Self-cleaning slippery infused surfaces for dairy processing

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1. Introduction

In dairy pasteurization processes, biofouling is a major issue. Indeed, in order to avoid microbial contaminations, milk needs to be heated to specific temperatures (72-85°C), which generates mineral and proteinaceous deposits on stainless steel walls. This heat-induced fouling impairs the good execution of the process through the addition of an increasing thermal resistance to the system and is therefore a threat to food safety. Moreover, the required cleaning procedures burden both the financial balance and the environmental footprint of thermal processes.
As for others applications where biofouling is a key parameter, a biomimetic approach, from Lotus leaves to Nepenthes pitcher plants, has been considered. In the first case, the dual-scale roughness (i.e. a micrometric roughness supporting a nanometric roughness) of its surface allows them to reach the metastable Cassie-Baxter wetting state, in which air remains trapped between the liquid and the solid surface, which results in very high contact angles and very low contact angle hysteresis. For the second one, the impregnation of the rough surface by a non-miscible low surface energy liquid leads to a stable state with a quasi-null hysteresis even for liquid presenting a low surface energy [1].

2. Results

In this work, different stainless steel based surfaces have been texturized *via* femtosecond laser ablation to generate dual-scale cauliflower-like structures on its surface [2] and were then modified either by (i) silanzation with Perfluorodecyltrichlorosilane or (ii) silanization followed by impregnation with a fluorinated oil to create Slippery Liquid Infused Porous Surfaces (SLIPS-like). All surfaces were tested for their fouling properties in a pilot pasteurization equipment allowing to mimic the conditions of an industrial pasteurization process (heating between 65 to 85°C, model milk flow rate equal to 300L/h during 1.5h) [3]. Among the different results obtained, we will present outstanding ones regarding antifouling properties of dual-scaled roughness surfaces in dairy processing conditions, with a reduction of fouling by more than 90% in weight [4].

References

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