

Structural optimization of super-repellent surfaces

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Abstract

Micro-patterning is an effective way to achieve surfaces with extreme liquid repellency [1]. This technique does not rely on chemical coating, and is therefore a promising concept for application in food processing, bio-compatibility and several other fields.

This super-repellent behavior is obtained by suspending the liquid phase on a brush of micro- and nano-posts, thus minimizing the contact with the substrate, i.e. the adhesion force.

While a lot of experimental work has been carried out in this field, relatively little has been done from a theoretical point in rationalizing and optimizing the geometry of the posts that generate the super-repellent effect.

We here present two different approaches to optimal liquid repellent surfaces, addressing some fundamental aspects of the problem.

First, we focus on the wetting aspect, and we apply topology optimization [2] to search for an optimal pattern to support the liquid phase in the suspended state [3]. Second, we consider simpler geometries, but we account for both the wetting and mechanical properties of the micro-posts, observing an interesting balance of conflicting design objectives [4].

In conclusion, we present a wide perspective on how numeric optimization tools can be applied to this new, dynamic engineering field with significant results.

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