Supplementary Text

Ultra-Thin Membrane Characterization Theory

To obtain predictive estimation of the wavelength, amplitude and number of wrinkles, we consider the 1D out-of-plane displacement of an initially flat sheet of area ($W \times L$, where W is width and L is length) as a function of spatial dimension $(\xi(x,y))$ (supplementary figure 1 (b)). The thickness of the sheet, t, is much smaller than W and L, where $0<y<W$, for simplicity, $W<<L$. When a stretching strain ε is applied in the x direction, then the total energy of the system is:

$$U = U_B + U_S - L \tag{1}$$

Here U_B is the bending energy due to deformation in the y direction:

$$U_B = \frac{1}{2}\int B(\partial y^2\xi)^2 dA \tag{2}$$

where B is the bending stiffness. U_S is the stretching energy in presence of tension $T(x)$:

$$U_S = \frac{1}{2}\int T(x)(dx\xi)^2 dA \tag{3}$$

As the sheet wrinkles in the y direction under the action of a small compressive stress, it satisfies the condition of inextensibility,

$$\int_0^L \left[\frac{1}{2}(\partial y^2\xi)^2 - \frac{\Delta(x)}{w}\right] dy = 0$$

This constraint is found in the final term of equation 1,

$$L = \int_A b(x)\left[(\partial y\xi)^2 - \frac{\Delta(x)}{W}\right] dA \tag{4}$$

where $b(x)$ is the Lagrange multiplier and $\Delta(x)$ imposed the compressive transverse displacement.

Boundary Conditions:

$$\xi(0,y) = 0 \quad \xi(L,y) = 0$$

After applying boundary conditions we determine:

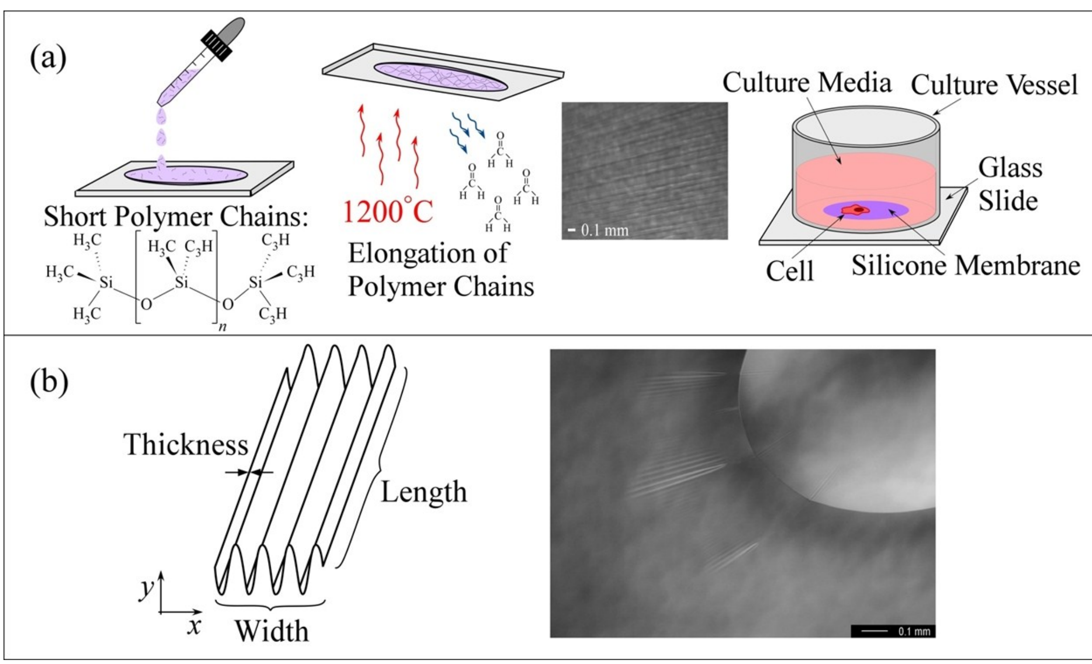
$$\lambda = \frac{\sqrt{2\pi L t}}{\left(3\left(1-v^2\right)\varepsilon\right)^{1/4}} \tag{5}$$

$$A = \sqrt{vLt}\left(\frac{16\varepsilon}{3\pi^2\left(1-v^2\right)}\right)^{1/4} \tag{6}$$

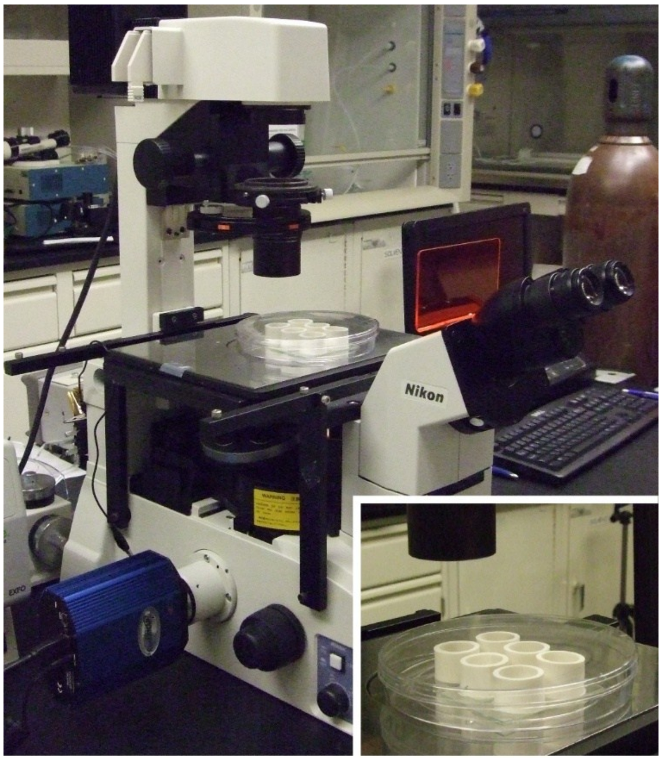
where λ is the wavelength and A is the amplitude of the sinusoidal wrinkling (supplementary figure 1 (b)), L is the length of the membrane, t is the thickness of the membrane, v is the Poisson's ratio of the membrane, and ε is the strain of the membrane (Cerda and Mahadevan, 2003). We approximated the number of wrinkles by dividing the wavelength of the wrinkle pattern by the circumference of the water droplet ($\pi d/\lambda$), where d is the diameter of the droplet.

Cerda E., Mahadevan L., 2003. *Phys. Rev. Lett.* 90, 074302.

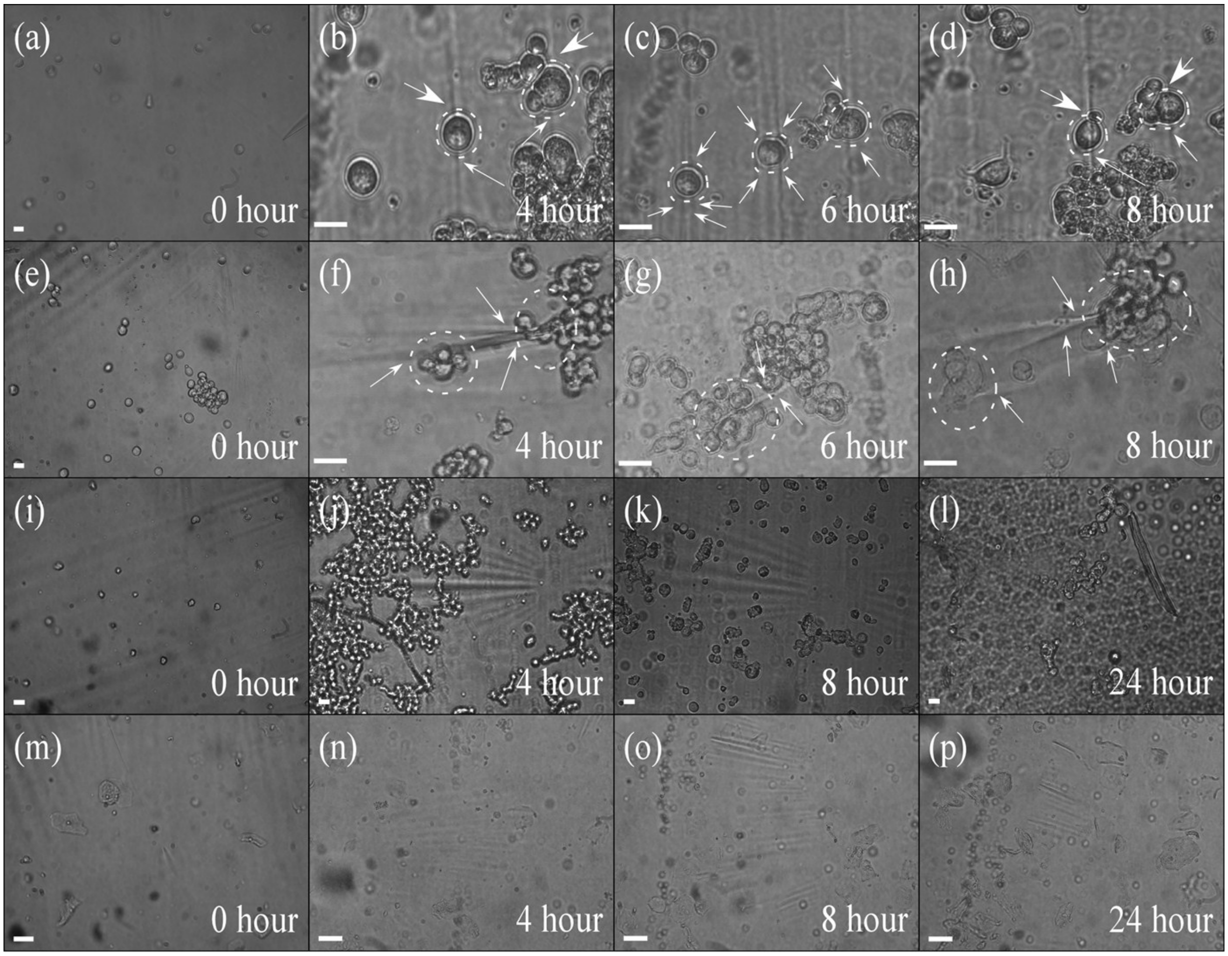
Supplementary Figures



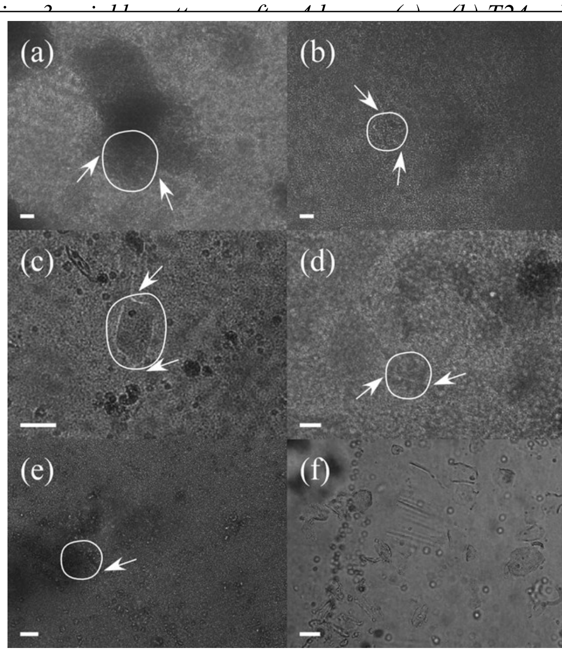
Supplementary Figure 1: Membrane Characterization and Fabrication ***(A)*** *Membrane fabrication method, beginning with high viscosity liquid silicone in a concave glass slide, then the top layer of the liquid silicone is cross-linked via heat forming the ultra-thin membrane; a culture vessel is then applied creating a water-tight seal with the glass slide.* ***(B)*** *Membrane characterization method, using water droplets to determine membrane thickness.*



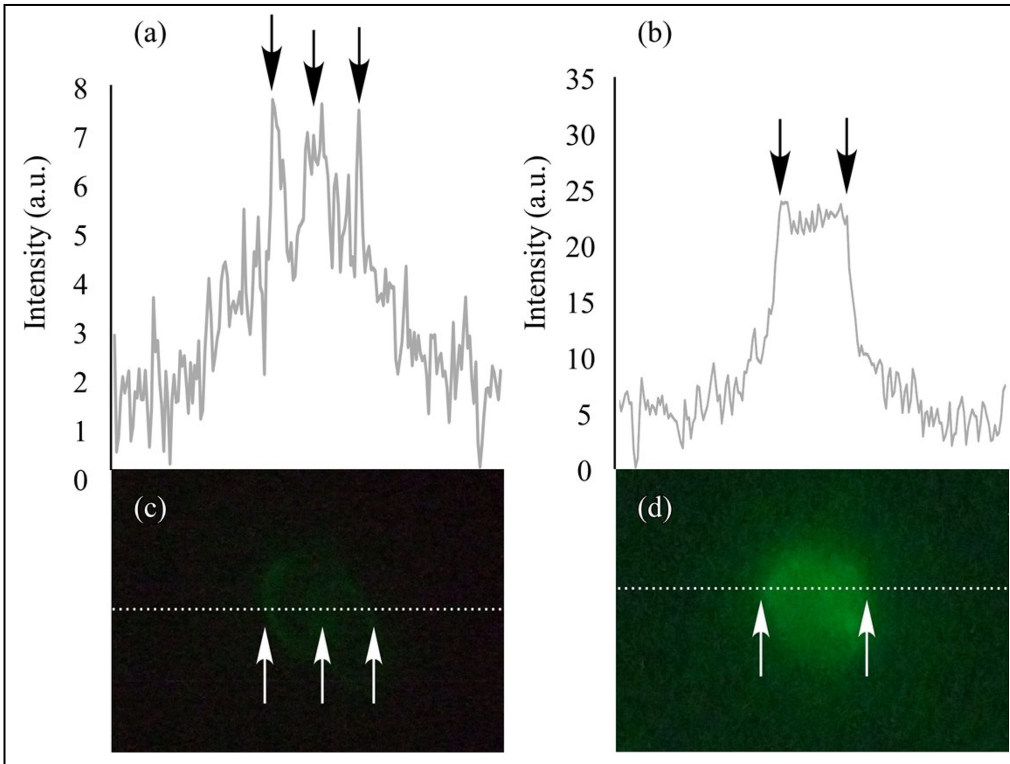
Supplementary figure 2: Overall imaging set-up for the observation of wrinkle patterns generated by cancerous cells. Inset shows 6 devices which each contain ultra-thin membranes, culture media and cells.



Supplementary Figure 3: Time Lapse of Wrinkle Pattern Formation in All Cell Types (a) – (d) RT4 cells at 0, 4, 6, & 8 hours, gen[illegible] *0, 4, 6, & 8 hours, generating 2 wrinkle pattern*[illegible] *no wrinkle patterns are present, (m) – (p) healthy d*[illegible]*s are present. All scale bars are 20 µm.*



Supplementary Figure 3: Wrinkle Patterns Formed by Clinical Patient Samples (a) wrinkle pattern generated by patient 1 after 24 hours (b) wrinkle pattern generated by patient 2 after 24 hours (c) wrinkle pattern generated by patient 5 after 12 hours (d) wrinkle pattern generated by patient 3 after 24 hours (e) wrinkle pattern generated by patient 4 after 12 hours (f) no wrinkle patterns generated by healthy donor control. All scale bars are 20 µm.



Supplementary Figure 4: Fluorescent Intensity Traces Comparing F-Actin in T24 & HEK293f Cells ***(A)*** *&* ***(B)*** *are intensity traces which follow the dashed white lines in* ***(C)*** *and* ***(D)*** *respectively,* ***(C)*** *is a fluorescently stained T24 cell and* ***(D)*** *is a fluorescently stained HEK293f cell. Arrows indicate spikes the corresponding areas responsible for spikes in the intensity traces. All scale bars are 20 µm.*