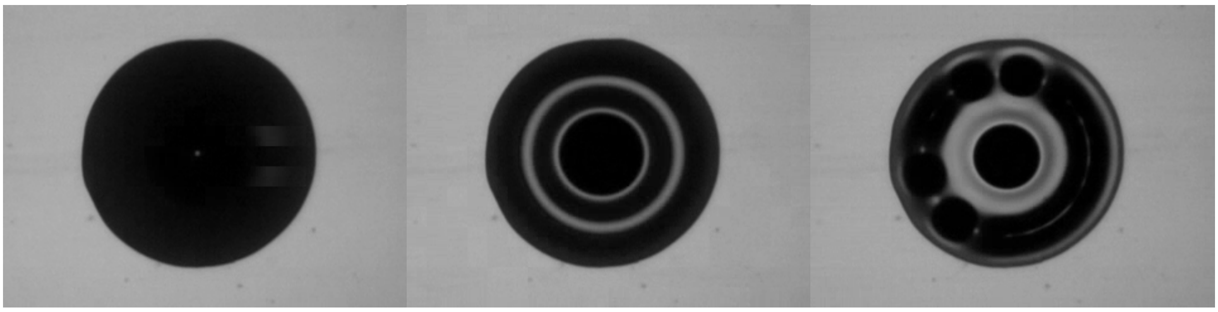
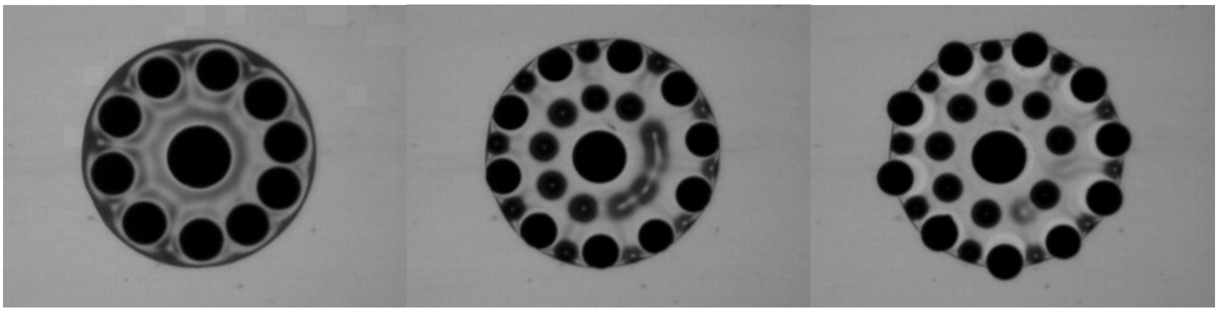
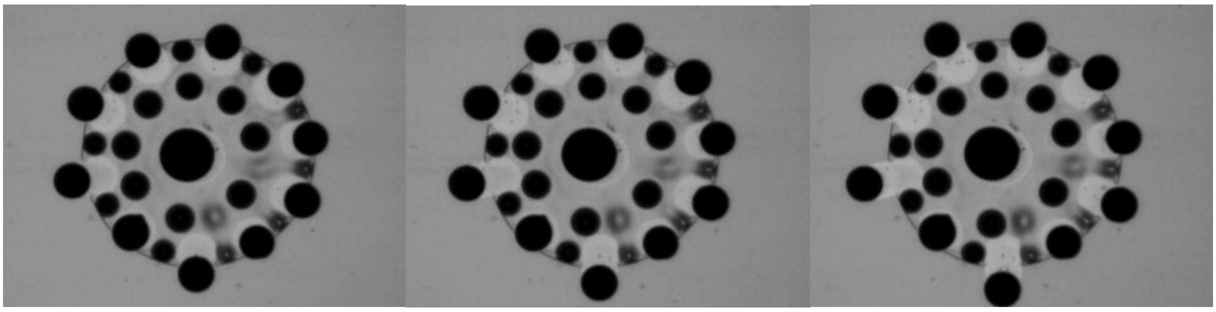


(a) t=0s. (b) t=1s. (c) t=1.5s.



(d) t=2s. (e) t=3s. (f) t=6s.



(g) t=8s. (h) t=15s. (i) t=19s.

Rupture of a magnetic thin film in a perpendicular field

Submitted by
Ching-Yao Chen and L.-W. Lo, National Yunlin University of Science & Technology, Taiwan.

We perform experiments of the Rosensweig instability on a circular thin film of magnetic fluid of a diameter $d \approx 1{,}700\mu m$. The circular thin film is placed on a glass plate and subjected to a perpendicular field. The magnetic fluid used is a light mineral oil-based ferrofluid (Ferrotech EMG901) with a saturated magnetization $Ms=600$ *gauss*. A magnetic field strength of $H=584$ *gauss* is applied. The sequential top views of circular film are recorded by a CCD camera.

Shown in Fig. (a~i) are the snapshots at various times. The film is nearly circular before the field is applied as shown in Fig. (a). Once the field is present, the magnetized film is subjected to an instant lifting force, and consequently pulls the circumference toward the center. However, the surface tension and gravity resist this sudden inward pulling force. As a result, the film is ruptured into three parts, a “central droplet” surrounded by two layers of “fluid annuluses” as shown in Fig. (b). As time proceeds, the outer annuluses are further destabilized by the lifting force, and eventually evolve to a circular array of ten “secondary droplets” with amazing symmetry as demonstrated by Fig. (c,d). By the continuous influences of magnetic energy, numerous additional “derivative droplets” are formed within the middle region and the intervals between secondary droplets as shown in Fig. (e,f). Balanced between magnetic, gravitational and surface energies, an equilibrium state is reached after time t=6s. This equilibrium state is nicely preserved before the removal of field. Nevertheless, induced by imperfect uniformity of the field apparent drifts of secondary droplets are seen as shown in Fig. (g,h,i).

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