Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

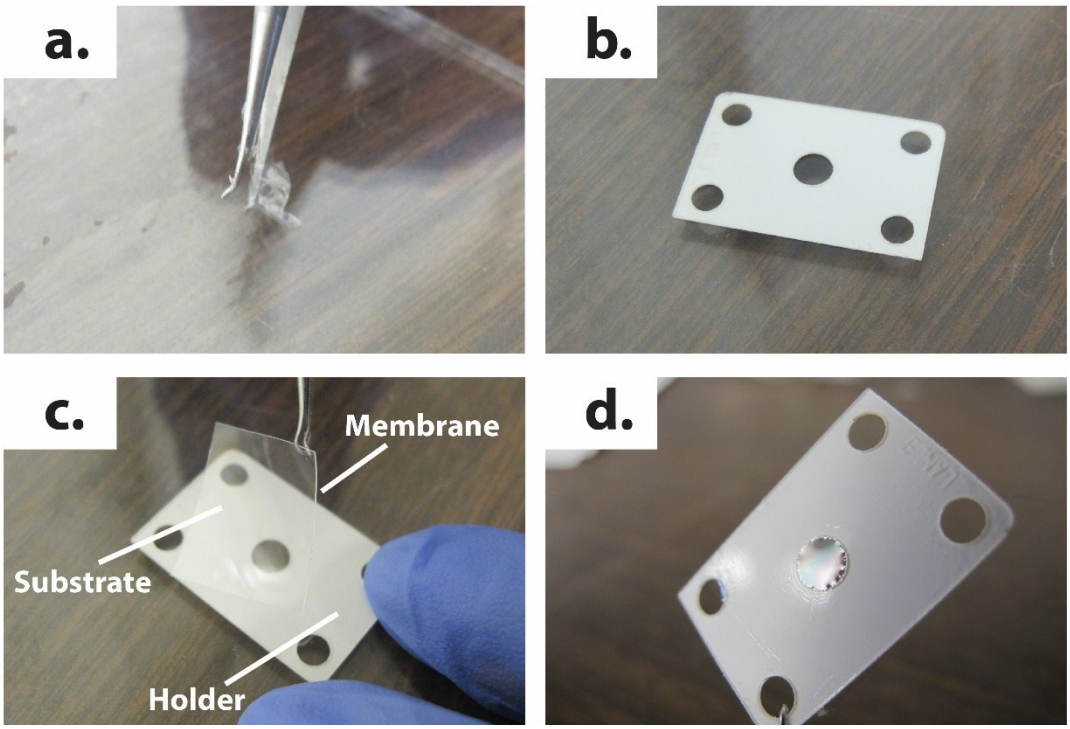

FIG. S1. (a) The crumple of PDMS. (b) Laser cut membrane holder with adhesive tape. (c) PDMS membrane coated on the polycarbonate film was placed on the membrane holder. Once the PDMS membrane was attached to the holder, the substrate can be removed and the PDMS membrane remained on the holder. (d) The PDMS membrane was bound on the holder.

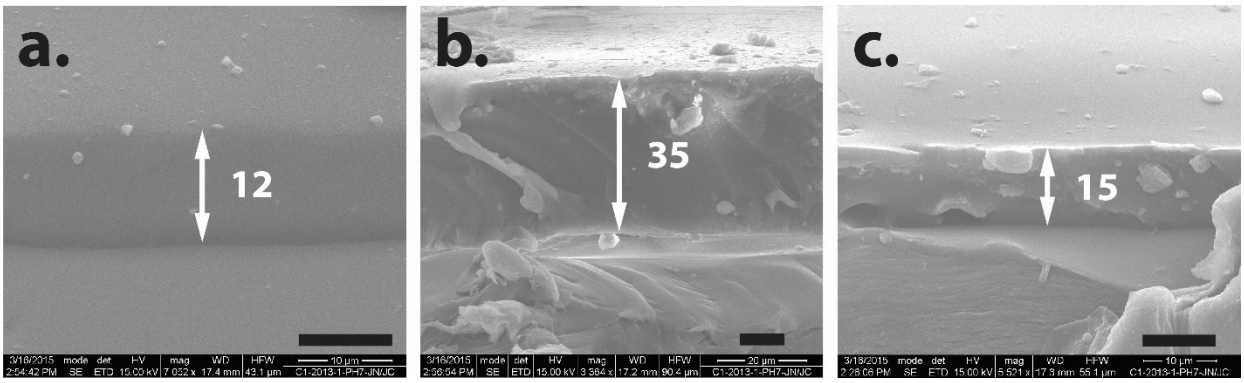

FIG. S2. The thickness of the thin membrane can be measured using scanning electron microscope. (a) PDMS membrane with 12 μm of thickness. (b) PDMS membrane with 35 μm of thickness. (c) PU membrane with 15 μm of thickness. Each scale bar equals to 10 μm.

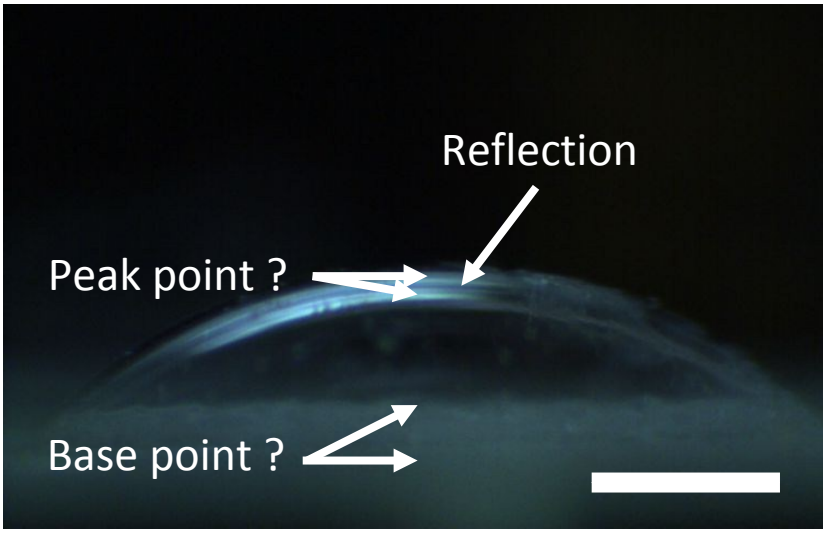

FIG. S3. The bulging height of PDMS membrane was determined using a stereo microscope. The image shows that the bulging of membrane is a form of spherical cap. The bulging height can be determined by measuring the length between peak point and base point. The figure shows that the peak and base point can be subject to interpretation.

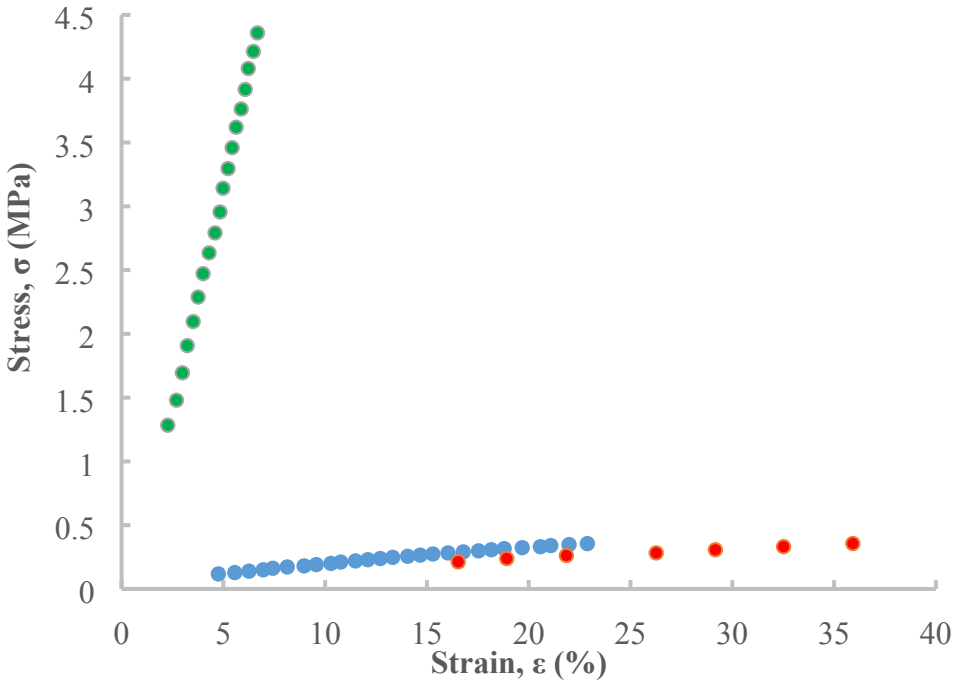

FIG. S4. The stress-strain curves obtained using microfluidic-based bulging test device. PDMS membrane with 35 µm thickness (blue dots). PDMS membrane with 12 µm thickness (red dots). PU membrane with 15 µm thickness (green dots).

Table S1. The sensitivity of the microfluidic method to measure minimum bulging heights for a channel width of 1 mm and observed liquid displacement length of 1 mm. This shows that by designing the channels heights and bulging windows one can measure very small bulging heights that would be difficult to detect by other means.

Channel height (*h*, mm)	**Bulging window radius (*r*, mm)**	**Bulging height difference (Δw_0, µm)**
0.25	2	36
0.1		16
0.05		8
0.25	3	18
0.1		7
0.05		3