**Supplementary material on**

**Bubble dynamics and atomization in evaporating polymeric droplets**

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**Supplementary figures:**

1. **Shear thinning behavior of polymer solution**

Figure S1 shows variation of viscosity of PAM solution with shear rate at . The viscosity decreases with an increase in shear rate showing shear thinning behavior of polymer solution.

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**Figure S1.** Variation of viscosity with shear rate at  showing shear thinning nature of polymeric fluid for - 5106 g mol-1.

1. **Skin layer thickness attained during droplet evaporation phase**

The skin layer thickness obtained during evaporation phase (phase A) is used to explain the inflation of viscoelastic membrane and its rupture through hole nucleation. The thickness of the skin layer decreases with irradiation intensity as seen in Figure S2.

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**Figure S2.** Variation of skin layer thickness with irradiation intensity at

1. **Characterization of catastrophic breakup**

After the membrane inflation and its rupture (see movie S2), droplet undergoes catastrophic breakup. The catastrophic breakup is characterized by ejection of secondary droplets. Figure S3 depicts distribution of secondary droplet diameter, velocity, and the correlation between diameter and velocity.

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**Figure S3.** (a) Diameter distribution of secondary droplets ejected during catastrophic breakup (b) Velocity distribution of secondary droplets ejected during catastrophic breakup (c) diameter versus velocity distribution of secondary droplets.

1. **Hole evolution on membrane**

After the growth of membrane, its rupture occurs through nucleation of holes. Thetemporal evolution of different holes on the membrane is shown in Figure S4. The prehole and hole diameter on unstable sheet varies linearly with time (see figure 13) which is not seen in holes on the membrane.

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**Figure S4.** Temporal evolution of hole diameter corresponding to several holes on the membrane.

1. **Absorbance comparison between water and polymer solutions:**

The absorptivity comparison for water and polymer solutions is done by using FTIR spectrometer. Figure S5 compares the absorptivity of water and PAM solution of concentration for a wavelength range of to As seen in the figure, the absorptivity is almost identical to that of water.

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**Figure S5:** Comparison of absorptivity for water and PAM solution for .Wavelength of light from continuous CO2 laser is 10.6 m.

1. **Laser droplet interaction and bubble induced membrane growth**

Figure S6 (a) schematically represents interaction of laser and polymer droplet. Once the bubble nucleates and interacts with skin layer developed during evaporation phase it evolves as membrane.

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**Figure S6:** (a) Schematic representation of laser droplet interaction (b) Schematic representing interaction of nucleated bubble with skin layer and subsequent growth of the membrane.

1. **Effect of beam profile on temperature distribution of droplet**

Figure 1 shows a schematic representation of the IR beam droplet geometry and its interaction.

The incident beam has a diameter of 3.5 mm. The beam diameter is approximately four times larger than the droplet diameter (850 m). The beam-to-droplet size ratio controls the temperature distribution. For higher beam to droplet size ratio the actual temperature distribution can be approximated by the average temperature distribution inside the droplet

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**Figure S7:** Schematic representing the effect of ratio of diameter of beam to droplet on the absorption of laser irradiation intensity

**Supplementary movies:**

**Supplementary movie 1**. Symmetric bubble growth and buckling.

**Supplementary movie 2**. Asymmetric bubble growth, rupture and catastrophic breakup of the droplet.

**Supplementary movie 3**. Solidification of polymeric membrane during evaporation.

**Supplementary movie 4**. Stable sheet fragmentation of droplet

**Supplementary movie 5.** Unstable sheet fragmentation of droplet