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Adsorption of thiophene-based molecules at passivated silicon surfaces

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Molecular self-assembly of organic layers at surfaces is a powerful method to achieve the design and fabrication of nanostructures. The self-assembly of large-scale 2-d supramolecular networks at silicon surfaces is a particular challenge due to the large number of dangling bonds which suppress the diffusivity of adsorbed molecules and even break the molecules apart via the formation of Si-C bonds. An essential requirement for the fabrication of high quality organic layers on silicon is passivation of the dangling bonds.

We have studied the adsorption of brominated π conjugated tetrathienoanthracene molecules (TBTTA) onto the passivated Si(111)-B surface at room temperature. Thiophene based molecules like TBTTA are of considerable interest in organic semiconductor research due to their efficient conjugation and the chemical stability [1]. The Si(111)-B surface is prepared by annealing highly boron doped silicon wafers under ultrahigh vacuum for extended periods. Annealing leads to boron segregation at the surface. At a maximum boron surface atom concentration of 1/3 of a monolayer (ML) the sample exhibits a $\sqrt{3} \times \sqrt{3}R30°$ reconstruction. This surface has no Si dangling bonds and therefore should provide a high mobility surface for TBTTA adsorption. We will discuss our recent results on the boron surface and compare with our earlier work on the passivated Si(111) $\sqrt{3} \times \sqrt{3}$-Ag surface. On the silver surface TBTTA molecules are highly mobile and form large 2-d supramolecular domains with a unit cell dominated by relatively weak intermolecular interactions.

1. R. Gutzler et al., Nanoscale 6, 2660-2668 (2014).

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