Ordered SAMS of Peptide Nucleic Acids on Surfaces with DNA Recognition Capability

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Self-organisation of molecules have inspired new trends in nanotechnology based on a bottom-up approach. Self-assembled monolayers (SAMs) of alkanethiols were widely studied due to their relevant technological properties. Based on such knowledge, thiolated DNA has been immobilised on surfaces, although it forms disordered formless globular structures with reduced bioactivity.

We report on the formation and structural characterization of ordered SAMs of peptide nucleic acid (PNA) on mono- and polycrystalline gold surfaces. PNA is an achiral and uncharged DNA mimic of high biochemical stability which allows different applications in biotechnology. We show that, in spite of their length of up to 7 nm, cysteine-modified single-stranded (ss) PNA oligomers assemble by themselves standing-up on gold surfaces similarly to the SAMs of short alkanethiols. They stabilize on the surface by chain-chain interaction trough non-complementary H-bonding. BioSAMs of ssPNAs maintain their capability for recognizing ssDNA, and discriminate even a point mutation in target ssDNA. These structural and functional results have been obtained using label-free techniques for surface characterization such as synchrotron radiation based X-ray photoemission spectroscopy, X-ray absorption near-edge spectroscopy, atomic force microscopy and infra red spectroscopy.

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