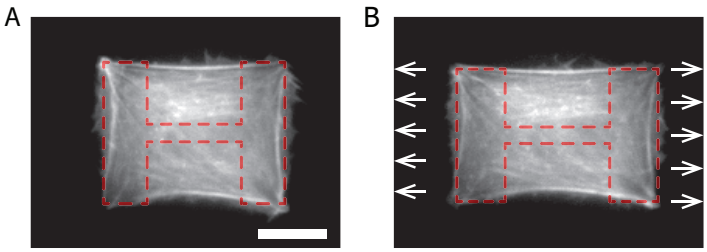
Evidence of a self-healing mechanism of stress fibers under mechanical stretch

R. Bernal[1], D. Cuvelier[2]

1 Dep. de Fisica and SMAT-C, Universidad de Santiago de Chile, 9170124 Santiago, Chile
2 Institut Curie UMR144, Institut Pierre-Gilles de Gennes, Paris, France

The response of non-adherent peripheral stress fibers (SF) is under scope when mechanical stretch is applied. Epithelial cells plated onto deformable micro patterned substrates, displays elastic response at short time scales after a fast stretch. More interesting, at long time scales SF on compression behaves as a Maxwell material, whereas in extension the SF displays strain-softening features due to the polymerization of fresh f-actin along the SF. The SF curvature is used to obtain mechanical parameters from a simply stretching experiment. Whereas global fluorescence analysis reveals that the f-actin bundle density increases in compression, as in the case of the contraction of severed SF. In contrast, under extension conditions, new actin proteins are incorporated into the SF, in order to keep a constant bundle density. At a local scale, fluorescence analysis of extension experiments reveals strengthening and weakening at specific locations of the SF. Thus, we suggest that a self-healing mechanism is required, based on a mechano-sensing or mechano-chemical pathway, to coordinate the local polymerization and rearrangement of the existing actin proteins, by molecular motors activity, along the SF in order to prevent a spontaneous severing.



F-actin labeled RPE-1 cells on PEG/Fibronectin patterns before and after stretch.