Auto-Orientation and Manipulation of G-wire DNA Networks

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Scanning probe microscopy was used to examine quadruplex DNA networks, a.k.a. "G-wires", after adsorption onto mica. The angles the G-wires made with the fast scan direction were measured. The angle-frequency information was compared with the underlying lattice structure of the mica substrate. The G-wires appear to have a preferential orientation at 60° intervals after thorough rinsing and slow drying upon the surface of freshly cleaved mica. Evidence from AFM imaging suggests the G-wires adsorb onto the mica surface in single strands or in pairs as adjacent strands collapse upon drying. This orientation could be quantitatively characterized by a correlation coefficient. A model is proposed to explain this auto-orientation affect due to alignment of the G-wires' phosphate backbone and the underlying mica lattice. Pairs of adjacent, parallel phosphate groups of the G-wires (0.95 nm apart) appear to align with the next nearest neighbor potassium vacancy sites of mica (0.90 nm apart). We confirmed that this behavior is independent of mica type as it works on both muscovite and biotite. A different G-wire DNA orientation behavior is observed in solution suggesting subtle differences between "dried" and solution forms of G-wire DNA. The potential for using the auto-orientation phenomena in the development of high-density biomolecular nano-electronic devices is explored.