Self-Assembly of new G-Rich Oligonucleotides Incorporating a 3'–3' Inversion of Polarity Site

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The development of new DNA-based biomaterials is very important in the field of nanotechnology and represents one of the most interesting challenges in the scientific world. Previous studies have shown that DNA can adopt specific structures that act as building blocks for the assembly of supramolecular structures [1]. Among the DNA secondary structures there is the G-Quadruplex, which is formed by selected guanosine-rich sequences and is characterized by the presence of structural units called G-quartets consisting in planar arrangements of four guanines held together by eight Hoogsteen type hydrogen bonds. In the G-quadruplexes, two or more G-quartets are stacked one on top of the other by π-π hydrophobic interactions and the resulting structure is stabilized by monovalent cations located in the central cavity of the G-quadruplex axis. The combination of π-π stacking interactions and coordination with cations render G-quadruplexes by far more stable than DNA duplexes of the same length [2]. In this study, we report an innovative strategy to obtain a new type of DNA G-wire nanomaterial, called Q_n, starting from the short unmodified G-rich oligonucleotide d(5'-CGGT-3'–3'-GGC-5') (1), exhibiting a 3'–3' inversion of polarity site. The inversion of the polarity site was achieved by performing the first four coupling cycles with 5'-phosphoramidites and the remaining three with standard 3'-phosphoramidites. The "n" subscript in Q_n indicates the number of tetramolecular G-quadruplex building blocks involved in the G-wires elongation. The described building block can multimerize in a stacked G-Wire polymer through 5'–5' π-π stacking interactions [3][4]. The effect of the presence of polar or lipophilic groups at the edges of the G-rich ODNs on the topology and stability of resulting G-quadruplexes is also under study in our laboratories.

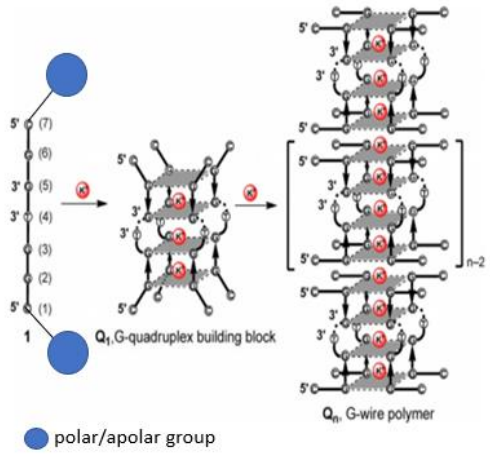

Figure 1. Formation of the G-quadruplex building block Q_1 and its multimerization into Q_n G-wire polymers starting from the ODN 1. Polar/apolar groups are shown as blue spheres.

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