Elucidating the physical mechanisms behind foam cleaning efficiency

DIRECTEUR DE THÈSE : WIEBKE DRENCKHAN
INSTITUT CHARLES SADRON, 23 RUE DU LOESS, 67034 STRASBOURG
TEL : 03 88 41 40 43; E-MAIL : DRENCHAN@UNISTRA.FR

We recently demonstrated the surprising capacity of liquid foams to clean efficiently an astoundingly wide range of solid surfaces contaminated by liquid or solid substances [1,2]. We showed (Fig. a) that it is sufficient to deposit an appropriately designed liquid foam (small bubbles, low liquid content, intermediate stability) for a few minutes on the contaminated surface – while the non-foamed solution has no measurable cleaning effect. This observation is against previously held believes that foams are merely side products of cleaning processes without a direct impact on the cleaning action. While the observed effects are impressive, a sound explanation of the underlying mechanisms is still lacking.

The goal of this PhD thesis is therefore to develop model systems which allow to rationalize the different mechanisms which contribute to the observed cleaning efficiency. For this purpose, we will work with model contaminations of lipid multilayers [3,4], and we will develop an experimental setup which allows to put simplified "model foams" (a single bubble (Fig. b) or a layer of bubbles) in controlled static & dynamic contact with the contaminated surface. To analyse the surface response, we will combine interferometry, fluorescence/confocal microscopy, Fluorescence Recovery after Patterned Photo-Bleaching (FRAPP) and AFM. We will also investigate the influence of different types of surfactants (used to stabilise the foams) on these processes.

This PhD will take place in close collaboration between the MIM team (expertise in interfaces and foams) and the M3 team (expertise in lipids, T. Charitat & Pierre Muller) of the ICS.

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