MICROMECHANICAL STUDY OF CHROMATIN INSIDE LIVING CELLS USING HIGH FORCE MAGNETIC TWEEZERS

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This is the first report describing micromechanical studies of chromatin inside the nucleus of a living cell. A micrometer scale magnetic tweezers setup was developed, that it capable of exerting forces up to 110 pN on small magnetic beads that were microinjected into the cell nucleus of a HeLa cell. The measured displacement of the magnetic beads upon the action of force gives insight in the rigidity of the nuclear architecture. The results can be interpreted in terms of viscoelastic parameters showing that the chromatin inside the cell nucleus exhibits a Youngs modulus comparable to that found for chromosomes isolated from cells. Furthermore it was observed that the beads could only be moved over a very small distance indicating that the nuclear architecture is very rigid and cannot easily be rearranged. This in contrast to similar experiments performed in the cytoplasm of cells, where the beads could be moved relatively easy due to a two order of magnitude lower apparent viscosity [1].

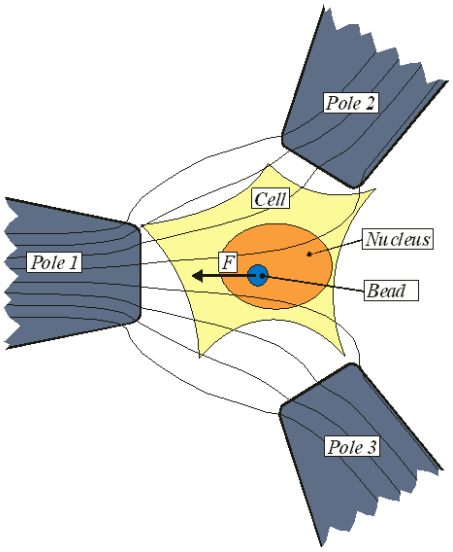

Figure 1: Scheme of the magnetic tweezers system. Micronscale magnetic poles with a seperation of 20 μm are produced on glass substrates [2], so that a single cell can fit in between. The magnetic poles are driven by external coils (not shown). Due to the small scale of the system, very high magnetic gradients can be produced, into the direction of one of the poles. Changing the current in the external coil, allows for full control of magnitude and direction of the magnetic force on the bead. Bead detection is performed by bright field of fluorescence microscopy.

(1) A. H. B. de Vries, B. E. Krenn, R. van Driel, and J. S. Kanger. 2005. Micro magnetic tweezers for nanomanipulation inside live cells. *Bioph. J.* accepted.
(2) A. H. B. de Vries, J. S. Kanger, B. E. Krenn, and R. van Driel. 2004. Patterned electroplating of micrometer scale magnetic structures on glass substrates. J. Mems.13(3):391-395.