Captive-air-bubble aerophobicity measurements of antibiofouling coatings for underwater MEMS devices

Massimo Mariello[1,2]
F. Guido[2], V. M. Mastronardi[2], F. De Donato[2], M. Salbini[2,3], F. Rizzi[2], M. De Vittorio[1,2]

[1] Dipartimento di Ingegneria dell'Innovazione, Università del Salento, Lecce, Italy
[2] Center for Biomolecular Nanotechnologies, Istituto Italiano di Tecnologia, Arnesano (Lecce), Italy
[3] Dipartimento di Scienze e Tecnologie Biologiche e Ambientali, Università del Salento, Lecce, Italy
massimo.mariello@iit.it

Micro and nanoscale electronic devices that are aimed at being employed in harsh environments, such as underwater, must be protected with electrically insulating coatings. Moreover, for applications involving flexible devices it is important that the external coating has some specific characteristics: it should be conformal, lightweight, not fragile and insulating. Furthermore, one of the main issues related to submerged objects is the accumulation of micro- and macro-organisms on the solid surfaces, i.e. *biofouling,* which could negatively affect the mechanical performance of the devices, especially in the field of MEMS micro-fabricated systems. In order to contrast the deposition of microbial organisms on micro-devices which have to work underwater, one commonly adopted technique is to control the physical and chemical character of the surface by modifying the morphology and the wettability.
In our work, we investigate the surface behavior of different selected polymeric coatings: parylene-C, poly-methyl methacrylate (PMMA), poly-dimethyl siloxane (PDMS), a mixture of diluted PDMS and molten poly-vinylidene fluoride (PVDF), a mixture of PDMS and PVDF powder, and parylene-C decorated with PVDF nanoparticles through sonication.
We analyze the wettability by measuring the contact angle and comparing the classical sessile-drop method (in air) with the captive-air-bubble method (for substrates submerged in seawater), in order to evaluate the underwater aerophobicity of the surfaces. Additionally, AFM measurements provide further information in terms of surface morphology.
We find that the application of PDMS diluted in Hexane solvent provides the highest air-bubble contact angle, but the nanoparticles-decorated parylene coatings show the best combination of a rougher surface (to reduce *biofouling*) and a higher aerophobicity (higher surface concentrations of PVDF nanoparticles provide higher underwater aerophobicity).

References

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Figures

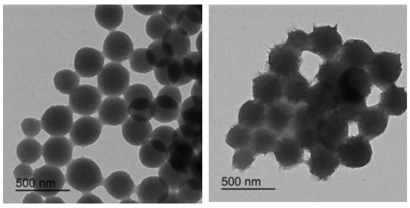

Figure 1. TEM images of PVDF nanoparticles in MEK at concentrations of 1mg/mL (left), 5mg/mL (right).

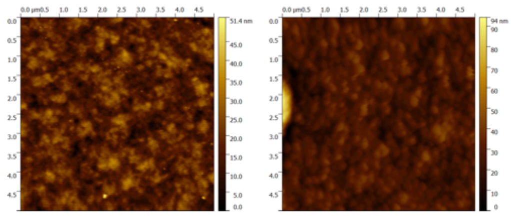

Figure 2. AFM images of parylene C decorated with PVDF nanoparticles from MEK solution at 1mg/mL (left) and 5mg/mL (right).

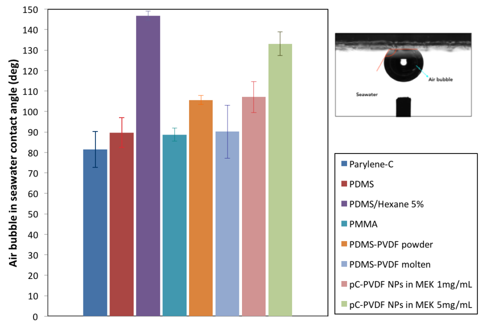

Figure 3. Captive air bubble method for measuring wettability underwater: comparison between different selected polymeric coatings.