Cu-phthalocyanine long range ordered bulk growth due to the weak interaction with highly oriented pyrolytic graphite

Daniele Paoloni[1*], Alessandro Ruocco[1]
*lead presenter: daniele.paoloni@uniroma3.it
1 Università degli studi Roma Tre, Via della Vasca Navale 84 00146 Roma

Electronic devices based on organic molecules, such as solar cells and transistors, improve their performances as it increases the film order [1]. In particular, a clear correlation between long range order and larger electron mobility has been demonstrated [1]. Long range ordered monolayer phases can be obtained via the substrate templating effect [2]. However, technological applications require long range order in 3D dimension and a fully comprehension of the relation between the interaction of the first molecular layer and bulk order is still lacking. In this context, we study CuPc/HOPG electronic structure and morphology. From the spot profyle analysis of the low energy electron diffraction patterns (SPA-LEED) we obtain that the surface cell is close to a square and that the diameter of ordered 2d regions is 50 nm, which is the first measurement of the size of Pc films ordered domains using this technique. Electronic structure of the CuPc/HOPG interface was studied by means of photoelectron spectroscopy and electron energy loss spectroscopy (EELS). It is well known that different Pc phases have a different Q band (HOMO-LUMO transition) [3]. The Q band of CuPc/HOPG, measured via EELS, is different from the ones of the most common Pc phases. Therefore, CuPcs on HOPG form a long range ordered structure, which is observed only at this interface. From photoelectron spectroscopy we observe that HOPG does not modify Pc electronic structure then, we conclude that the molecules are weakly physisorbed and able to give rise to ordered 2d islands. The weak interaction with the substrate allows the second CuPc layer to grow stacked on the first one. Since Pc adsorbs flat on HOPG [4], the same tilt is maintained by stacked Pcs, forming columns composed of flat molecules. Considering that columns grow on top of ordered 2d islands [4], we conclude that HOPG is indirectly responsible of the formation of long range ordered 3d islands.

References (if needed)

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