Controlling plasma polymers morphology: the role of substrate surface chemistry

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Résumé :

Plasma polymerisation is a versatile strategy that enables the surface modification of materials by depositing thin polymeric films ranging from micrometres to nanometres in thickness. Unlike conventional polymerisation methods, which often require solvents or initiators, plasma polymerisation involves the fragmentation and recombination of organic precursors in a plasma phase. This process results in the formation of functional coatings known as plasma polymers.

Plasma polymers are typically deposited as uniform, homogeneous thin films. However, some studies have shown that under certain conditions, micro and nanoscale structures can also form (*cf.* Figure). The morphology of the plasma polymer coatings (whether thin films or nanostructures) is influenced by several experimental parameters, including plasma deposition operating conditions [1] and the surface chemistry of the substrate [2]. While these variables are known to affect the deposition process, the underlying mechanisms driving these morphological differences remain poorly understood.

In this context, our study focuses on elucidating the role of substrate surface chemistry in controlling the morphology of citronellal-based plasma polymers. Reactive self-assembled monolayers, followed by post-functionalisation via thiol-ene photochemistry, were used to generate chemically distinct surfaces with minimal differences in topography. A maskless photolithography strategy was employed to create both uniformly functionalised and chemically patterned surfaces.

Following surface characterisation, these tailored substrates were exposed to citronellal plasma deposition. The resulting coatings were then analysed to assess the influence of initial surface chemistry on the morphology of the plasma polymer. Through this work, we were able to verify the differences in plasma polymer growth mechanisms according to the surface chemistry.

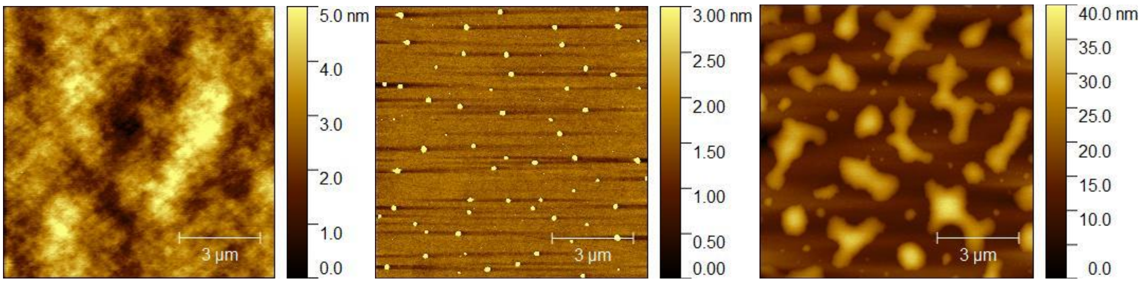

Figure - Height AFM images (10 x 10 µm) for several morphologies of citronellal-based plasma polymers. From left to right: thin film, nanostructures, microstructures.

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Références :

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