Supporting Information

Effects of Standing Waves on the Growth and Stability of Vapor Deposited Polymer Films

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Description of videos: Videos of *in situ* modulation of a silicone oil lens captured using an iPhone X camera and polymer deposition onto moving liquids are provided in MP4 format. Agitation of polymer films after deposition are also included. Videos are set to 2X playback speed.

Video S1: Modulation via sound at 250 Hz of a lens of 5 cSt silicone oil on a Krytox bath.

Video S2: Deposition of crosslinked fluoropolymer on an elongated 5 cSt silicone oil lens on a Krytox bath.

Video S3: Rupturing of a 25 nm crosslinked fluoropolymer film on a 5 cSt silicone oil lens on a Krytox bath via agitation at 250 Hz and 6 Vpp amplitude.

Video S4: Elongation of a 5 cSt silicone oil lens on a Krytox bath encapsulated with 1μm of linear fluoropolymer at 250 Hz and 3 Vpp amplitude.

Video S5: Rupturing of a 100 nm crosslinked fluoropolymer film on a 5 cSt silicone oil lens on a Krytox bath via agitation at 250 Hz and 7.5 Vpp amplitude.

Video S6: Rupturing of a 300 nm crosslinked fluoropolymer film on a 5 cSt silicone oil lens on a Krytox bath via agitation at 250 Hz and 8.5 Vpp amplitude.

Video S7: Agitation of 1-micron crosslinked fluoropolymer film on a 5 cSt silicone oil lens on a Krytox bath at 250 Hz and 10 Vpp amplitude.

Video S8: Agitation of a 25 nm crosslinked fluoropolymer film on a 5 cSt silicone oil lens on a Krytox bath at 260 Hz and 10 Vpp amplitude.

Thickness measurement: The poly(1H,1H,2H,2H-perfluorodecyl acrylate-co-ethylene glycol diacrylate) (P(PFDA-co-EGDA)) films were grown on the surface of stationary and agitated

silicone oil (regime D) by depositing polymer for 4 minutes. The films were removed from the liquid surface with tweezers and rinsed with hexane to remove the silicone oil. The top surface and cross-section of the dry films were imaged via SEM (JEOL-7001). We measured the cross-sectional thickness at five points on each image. The average thickness of the film was found to be 120 nm ± 22 nm on the stationary liquid and 115 nm ± 38 nm on the agitated liquid. The top down images of the dry films in Figure S1 show that a wrinkled film grew over the agitated liquid compared to a smooth film on the stationary liquid.

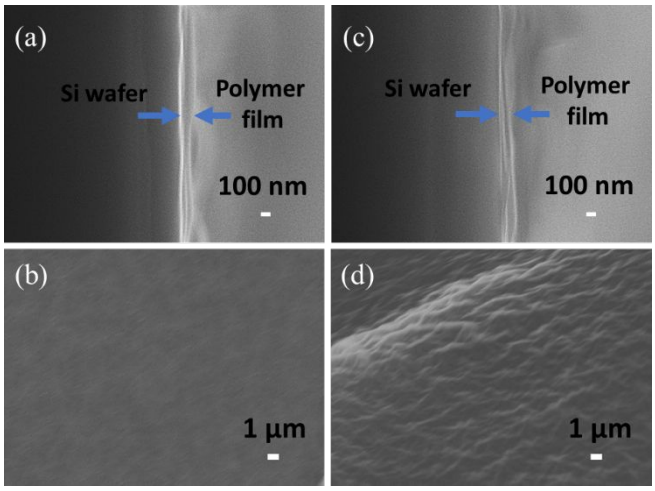

Figure S1. (a) Cross-section and (b) top down image of a dry P(PFDA-co-EGDA) film removed from the stationary liquid surface and (c) cross-section and (d) top down image of a dry P(PFDA-co-EGDA) film removed from the agitated liquid surface.