CIRMM

BOSSEBOEUF LAB.

[Top-down fabricated Si nanowire strain gages]

A. Bosseboeuf[1,2], P.E. Allain[2], F. Parrain[2], X. Leroux[2], S. David[2], A. Walther[3]

[1]Centre for International Research on MicroNano Mechatronics
[2]IEF, CNRS- Université Paris –Sud, France [3]CEA-LETI, France

Fundamental Microsystems Engineering

Objective

Owing to their small cross section and their potential giant piezoresitivity, Si nanowires are promising for mechanical strain integrated detection. Electro-thermo-mechanical properties of Si nanowires fabricated by surface micromachining of thinned SOI and MEMS motion detection with a nanowire strain gage were investigated for this application.

- *Fabrication of Si nanowires with a width downto 25nm and a length to width aspect ratio L/W up to 150: Evidence of a high compressive stress related to wafer thinning leading to nanowire buckling for L/W>50*
- *Developpement of a 4 point die bending system compatible with a cryogenic probe station for nanowire piezoresistance measurement*
- *MEMS motion measurement with a a nanowire strain gage up to 180 nm with a resolution better than 0.2nm owing to a demultiplying spring*
- *Evaluation of effective thermal conductivity versus temperature by TCR and 3ω method measurements*

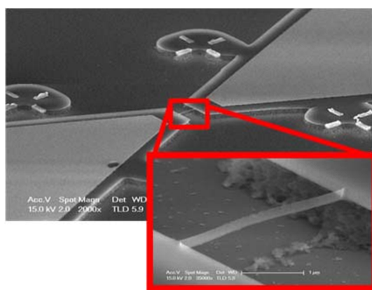

Fig.1 Si nanowire device fabricated by SOI wafer thinning, e-beam lithography and HF vapor release

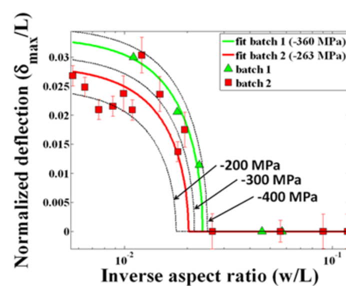

Fig.2 Post-buckling of Si nanowires evidencing a high compressive stress generated during SOI wafer thinning

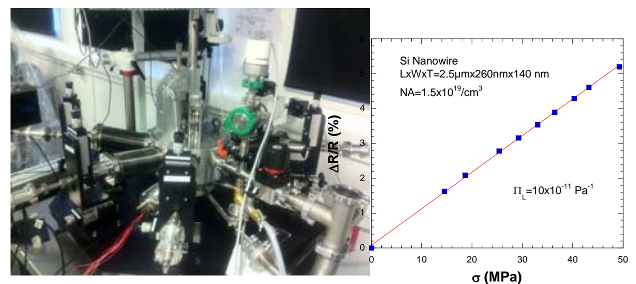

Fig.3 Piezoresitivity measurement by direct four point die bending in a cryoprobe station. Measurement system and example of measurement

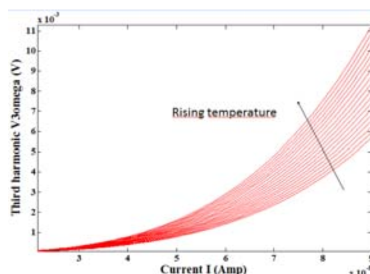

Fig.4 3ω thermal conductivity measurement on a Si nanowire. LxWxh=2.5 µmx160 nmx140 nm

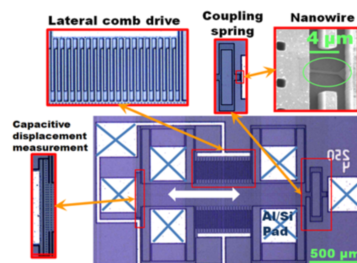

Fig.5 MEMS Tang resonator with Si nanowire and capacitive motion detection

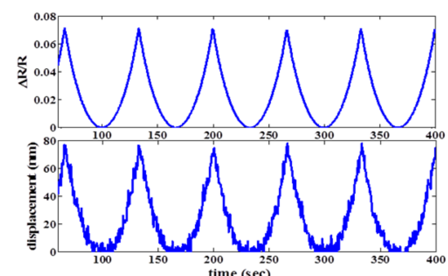

Fig.6 Comparison of Si nanowire strain gage and capacitive MEMS measurement