**Design and testing of smart antifouling materials: beyond biocidal approaches**

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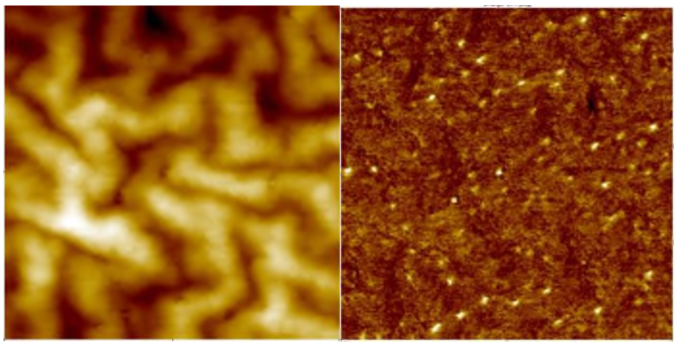
The fouling of surfaces in contact with liquids and in particular biofouling creates important and costly problems, for example to buildings and to the hull of ships. In the shipping industry alone, the problem of bio-fouling costs more than £4 billion every year. Aside from the issue of costs, it is responsible for significant pollution due to excess fuel being used. Antifoulings are therefore critical to make ships more efficient. Most current antifouling strategies rely on the progressive release of biocidal chemicals. While effective at preventing fouling, this creates a separate environmental problem with measurable depletion of certain organisms in dense water ways.

One possible way forward is to develop new surfaces able to control the behaviour of water and fouling organisms at the nanoscale, potentially preventing the conditioning for fouling and the need for biocidals. This project aims to exploits recent advances in atomic force microscopy to gain new, molecular-level insights into the interface between coatings and liquids containing fouling agents, focusing on (i) local liquid dynamics, (ii) details of the fouling adhesion and (iii) the ageing of the surface.

Some topic of research could include:

- Nanoscale mapping of the hydrophobicity/philicity of the surface when immersed in different relevant conditions (Fig. 1),
- Local liquid shear dynamics at the surface of coatings,
- Quantification of the adhesion of fouling agents at different location of surfaces of interest, including variation over time,
- Quantification of the adhesion of single, whole living organisms (e.g. unicellulars) on coatings,
- Effect of ageing on the surface properties at the nano and macro scale.

The project will help develop in-situ nanoscale understanding of well-established anti-fouling strategies, map their function with molecular precision and identify strength and weaknesses. This should provide unprecedented insights into fouling process and identify any scale-dependent effect. Results will help design better coating that can also exploit liquid flow and bio-adhesion at all scales simultaneously.



A thin layer of poly-acrylic acid offers a simple example of a smart interface: the topography is relatively smooth with shallow wrinkles (left) but mapping the surface's wetting properties in water (right) reveals 20 nm wide hydrophobic domains in an otherwise hydrophilic surface (bright spots).
The image is 1 μm by 1 μm (30 nm height variations) and acquired by atomic force microscopy in water.

Aside from contributing directly to the development of novel, more ecological products for AkzoNobel (impact beyond academia), the strategy and goals are in themselves highly ethical and in line with Responsible Innovation. A success would help reduce carbon emissions, global fuel consumption all while helping to better preserve marine life.