Morphology and mechanics of membrane nanotubes interacting with reconstituted actin networks

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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. To address this question, 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 actin networks from purified proteins. By using optical tweezers, we show that actin stabilizes tubes but, depending on the actin actin amount on the tube, transient heterogeneities in the tube radius can appear upon tube elongation.

In parallel, we develop a novel assay to image and study the mechanics of supported nanotubes at the nanometric scale by using Atomic Force Microscopy. A theoretical description of the AFM tip-membrane interaction allows us to relate AFM measurements of the nanotubes' morphology to the membrane mechanical parameters. In addition, we use AFM to assess the induced changes in nanotube physical properties when actin polymerizes at their surface.