High resolution nc-AFM and KPFM imaging of dipolar molecule assemblies on Si(111):B by stiff-probe non-contact AFM at low-temperature

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We studied by non-contact AFM (nc-AFM) the formation of molecular self-assemblies on the passivated surface of boron-doped Silicon B-Si(111)-($\sqrt{3}\times\sqrt{3}$)R30°. The investigated molecules (1-(4'cyanophenyl)-2,5-bis(decyloxy)-4-(4'-iodophenyl)benzene) possess aliphatic chains attached to a triphenyl core ended with two possible different terminations (either iodine or cyano group). The use of a passivated semiconductor substrate enables creating regular and extended structures without significant change in electronic properties of molecules [1]. Scanning tunneling microscopy and nc-AFM imaging have been performed using a low-temperature (AFM/STM (JT AFM/STM,SPECS) operated at T=4K with high stiffness Kolibri sensors (k=540 kN/m, f_0=1 MHz). The growth of a periodic molecular network is observed, formed by parallel lines made by molecule aromatic cores and interdigitated aliphatic chains placed between adjacent rows. We obtain submolecular resolution in the constant height Δf images without intentional tip functionalization, but only by conditioning the tip on the Si surface [2]. Kelvin Probe Force Microscopy (KPFM) images of single molecules and molecular assemblies with sub-elementary charge sensitivity [3] and submolecular resolution will be shown. They attest of the dipolar character of asymmetric molecules and are consistent with the formation of dipole-driven molecular arrays.

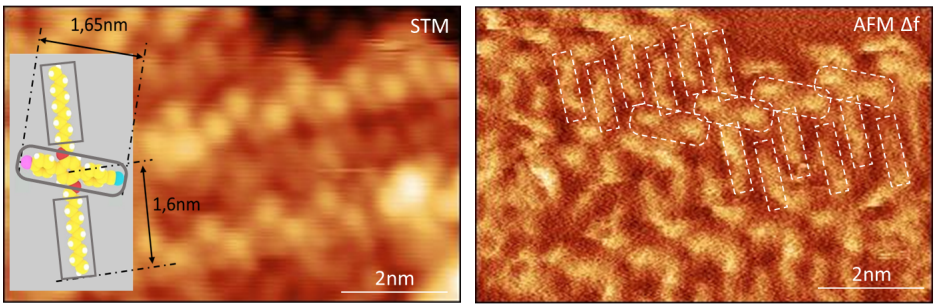

Figure : STM (left) and nc-AFM Δf image (right) of the investigated molecular array (see text), using an oscillating probe with total oscillation amplitude A_{pp}=100pm.

References

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