coatings

SupplementaryMaterials

Dynamic Reversible Evolution of Wrinkles on Floating Polymer Films under Magnetic Control

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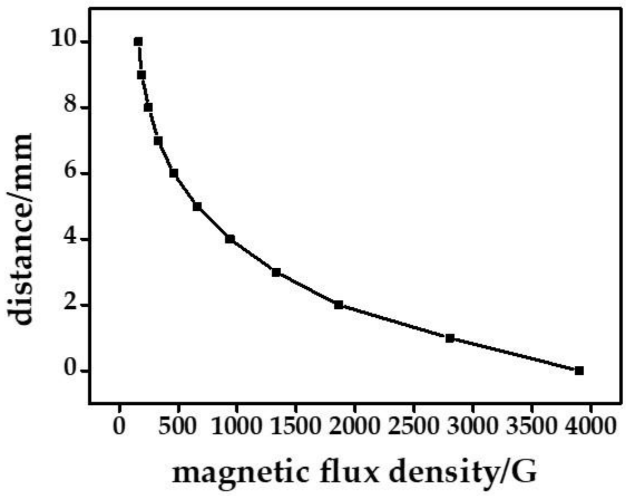

Figure S1. The relationship between magnetic flux density of the used permanent magnet and distance away from its surface.

The used permanent magnet is ND35 D8*5mmT, and the relationship between its magnetic flux density and the distance away from its surface is shown in the Figure S1.

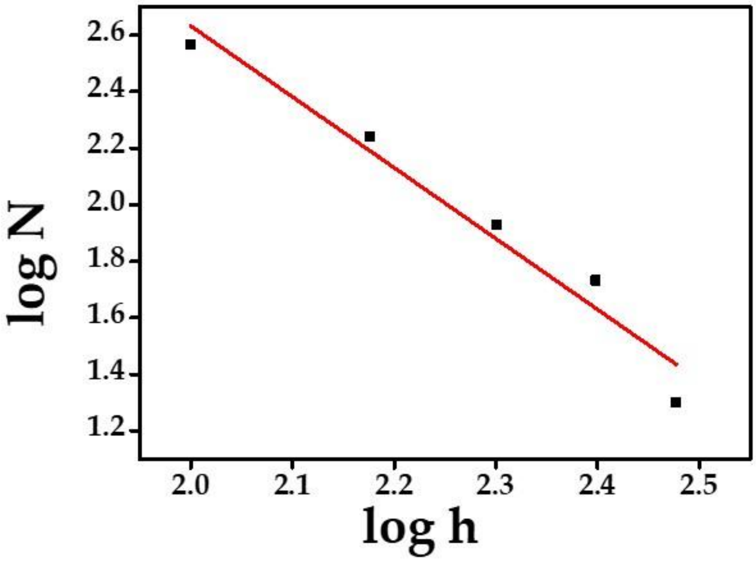

Figure S2. The plot of the logarithm of wrinkle number lgN versus the logarithm of film thickness lgh.

According to the data of wrinkle number and film thickness presented in Figure 3f, the logarithm of wrinkle number lgN versus the logarithm of film thickness lgh has been re-plotted and fitted in Figure S2. The logarithm of wrinkle number lgN decreases linearly with the logarithm of film thickness lgh and the fitted slope is −2.51. It can be deduced that $N \sim k{\cdot}h^{-2.51}$ could be satisfied in our system. Different laws between $N \sim k{\cdot}h^{-2.51}$ in our manuscript and $N \sim a^{1/2}h^{-3/4}$ in the literature basically originate from the slight differences of experimental systems. For example, a magnetic droplet is applied in our system while a pure water droplet is applied in the literature, an external magnetic field is imposed in our system while there is no magnetic interference in the literature. Even so, the variation trend of the wrinkle number N with the film thickness h in our current system is still consistent with the reported results in the literature.

Figure S3. The experimental setup of magnetic control over the surface morphologies of the floating polymer films through an electromagnet.

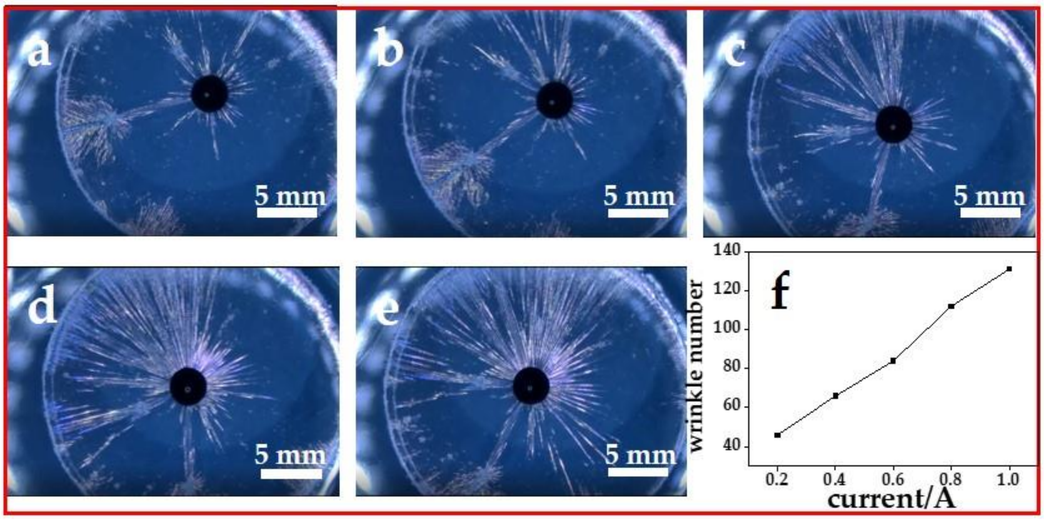

Figure S4. Optical microscopy images of surface morphologies of the floating PS film with a 4 μL magnetic droplet on it in the case of the electromagnet. PS film is 100 nm thick, and the current is (**a**) 0.2 A, (**b**) 0.4 A, (**c**) 0.6 A, (**d**) 0.8 A, (**e**) 1.0 A, respectively. (**f**) The relationship of wrinkle number versus the current in the dynamic process of loading magnetic field.

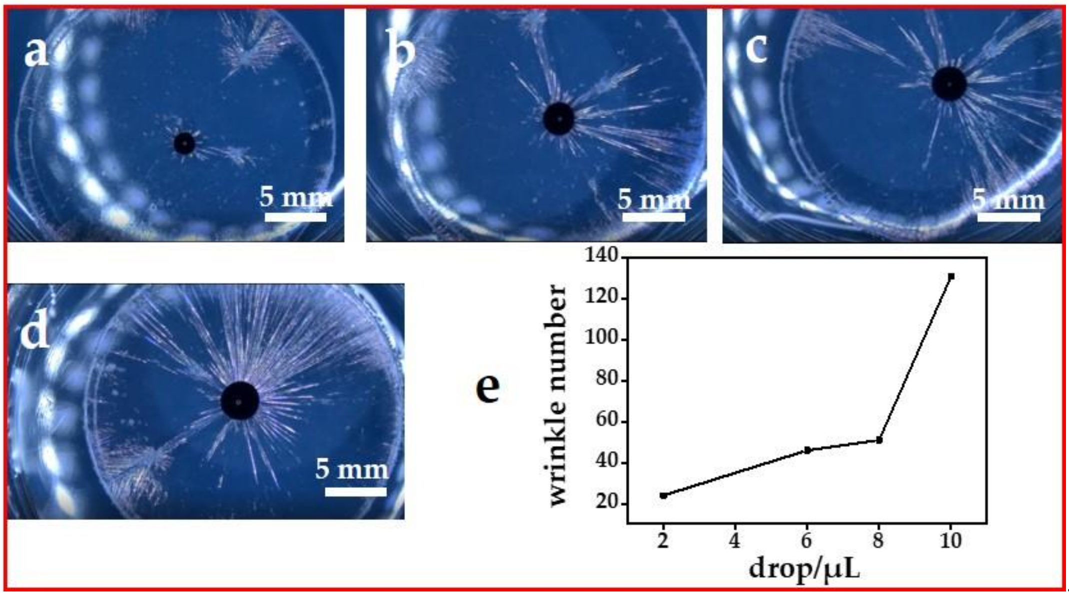

Figure S5. Optical microscopy images of surface morphologies on the floating PS film with a (**a**) 2 μL, (**b**) 6 μL, (**c**) 8 μL, (**d**) 10 μL magnetic droplet on it, when the PS film is 100 nm thick and the current is 1.0 A. (**e**) The relationship of wrinkle number versus magnetic droplet size.

An electromagnet instead of a permanent magnet has been made attempts to investigate the dynamic evolution of surface morphologies of the floating polymer film. In the case of the electromagnet, the magnetic force could be simply regulated by current through the coil. Specifically, a Keithley K2400 digital source meter is utilized to impose a constant voltage 12 V to the electromagnet (working voltage 12 V) and the corresponding current ranges from −1.05 A to +1.05 A. The experimental setup is shown in Figure S3 and the dynamic evolutions of surface morphologies of the floating PS film with the current or the magnetic droplet size in the case of the electromagnet have been shown in Figure S4 and Figure S5. It can be seen that the number and range of radial wrinkles on the floating PS film increasingly increase with the current or the magnetic droplet size. Whether the current or the magnetic droplet size increases, the magnetic force the floating PS film is subjected to increases. Finally, the larger magnetic force results in the larger wrinkle number and the larger wrinkling area, which is similar to the case of the permanent magnet. The dynamic evolution of surface morphologies of the floating PS film in the case of the electromagnet is not as obvious as that of the permanent magnet. It is believed that the optimum conditions have not been captured and further exploration is still under way.

Video S1 Dynamic evolution of surface morphologies of the floating PS film with the change of distance between the magnet and the magnetic droplet.

Video S2 Dynamic evolution of surface morphologies of the floating PS film with the change of current in the case of the electromagnet.