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Ordered supramolecular polythiophene structures on passivated silicon surfaces.

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The functionalization of semiconductor surfaces with organic molecules is a necessary step in the development of hybrid organic-semiconductor structures. A significant challenge to organic layer formation is the fact that semiconducting surfaces exhibit a large number of dangling bonds which suppress the diffusivity of adsorbed molecules and can even break the molecules apart via the formation of Si-C bonds. Recently it has been shown that these problems can be obviated by depositing the molecules onto a passivated surface [1].

We have studied the adsorption of brominated tetrathienoanthracene molecules (TBTTA) onto the Si(111)-√3×√3-Ag surface. Thiophene based molecules like TBTTA are of considerable interest in organic semiconductor research due to their efficient conjugation and the chemical stability [2]. The Si(111) √3×√3-Ag surface has no Si dangling bonds and should provide a high mobility surface suitable for TBTTA adsorption. Scanning Tunneling Microscopy images reveal that at low coverage the molecules readily migrate to step edges and defects in the √3 overlayer, in fact many images show direct evidence of molecular mobility. With increasing coverage the molecules eventually form compact supramolecular structures. In terms of the √3 lattice vectors (a and b), the oblique unit cell of the supramolecular structures is a_m = 3a + b, and b_m = a + 2b. These structures are quite fragile and can decompose under repeated STM imaging. Our results suggest that TBTTA is weakly bound to the √3 surface at room temperature and that the supramolecular structures are held together by weak van der Waals forces.

1. T. Suzuki et al., Phys. Chem. Chem. Phys. 11 , 6498–6504 (2009).
2. R. Gutzler et al., Nanoscale 6, 2660-2668 (2014).

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