Deposition and structural characterization of atomically-thin melanin biopigments

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Abstract

Mainly known for the tan it produces in humans, melanin is also responsible for a variety of functions, such as photo-protection of skin and eye, free radical scavenging and metal ion binding. It results from the combination of two monomers, DHI and DHICA, and their redox forms that polymerize in a disordered manner to form 2D oligomers that then form more complex layered structures. Recent reports in the literature point to the mixed ionic-electronic conduction properties of these structures and such properties renders melanin an interesting candidate for organic nanoscale devices featuring biocompatible and easily available "active" materials. A critical point concerns the metal ion binding properties that is not well understood despite the strategic importance it has to explain the biological role of melanin in our body as well as possible development of green solar conversion technologies. On one hand, metal ion binding can be advantageously used to tailor electrical conduction but on the other hand, it can increase the structural disorder in the pigment, thus limiting both the reproducibility of the experiments and that same conduction.

Using spin coating deposition, we exploit a new synthetic approach based on the solid state polymerization of the melanin monomers [1] to produce controlled samples of 2D melanin that will have different chain lengths and nominal thickness, ranging from the sub monolayer regime to a few monolayers. Using atomic force microscopy (AFM, Figure 1) we observed that thicknesses lower than five monolayers can be obtained and we correlated deposition method and surface coverage. Capitalizing on these findings, we explore the use of other characterization methods such as Raman spectroscopy and UV-Visible absorption to gain additional insight on the structural and optical properties of the obtained oligomers.

References

[1] A. Pezzella et al., Material Horizon, **2** (2015) 212-220.

Figures

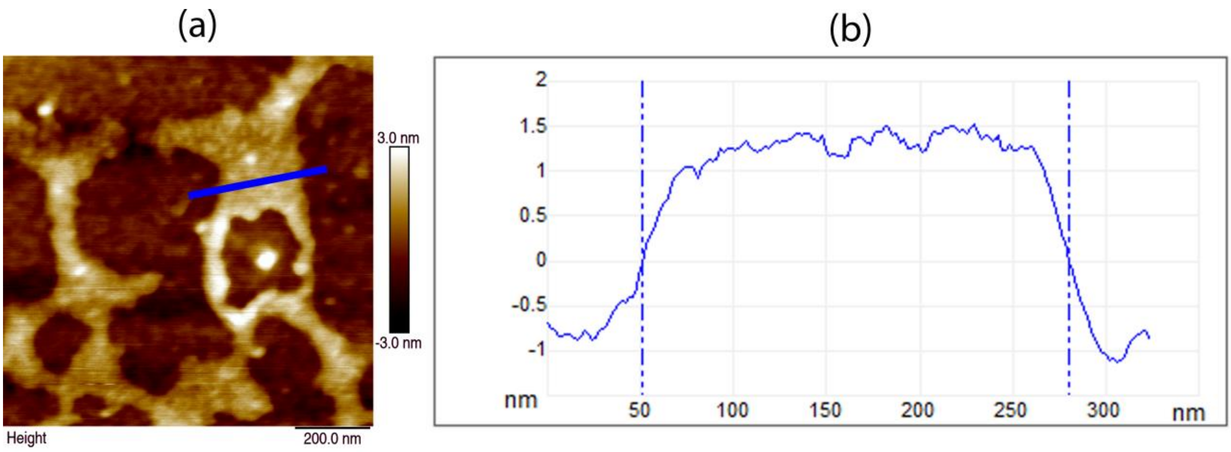

Figure 1 : 1x1 µm AFM scan of a DHI on SiO_2 sample. (a) shows the height diagram of the measured sample and (b) is the cross section shown by the line on (a) .