Reconstituting in vitro the remodeling of membrane nanotubes by actin dynamics

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Inside living cells, the remodeling of membrane nanotubes by the dynamics of acto-myosin networks is crucial for processes such as intracellular traffic or endocytosis. However, the mechanisms by which acto-myosin dynamics affect nanotube morphology are largely unknown. How much radial and axial forces are generated on the tube by acto-myosin dynamics? Can these forces lead to nanotube scission? How do they relate to the structure of the acto-myosin network? To address these questions, we perform *in vitro* experiments to decipher the physics of nanotube remodeling in biochemically controlled assays recapitulating key aspects of cellular membranes and actin dynamics. We use two complementary techniques to form membrane nanotubes on which we reconstitute acto-myosin networks from purified proteins. By using optical tweezers, we will measure the forces implied in nanotube formation and maintenance in presence of acto-myosin. In parallel, we develop a novel assay to image supported nanotubes and acto-myosin networks polymerizing on such nanotubes at the nanometric scale by using Atomic Force Microscopy. By combining these two techniques, we investigate how the structure of the acto-myosin network at the nanometric scale dictates tube reshaping at the micrometric scale and how this explains the results obtained in cells. This will shed new light on nanotube shape regulation and deepen our understanding of cellular functions.

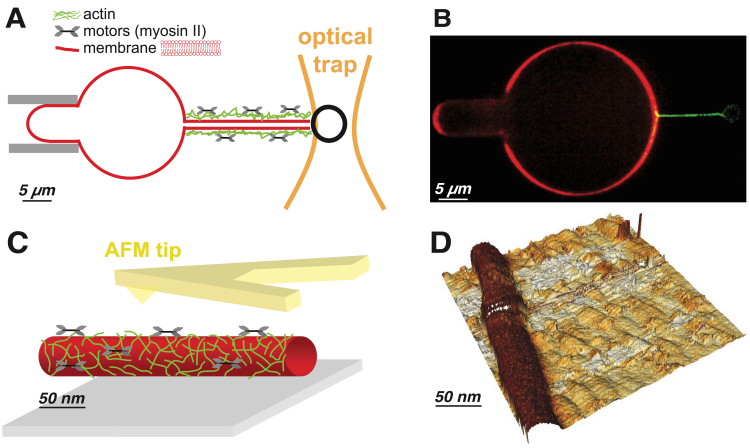

Figure 1 *A) Sketch of an acto-myosin network surrounding a membrane nanotube extruded from a liposome with an optical tweezer. B) Fluorescent micrograph of a nanotube on which actin polymerizes C) Scheme of the AFM observation of nanotubes able to trigger a reconstituted acto-myosin network D) AFM imaging of a membrane nanotube formed close to a substrate.*