Impact on breath figure.

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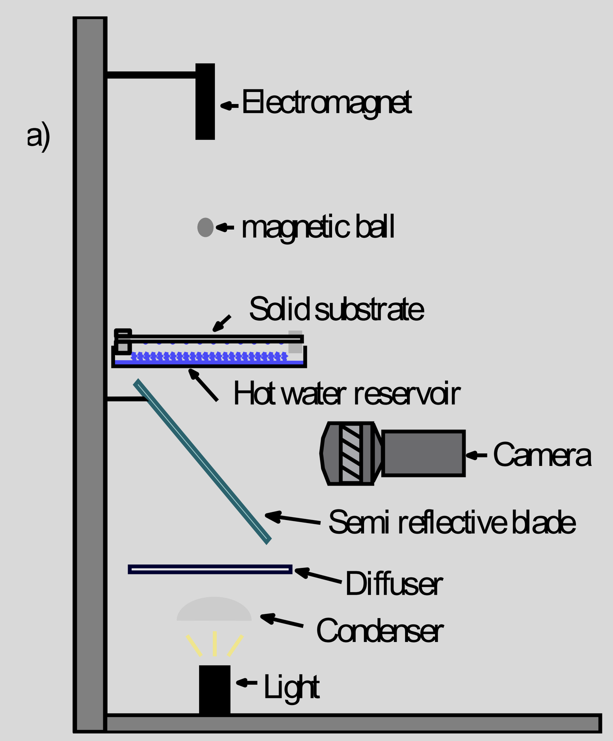
Introduction

A breath figure describes the droplet pattern formed when a vapor condenses onto a surface. First, nanometric droplets of spherical cap shape are created by heterogeneous nucleation. When vapor is constantly provided (supersaturated atmosphere, cold enough surface...), this breath figure evolves with time, the average droplets radii increase. This evolution has been actively studied in the last decades, motivated by understanding nucleation effects [1], thin film vapor deposition, development of anti-dew surfaces and dew recovery system [2-3].

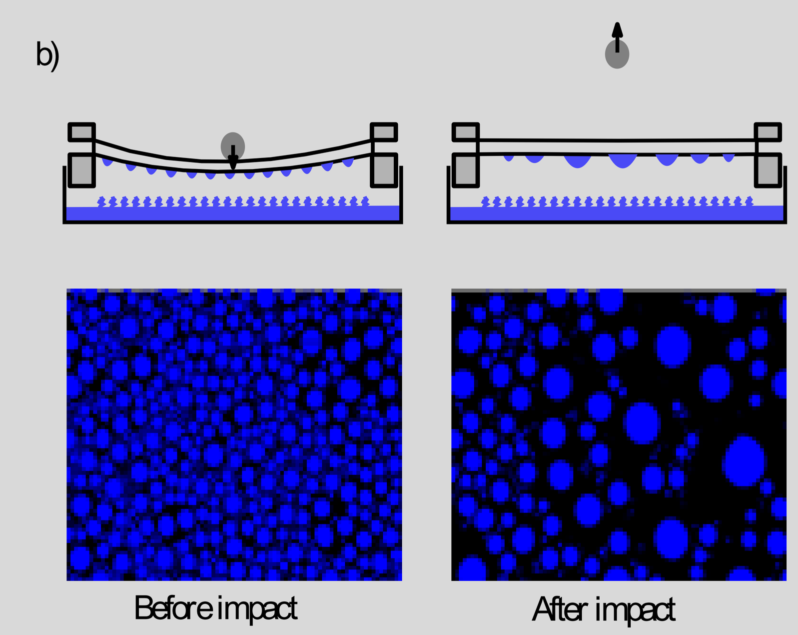
What happen when we solicit a breath figure ?

Experimental setup

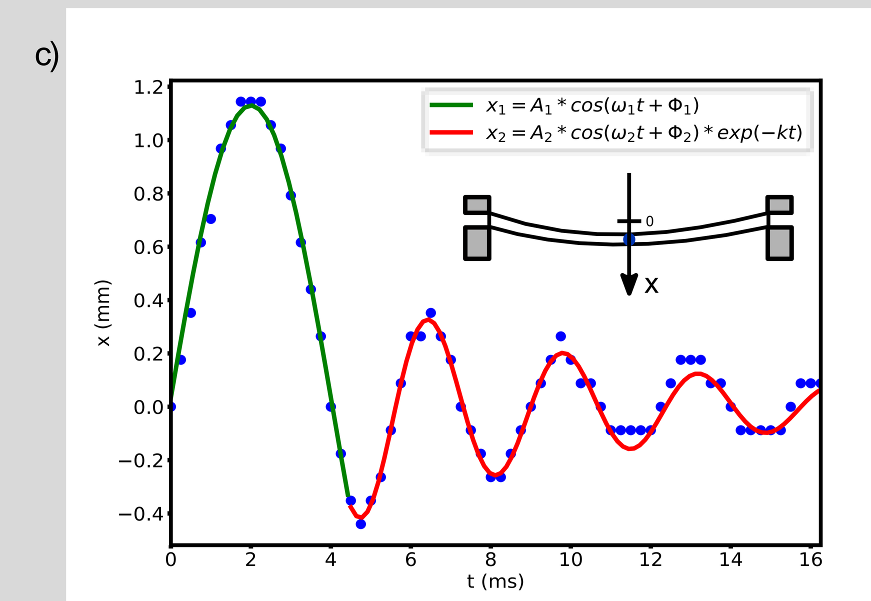
Experimental setup



What happen ?

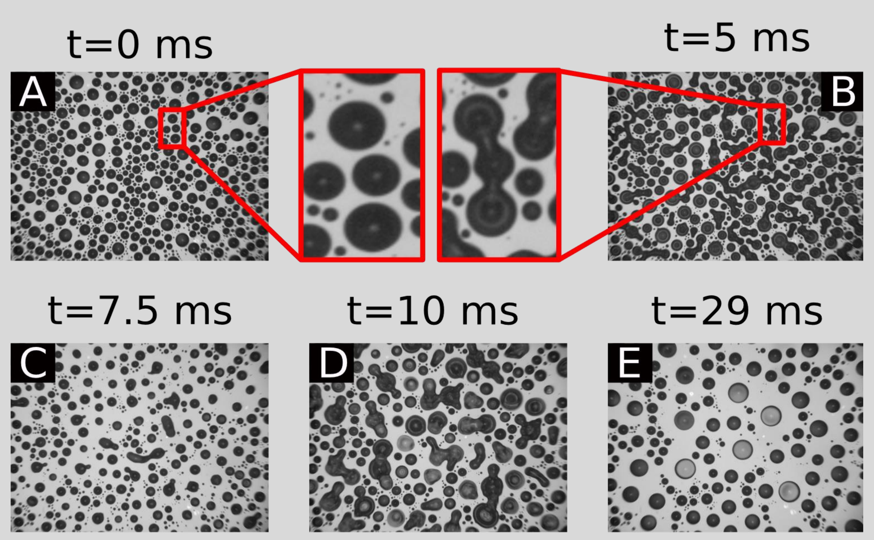


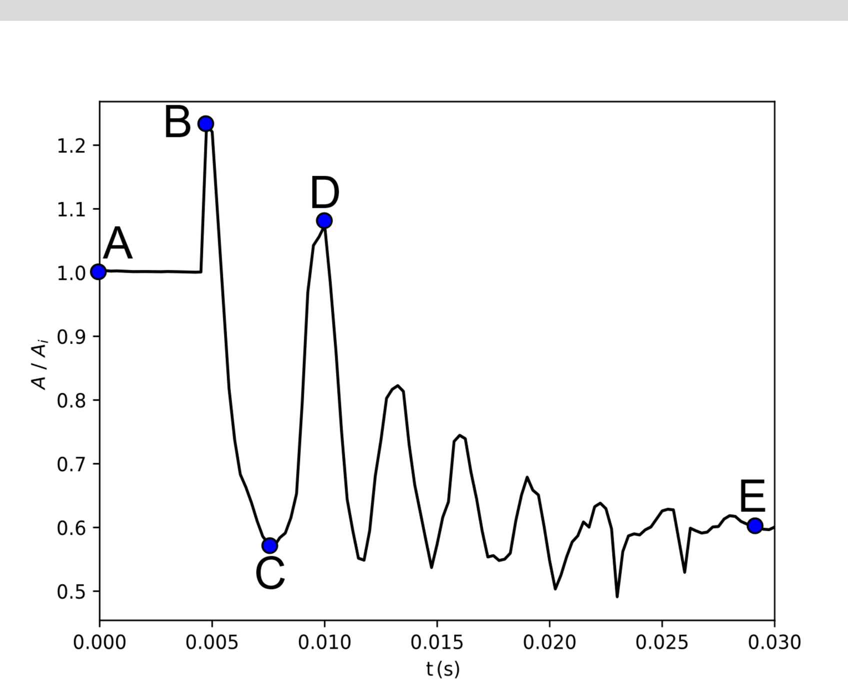
Local motion of the substrate

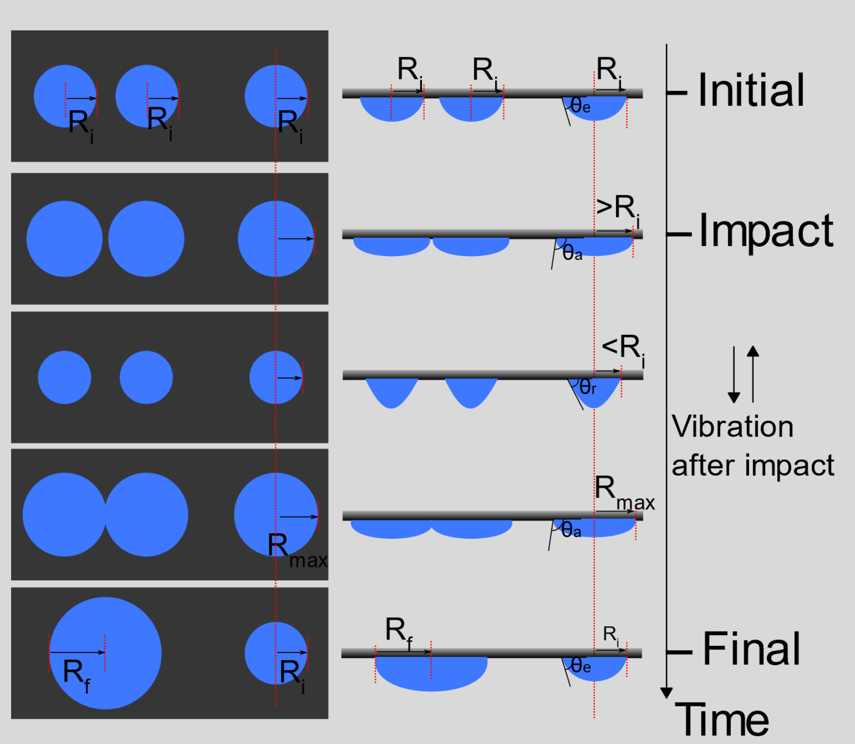


- A breath figure is obtained by exposing a returned substrate to the vapor of a hot distilled water reservoir during a certain duration.
- A solid magnetic ball is dropped on the substrate to make an impact.
- We record the breath figure evolution during the impact with a rapid camera.

Results





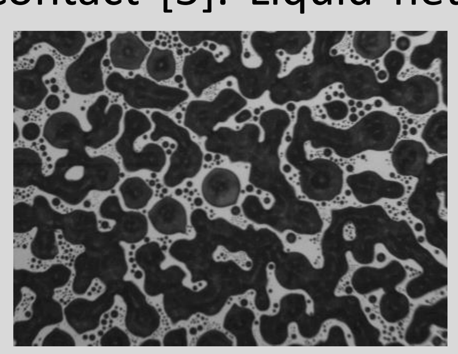


[A] Initial state (before impact):

We have a droplets pattern characterized by a mean plan radius : $< R >$

[B-C-D] Impact:

1. During the impact most of the drop reach their advancing contact angle if the acceleration is enough [4]. Their contact line is unpinned resulting on an increase of drop radius which will coalesce with their closed neighbors.
2. Little liquid bridge are created between droplets in contact [5]. Liquid network creation.

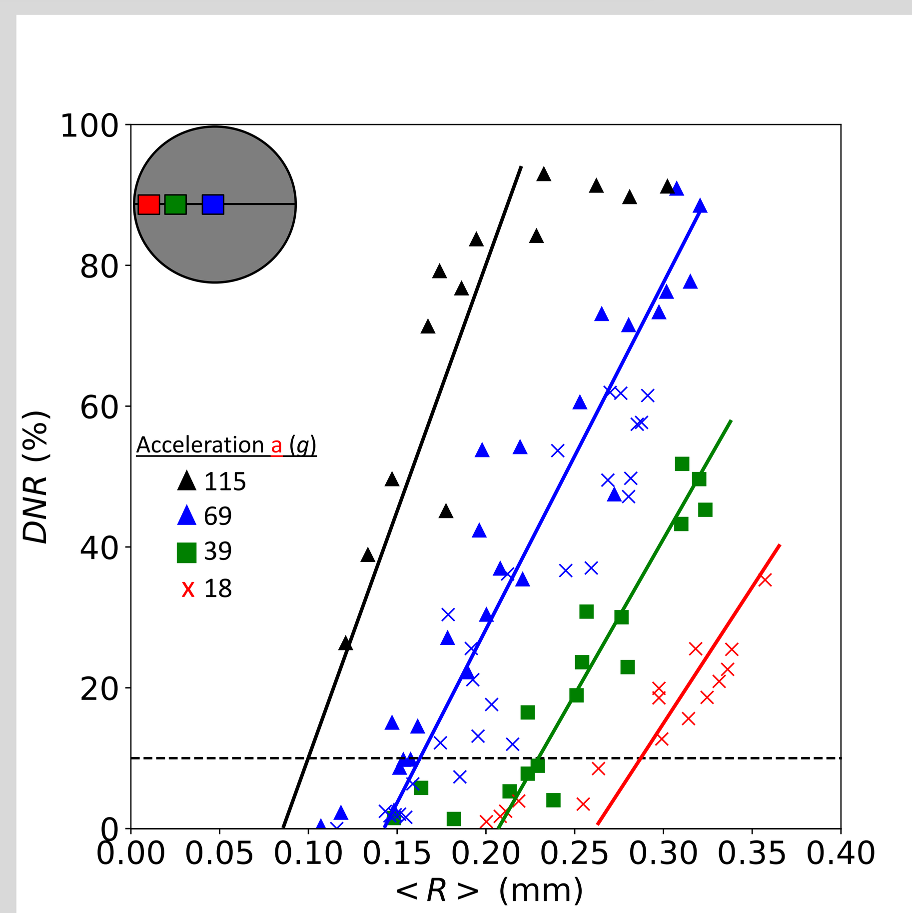


1. Because of the substrate vibration, the new pattern will oscillate creating new coalescence and decreasing the number of droplet.

[E] Final state:

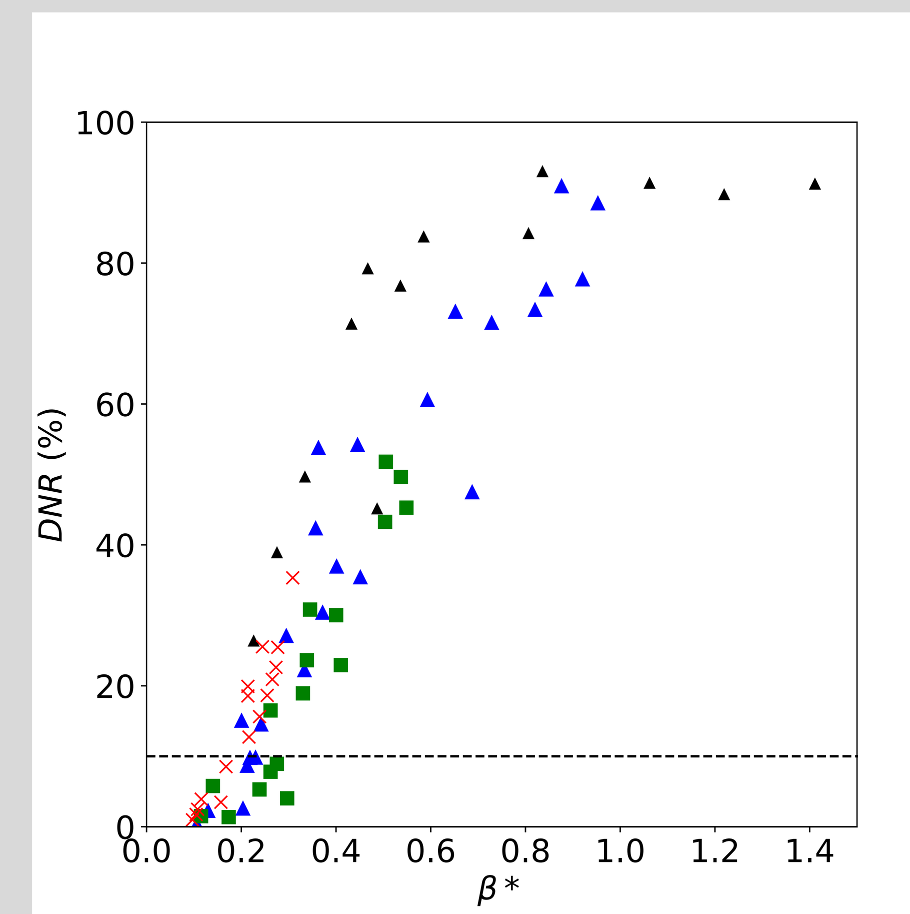
A certain amont of droplet have coalesce.

- **Less droplets.**
- **Smaller wetted area.**
- **Bigger droplets.**



- The droplet number reduction DNR represent the efficiency of an impact to clean the substrate.
- There is a critical mean plan radius.
- The specific Bond number β^* is a good parameter to describe the phenomena.

$$\mathrm{DNR} = \left(1 - \frac{N_f}{N_i}\right) \qquad \beta^* = \frac{\Delta\rho * a * R^2}{\gamma}$$



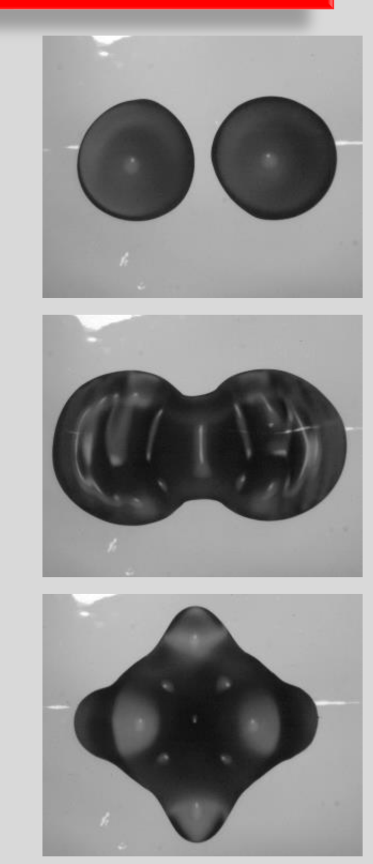
Conclusion

Take home message :

Droplet vibrations are a promising way to trigger droplet coalescence, which allows to accelerate the breath figure growth and decrease the wetted area. Very interesting to increase evacuation of dew from a surface.

For the next time ?

Works have been done, to well understand how the coalescence occur between two or more droplet under constant vibration.



References

[1] D. Beysens *et al*, How does dew form?, (1991).

[2] Meakin, Droplet deposition growth and coalescence, (1992)

[3] Lu *et al*,Dynamics of droplet motion induced by Electrowetti, (2017)

[4] X. Noblin *et al*, Vibrations of sessile drops, (2009)

[5] N. Kapur *et al*, Morphology and dynamics of droplet coalescence on a surface, (2007).