Anomalous Mullins efect in crosslinked actin networks under cyclic protocol
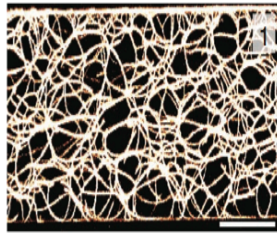## *Dr. Horacio Lopez-Menendez*

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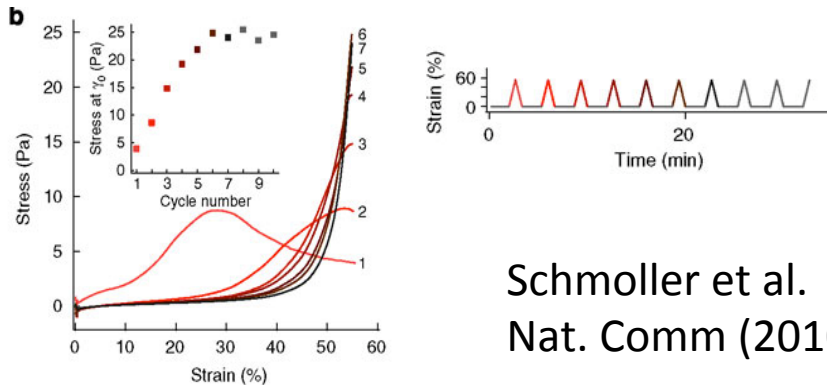## *The cell as complex material*

Cell
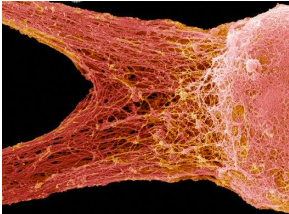
Actin network
crosslinked alpha actinin

Large deformation rheology

Schmoller et al.
Nat. Comm (2010)

Cyclic induced hardening

Modeling

Physical crosslink
(irreversible)

Chemical crosslink
(reversible)

Energy

reaction coordinate

reaction coordinate
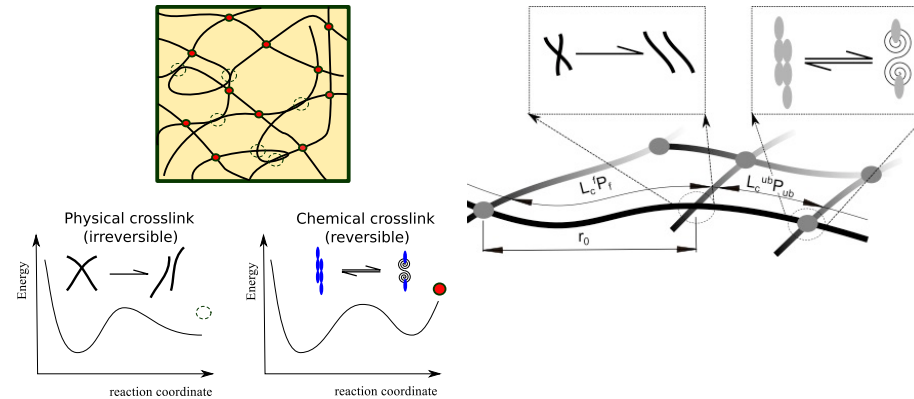
Equations

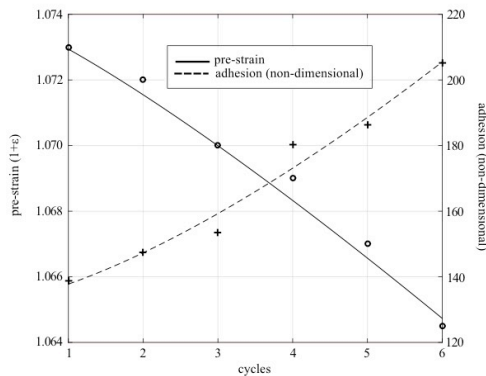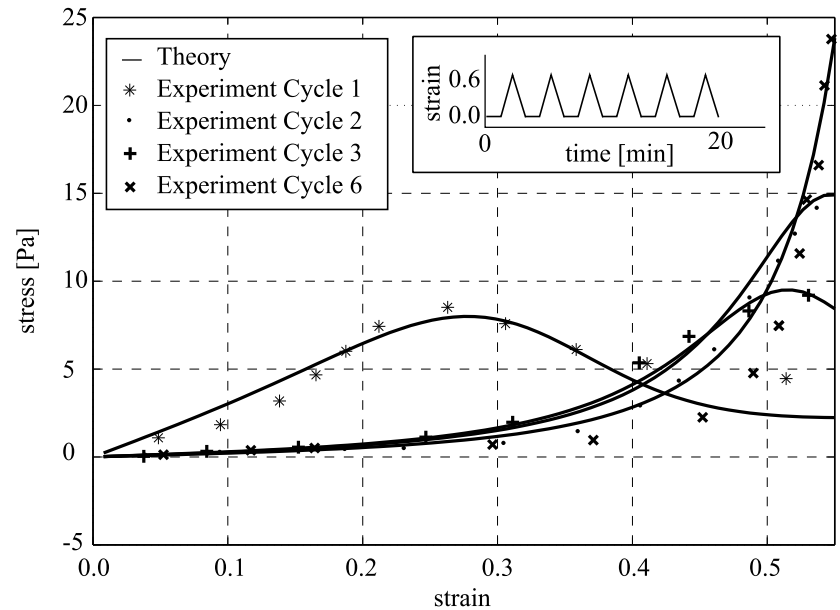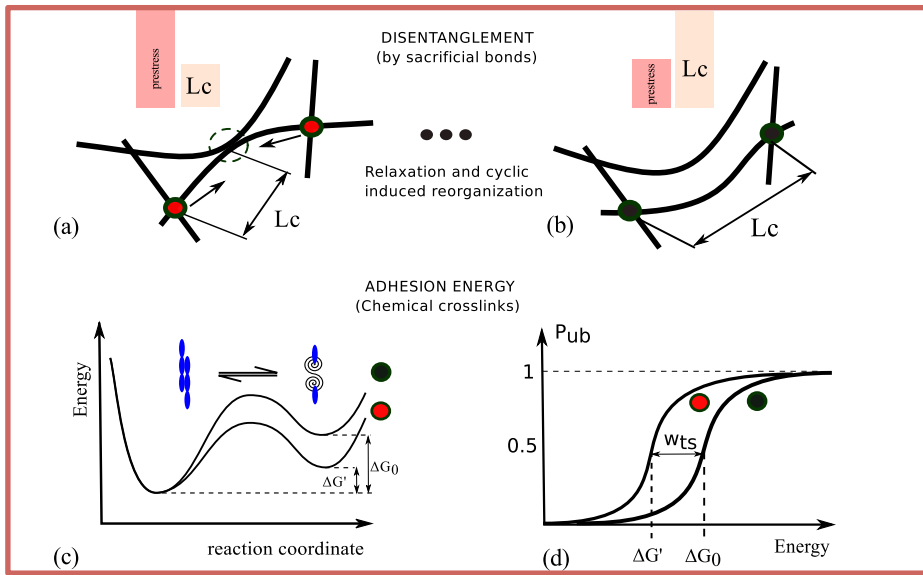$$\lambda = \sqrt{1 + \gamma^2/3}$$

$$\tau = \frac{nk_BT}{3l_p}\frac{r_0}{\lambda}\left[\frac{1}{4\left(1 - \frac{\lambda r_0}{L_c}\right)^2}\right]\left[\frac{\frac{L_c}{l_p} - 6\left(1 - \frac{\lambda r_0}{L_c}\right)}{\frac{L_c}{l_p} - 2\left(1 - \frac{\lambda r_0}{L_c}\right)}\right]\gamma, \quad (1)$$

$$r = \lambda r_0 = \lambda\left(1 + \epsilon_i\right)L_c\left(1 - \frac{L_c}{6l_p}\right), \quad (2)$$

$$L_c = L_c^f \exp\left[\kappa^f\left(\lambda_{\max} - \lambda_0^f\right)\right] + \frac{L_c^{ub}}{1 + \exp\left[\kappa_i^{ub}\left(\lambda_{0_i}^{ub} - \lambda\right)\right]}. \quad (3)$$

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López-Menéndez, H., & Rodríguez, J. F. (2016). Microstructural model for cyclic hardening in F-actin networks crosslinked by α-actinin. *Journal of the Mechanics and Physics of Solids*, *91*, 28-39.

Schmoller, K. M., Fernandez, P., Arevalo, R. C., Blair, D. L., & Bausch, A. R. (2010). Cyclic hardening in bundled actin networks. *Nature communications*, *1*, 134.