Advanced MEMS

Bio Mechanical Sensing of DNA with Silicon Nanotweezers Reaches Clinical Research and Triggers the SMMiL-E Initiative

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Keywords Nanotweezers, Biosensing, X-ray therapy, Clinical Research

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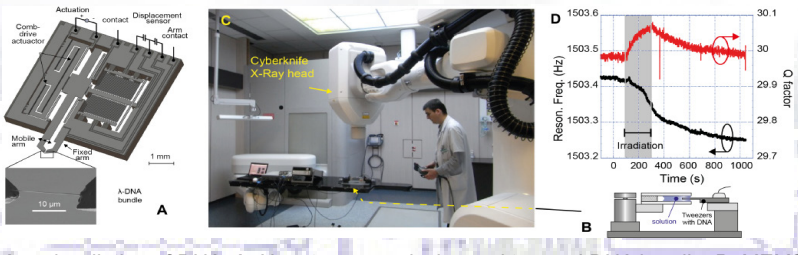
Context LIMMS have been pushing the Silicon Nano Tweezers (SNT) devices and concepts for 8 years. SNT have the ability to trap molecular bundle or cells between their 2 opposing tips and to sense their mechanical response when exposed to biochemical reactants and physical stimulation. The SNT biomechanical sensing accuracy proved to be unaltered even under the harsh environment of X-Ray beams. This unique capability allows to measure the DNA stiffness alteration due to the molecular breaks produced by the therapeutic X-ray. This real time acquisition allows evaluating theoretical DNA breakage model, a better understanding mandatory to improve tumor treatment protocol.

Feasibility This project was conducted in the radiotherapy department of Centre Oscar Lambret, Lille, the north France reference cancer center. The experiments revealed the alteration of DNA bundle stiffness when exposed to X-Ray. This feasibility convinced the oncologists that BioMEMS could provide a new approach to investigate scientific and clinical research against cancer. The context to set up a global research plan was very favorable as the research against cancer pursued in Lille was endorsed by the National Cancer under the SIRIC ONCO Lille program.

Results The SMMIL-E research agreement was signed in June 2014 and the scientific activities encompass bioMEMS research against Cancer – technology development and bio related experiments. The projects aims to bridge fundamental and clinical research around 4 workpackages: (1) Bio molecular mechanisms of the tumor resistance to treatment, (2) Cellular evaluation and diagnosis, (3) Cells interaction and therapeutic targets and (4) Biological adhesives and neo-tissues.

References

[1] G. Perret et al., Solid-State Electronics, 115(B), pp. 66-73, 2016.



X-ray irradiation of DNA. A: Nanotweezers device and trapped DNA bundle. B: MEMS set-up, the DNA bundle is inserted in microfluidic cavity. C: SNT-microfluidic platform under irradiation head of a 6 MeV Cyberknife. D: Frequency response of the SNT during irradiation showing DNA stiffness reduction.