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Unravelling mitochondrial DNA organization

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Mitochondria contain a high copy, double-stranded circular DNA molecule which is organized in protein-DNA complexes termed 'nucleoids'. The organization in nucleoids is accomplished with the aid of DNA binding proteins, including the mitochondrial transcription factor A (TFAM). The dynamics of the TFAM-DNA interaction and the mechanism of DNA compaction by TFAM are still unclear. Here we use an array of single-molecule tools to address these questions. Using TPM, we observe clear compactive effect of TFAM on DNA. Moreover, the combined use of optical tweezers and fluorescence microscopy will provide further information on the dynamics of the protein induced DNA compaction, and will permit the direct visualization of the process.

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Studying the effect of manipulating phagosome routing on its maturation

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We use magnetic tweezers to study the effect of manipulation of phagosomal routing on the maturation of phagosomes. Phagocytic cells are allowed to internalize 1-m pH sensing magnetic beads followed by application of an external magnetic force in order to influence the position of the bead-containing phagosomes. We have also developed a single pole magnetic tweezers capable of exerting forces of ~1nN on micron-sized magnetic particles. The effect of the manipulation on the phagosome maturation is characterized by measuring the pH in the phagosome by means of pH-sensing fluorescent dye coupled to the magnetic beads.

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Porous multilayer-coated AFM tips for dip-pen nanolithography of proteins

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A simple method for fabricating nanoporous-structure-coated silicon nitride AFM tips for dippen nanolithography (DPN) by using the layer-by-layer (LbL) technique has been developed. The pore sizes can be adjusted by treating the LbL films coated onto the amino-terminated self-assembled monolayer (NH2-SAM)-functionalized tip surface with a base solution for different periods of time. This hydrophilic porous material can absorb biomolecules easily and also provides a larger-volume ink reservoir compared with a bare silicon nitride tip. Proof-of-concept of the porous AFM tip is demonstrated by using fluorescent proteins as ink molecules to fabricate protein patterns at the micrometer and submicrometer length scales.