Single-molecule studies on SMC protein for DNA loop extrusion

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Abstract.

In each human cell, 2 meter DNA is compacted into chromosomes that are packed into a micrometer-sized nucleus, but the mechanism by which the extremely long and negatively charged polymer is compacted into this tiny structure remains elusive. Structural Maintenance of Chromosome (SMC) protein complexes such as cohesin and condensin are the key organizers of the spatiotemporal structure of chromosomes by extruding DNA losops[1–3]. However, the molecular mechanism of how such SMC motor proteins extrude DNA loops remains completely unknown. In our work using various single-molecule techniques such as single-molecule fluorescence imaging, Atomic Force Microscopy (AFM) and magnetic tweezers (MT)[4,5], we were the first to obtain experimental data for yeast condensin acting on individual DNA molecules. The findings suggest a scrunching model in which the SMC complex extrudes a DNA loop by a cyclic switching of its conformation between open and collapsed shapes. Our findings are indicative of a type of scrunching model in which condensin extrudes DNA by a cyclic switching of its conformation between the open and collapsed shapes. Moreover, this seminar will introduce some recent significant observations on SMCs-mediated genome organization that show universal principles of genome organization.

[References]

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