Silicon Nanotweezers for the Characterization of DNA Damage under Therapeutic Radiation Beams

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Context Tumor cell killing in cancer radiotherapy is currently based on a rather empirical understanding of the basic mechanisms and effectiveness of DNA damage by radiation. It is well assessed that radiation induces single-strand and double-strand breaks in DNA, by various mechanisms [1], whose details and efficacy are, however, largely unknown.

Objectives & Methods Study the mechanics of DNA damage under ionizing beams for optimized tumor treatment. The Silicon Nano Tweezers (SNT) is a MEMS device for direct manipulation of biomolecules [2], an excellent candidate for in-beam operation thanks to its tiny size. The SNT, Fig.1.a, comprise two parallel arms ending with sharp tips, designed to trap molecules. SNT + DNA in inserted inside microfluidic cavity (Fig.1.b) and placed under radiotherapy machine (Cyberknife). The mechanical characteristic of the trapped molecules (stiffness, viscosity) under X-ray are measured in real time by monitoring the resonance frequency of the SNT handling the molecules, Fig.2.

Results Silicon Nanotweezers operation under therapeutic irradiation conditions, and direct detection of DNA damage inside DI water under X-ray beam was demonstrated for the first time.

References