

## Ultrasonic characterization of materials

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These research activities focus on new ultrasonic characterization methods for microelectronic or energetic efficiency applications. The studied structures have dimensions lower than the usual ultrasonic wavelength

### Porous silicon characterization

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This work is carried out in a collaboration with the **porous Si** research group (**Microelectronic** research topic). The studied samples are porous silicon wafers obtained by electrochemical etching.

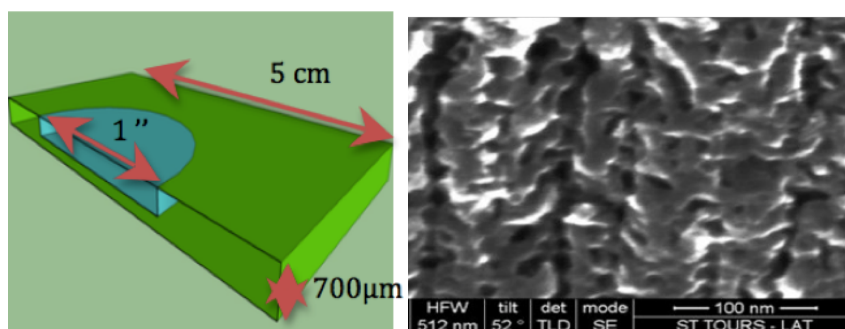


Figure 1 : Sample and micrography schema of studied porous silicon

An ultrasonic measurement technique of the etching depth and the porosity has been developed based on a comparison of theoretical and experimental spectra of the acoustic transmission coefficient through a bilayer stack (**crystalline Si** and **porous Si**).

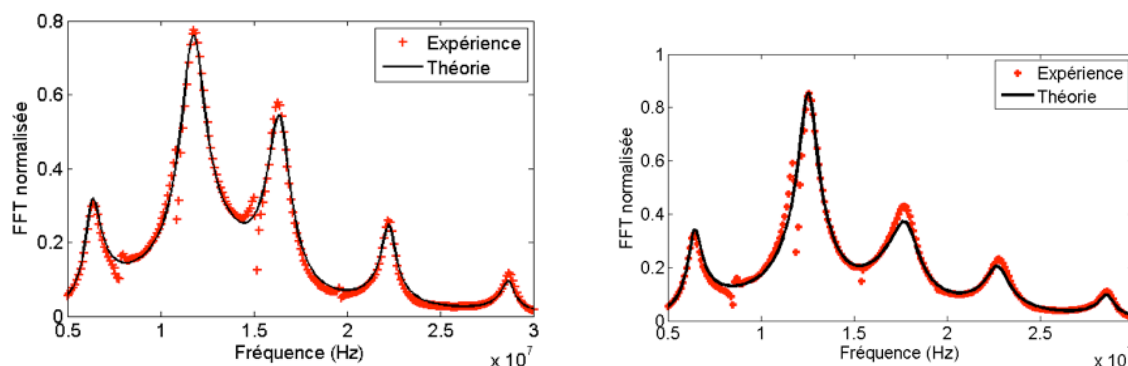


Figure 2 : Theoretical and experimental transmission coefficient for porous silicon samples (a : etching depth of 115 nm porosity 40%, b : etching depth of 119 nm porosity 45%)

The interaction between surface acoustic waves (SAW) and porous silicon layer are also studied, in order to develop innovative surfacic acoustic wave sensors, where the porous silicon plays both the role of sensitive and waveguide layers.

### Proton membrane characterization

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In collaboration with **CEA Le Ripault**, a technique of characterization of **NAFION membranes** is developed. The characterization of the thin membranes (typically 25 micrometers) requires a specific instrumentation (use of high ultrasonic frequencies, around 50MHz). In addition, a 'Matching pursuit' algorithm is adapted to determine the material properties, despite the strong overlap of the ultrasound echoes due to the small sample thickness in comparison with the wavelength.