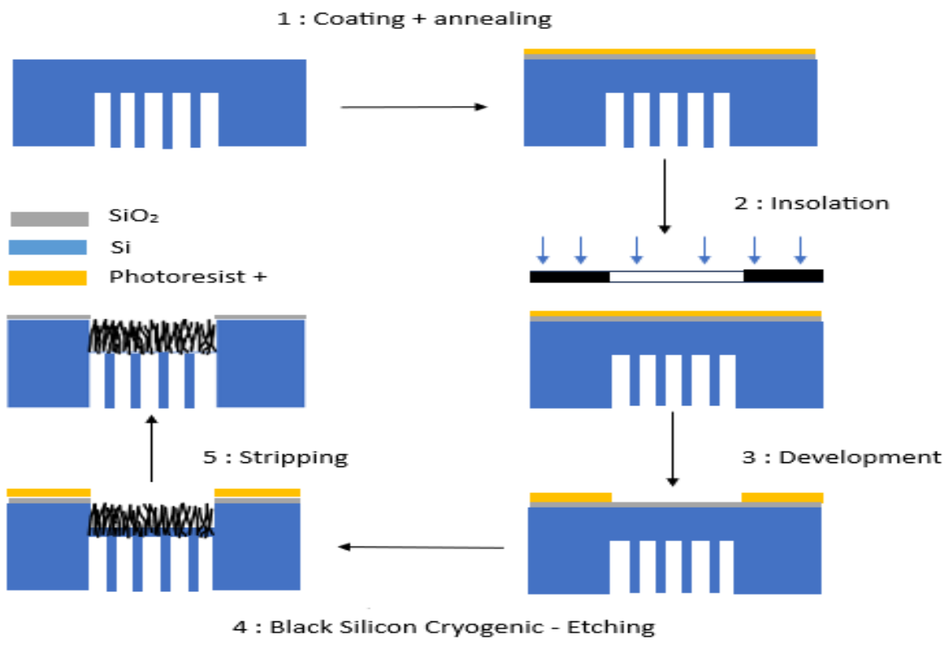
1. Principle and Objectives



- Establishing a manufacturing process
- Characterising our final structure
- To find an application domain

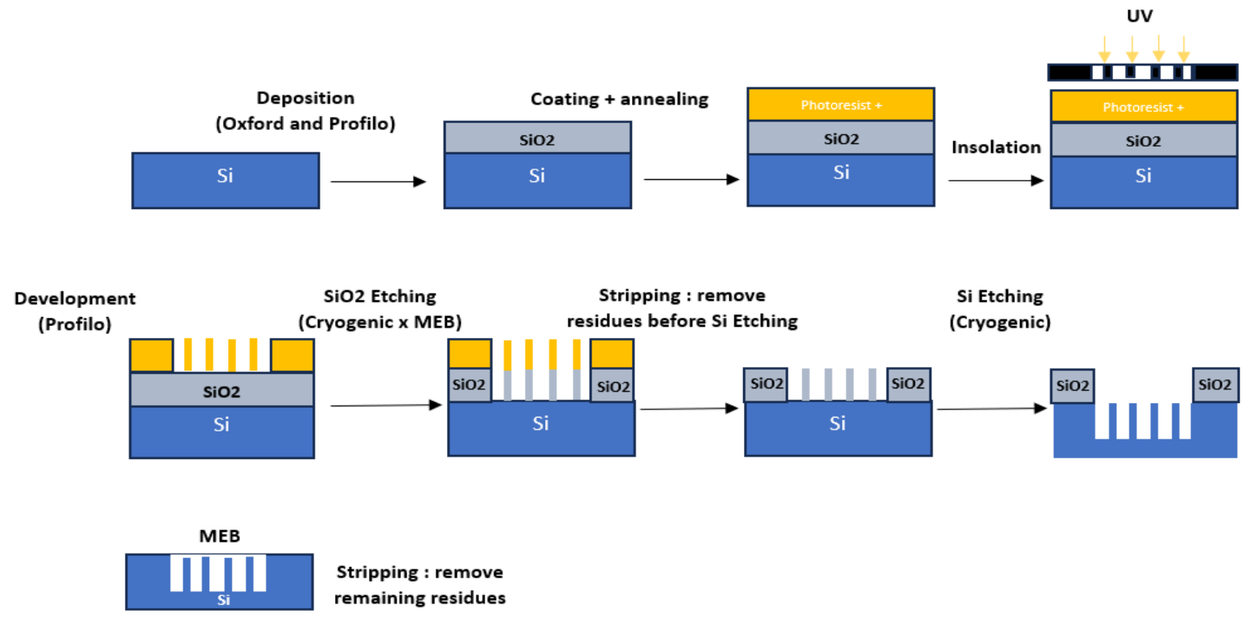
2. Etching on front face

Micromodels fabrication



3. Etching on back face

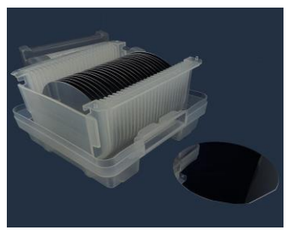
Micromodels fabrication



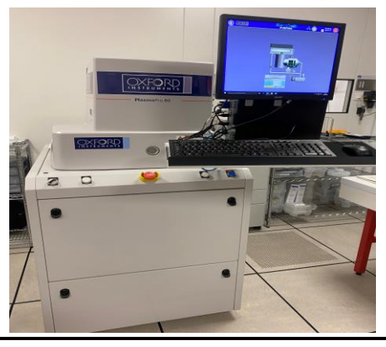
4. Equipments used

Cryo-etching machine : Alcatel A601E-2

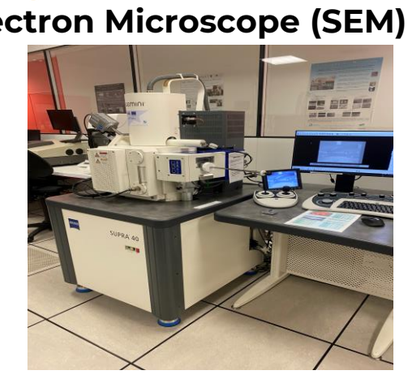
Silicon wafer 4" :



Deposition machine : Oxford

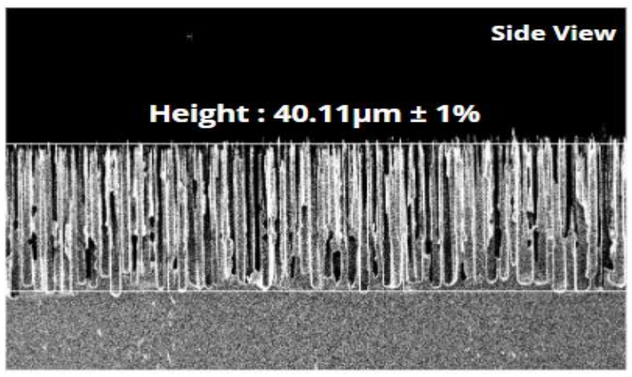


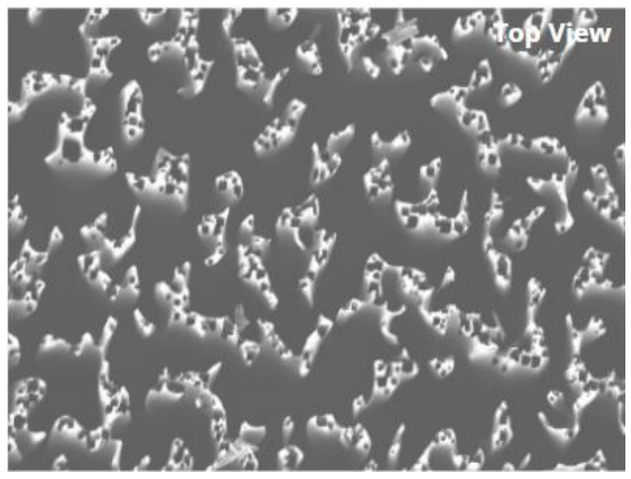
Analysis machine : Scanning Electron Microscope (SEM)



5. Results

Cryogenic process and CMS





Time = 30 min, Bias = -20v, Power = 1000W, O2/SF6 = 0.11, Temperature = -118°C, Pressure = 3 Pa

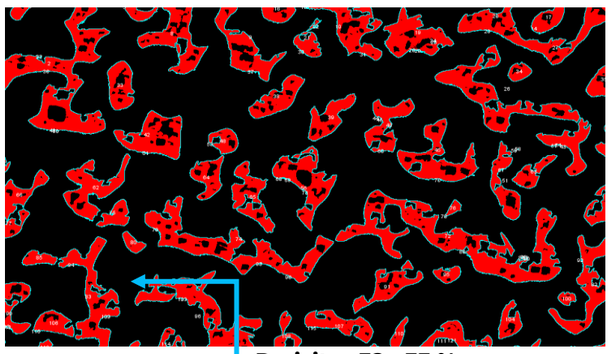
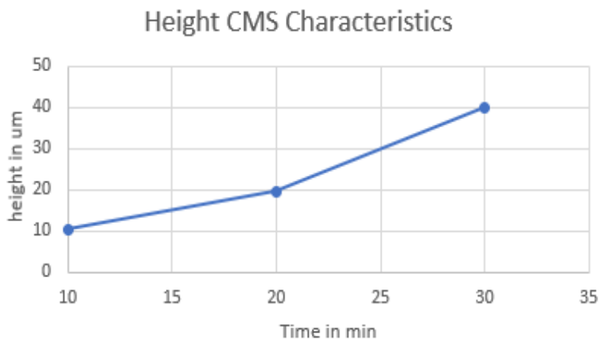


Image processing

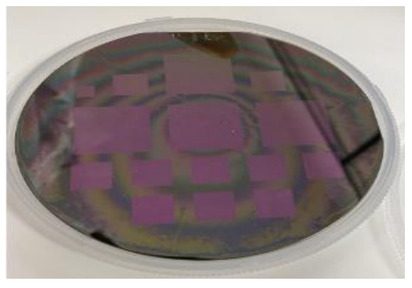
Porisity : 32 - 33 % ,
Desired porosity : 10 à 20%



Time = 10, 20 et 30 min, Bias = -20v, Power = 1000w, O2/SF6 = 0.11, Temperature = -118°C, Pressure = 3 Pa

Samples :

After deposition of SiO2



After Etching SiO2

Cryogenic etching and observation of CMS

Conclusion and perspectives

In conclusion, the MHSS project has made significant progress in the development of the hydrophobic silicon membrane. However, a number of crucial steps still need to be completed, in particular SMD training for the etching of the front face, with a minimum height of 5 µm, and the etching of the back face with a view to structuring the membrane support. At the start of the 2nd half of the year, we plan to initiate hydrophobicity tests to evaluate the membrane's performance under real conditions. With just one month to go before the end of the project, our plan also includes defining specific applications for the technology developed.

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