Abstract Submitted
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Machanistic basis of rigidity sensing at biological interfaces
ALIREZA SARVESTANI, University of Maine — We have outlined a framework to investigate the thermodynamic equilibrium adhesion of a bio-membrane to a compliant substrate functionalized with immobilized bio-adhesive ligands. The membrane is modeled as a soft elastic shell, subjected to surface tension and reconstituted with mobile receptors and a repelling layer on the ventral side. The free energy function of the system is assumed to be comprised from the following contributions: the membrane–substrate non-specific interactions, stored elastic energy (in deformed membrane and substrate), binding enthalpy, and mixing entropy of mobile receptors. Assuming a van der Waals form for the interfacial non-specific potential, the equilibrium configuration of the system is studied in detail. We have shown that the equilibrium spread area of the adherent membrane is very sensitive to the rigidity of the underlying substrate and decreases as the surface compliance increases. This prediction is reminiscent of the experimental observations of spread area of cells attached to soft substrates. This is an interesting result considering the lack of contribution of intracellular signaling or actively regulated cytoskeleton in the proposed physical model for the adhesion. This suggests that the mechanistic pathways inherent to membrane–substrate thermodynamic interactions can be equally important as intracellular signaling pathways to mediate the process of rigidity sensing by cells.

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