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Fluorescence enhancement strategy for evaluation of the minor groove binder DAPI to complementary ssDNA sequence including telomere mimics in (ssDNA@DAPI/LDH)n ultrathin films

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Nucleic acids, the hereditary material of living beings, perform a vital role in major life activities including growth, heredity, and variation. The genetic information is coded in specific nitrogenous bases, which are the key players in genetic transformation and identification of hereditary diseases. Telomeres are specialized DNA structures present at the end of eukaryotic chromosomes, consisting of repetitive non-transcribed sequences (TTAGGG) and some binding proteins. They protect the chromosomal ends from sticking to each other, and play a key role in the maintenance of genomic integrity. Currently, a number of methods are reported for nucleic acids and telomeres detection but they are not easy going. Therefore, development of sensitive and fast DNA biosensors to measure the nucleic acids and telomeres sequences is of great importance. This paper describes a systematic study on the preparation of simple ultrathin films (UTFs) composite of fluorescent dye 4',6-diamidino- 2-phenylindole (DAPI), having binding properties in the minor groove of AT-rich DNA segments, blending with single-stranded DNA (ssDNA) and incorporation into layered double hydroxides (LDH) nanosheets using layer-by-layer self-assembly method. The resulting UTFs exhibits excellent sensitivity, selectivity and reversibility for long complementary ssDNA sequence on the basis of DNA hybridization and fluorescence enhancement strategy. The dynamic range was 3–20 µg/mL with a detection limit of 20 µg/mL. This new (ssDNA @DAPI/ LDHs)n UTFs, could be an efficient hybrid composite with potential applications in the field of bioluminescent sensoring materials.

Keywords: ssDNA, Telomere, DAPI, DNA-biosensor, Layered double hydroxide, Layer by layer co-assembly, Hybridization, Fluorescence enhancement.

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