Synthesis and Characterization of Symmetrical Perylene Diimide with Polyamine; its Potential Interactions with G-quadruplex DNA

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Perylene tetracarboxylic diimides (PDIs) have been attracting considerable attention as lightfast colorants, highly efficient fluorophores, the best n-type organic semiconductors and versatile building blocks in self-assembly [1]. Furthermore, this class of compounds has been widely studied for biochemical and pharmacological purposes because perylene diimides can be considered as potential antitumor drugs acting as telomerase inhibitors [2]. The parent PDI has a rigid planar π system. Due to strong π stacking interaction, PDI does not dissolve in any organic solvents. Therefore, solubilizing substituents are often required to improve the possibility of PDIs. The imide nitrogen atoms are the preferred sites to attach solubilizing groups when retaining the planarity of PDI core is important [1].

Immortality and the related high proliferation of cancer cells is often due to telomerase activation. Telomerase is a specific transcriptase with endogenous RNA template; it has a fundamental role in the maintenance of the eukaryotic chromosomes' terminal ends, the telomeres, which are characterized by a repeated G-rich DNA, specific proteins and a single-stranded terminal region, which shortens when a cellular replication occurs ('end replication problem'). The majority of cancer cells (>85) show telomerase activity, where the enzyme lengthens the single-stranded region of the telomere through the addition of discrete repeats of bases giving rise to the cellular immortalization. One of the strategies to inhibit the enzyme is the modification of its substrate; since telomeric DNA contains a single-stranded G-rich 3'-overhang, it is possible to induce the formation of G-quadruplex structures, in order to keep telomerase from lengthening chromosome ends [3].

Ideal G-quadruplex ligand should bind selectively to their target with little interaction with duplex DNA. Perylene core seems to have a binding preference for the G-quadruplex structure. Variations in the side chains of perylene derivatives might enable them to induce and/or stabilize certain G-quadruplex structures. Whether to inhibit to telomerase or other potential targets, the ability to bind selectively will be critical for any successful anticancer agents [4].

In the present study, α-amino acid containing novel perylene dye, N,N'-bis(2-aminohexanoic acid)-3,4,9,10 perylenedibis(dicarboximide), (LPDI) has been synthesized. The compound was characterized by NMR, MS, IR, UV-vis, DSC and TGA measurements. The fluorescence lifetimes, quantum yields and singlet state energies are presented. The band gap energy, LUMO and HOMO energy values were calculated.

References: