Steering interfacial molecular self-assembly by substrate-molecule charge transfer

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Scanning probe microscopy has critically advanced our understanding of metal–molecule charge transfer [1]. Fullerene C_{60} is a prototypical electron acceptor. When adsorbed on surfaces, the self-assembly of C_{60} is dictated by an interplay between attractive Van der Waals forces and repulsive Coulomb interactions [2,3]. Here we report on the on-surface self-assembly of an intermixed phase composed of C_{60} and Zn(II)-5,10,15,20-tetrakis(4-aminophenyl)porphyrin (ZnTAPP) molecules (see Figure 1). Using a combination of Kelvin Probe Force Microscopy (KPFM) and Scanning Tunneling Microscopy and Spectroscopy (STM/STS), we investigated the extent of charge transfer to C_{60} molecules located in both island-like domains and row-like structures. Through detailed analysis of force and tunneling spectra, we reveal that the driving force behind the formation of the row-like structure is the alleviation of repulsive inter-fullerene Coulomb interactions, which in turn promotes a larger degree of charge transfer to the C_{60} molecules [4]. These results demonstrate that the balance between substrate-mediated electron transfer and inter-molecular Coulomb forces can be exploited to drive specific molecular self-assembly patterns on surfaces.

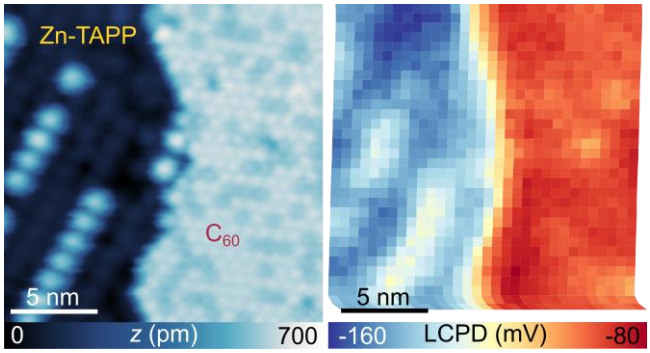

Figure 1. STM (left) and KPFM (right) images of C_{60} islands and the C_{60} row-like structures on Ag(111).

Reference

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