Minicolloque n° 16 **× Oral** **☐ Poster**

Observation of the drying dynamics of droplets using confocal microscope

Elodie RICHARD[a], Thomas DUBOIS[b], Maureen DELEPLACE[b], Thierry BENEZECH[b], Christine FAILLE[b*]

a. Univ. Lille, CNRS, INSERM, CHU Lille, IPL, US 41 - UMS 2014 - PLBS, F-59000 Lille, France
b. Univ. Lille, CNRS, INRAE, ENSCL, UMET, F-59650, Villeneuve d'Ascq, France

* email : christine.faille@inrae.fr

In the food industry, surfaces contaminated with bioaerosols (aerosols containing particles of biological origin) can be the source of new cross-contamination of foodstuffs with sometimes dramatic consequences for the health of consumers [1]. They can compromise the control of surface hygiene because 1/ some bacteria contained (including pathogens) can survive, even after the droplet evaporation; 2/ the deposits thus formed are highly resistant to hygiene procedures.

In this study, we investigated the evaporation of droplets containing bacterial spores (hydrophilic / hydrophobic) and latex microspheres of 1-µm diameter. First, the shape of the droplets placed on hydrophobic or hydrophilic glass was viewed throughout the drying process, using a goniometer. Various contact-line dynamics were observed on the different materials. The resulting deposit architecture was therefore affected by the material but also by the particle properties.

In order to follow the flow organizations within the droplets during desiccation, observations were carried out with an inverted confocal laser scanning microscope. First, image sequences (every 5 s) were recorded at the material level in order to follow the particle movements. Differences were observed between materials and between particles. First, the expected outward motion was clearly observed, mainly with latex microspheres and hydrophilic spores. Conversely, many hydrophobic spores (and spore clusters) remain stationary, probably as a result of strong interactions with the material. Similar observations were achieved at different distances from the surface and an azimuthal vortex pair pattern was often observed (Fig. 1) perhaps due to an asymmetric receding pattern of the contact line as previously suggested [2]. Multiple two-dimensional images (Z stacks) were also obtained at different depths in the droplets at different drying times, enabling the reconstruction of 3-D structures (Zen software). Depending on the material and particle properties, this representation enabled to observe the rapid sedimentation of particle clusters, the accumulation of particles at the air-liquid interface, or even the rapid formation of a peripheral ring (sharp vs diffuse).

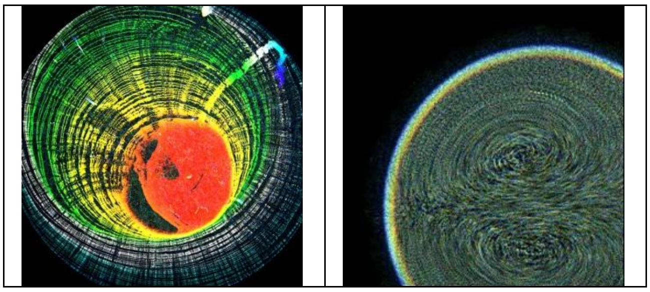

Figure 1. Examples of movement of microspheres within evaporating droplets. Left: At the material level; the color code ranges from purple (T0) to red (dried droplet). Right: at 125 µm height during the first 2 minutes of drying

[1] C. Faille, E. Billet, New Food Magazine. 23,51-54 (2020)
[2] D. Mampallil, D. van den Ende, and F. Mugele, Applied Physics Letters 99, 154102 (2011).