

Viscoelastic and Active Response of Neuronal Growth Cones to Mechanical Stimuli by AFM

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Neuronal growth relies on the actin-based motility of the growth cone. Actin filaments in conjunction with accessory proteins form an extensive and highly dynamic filamentous network at the leading edge of the nerve. Our study characterizes the active and viscoelastic changes in a growth cone that are required to push it forward. We have recently developed a scanning-probe technique (Mahaffy et al., PRL, 84, 2000), which allows us to obtain quantitative measurements of a cell's viscoelastic properties with sub-micron resolution. This microrheology technique and comparison of clonal populations of PC12 cells differing in the expression levels of the protein gelsolin, provide clear evidence that viscoelastic changes, i.e. gel-sol transitions, are key to growth cone motility. Further, these scanning-probe experiments allowed us to quantify that the growth cone exhibits quick active responses to localized mechanical stimuli.