Inorganic-Organic Hybrid Luminescent Binary Probe for DNA Detection Based on Spin-Forbidden Resonance Energy Transfer

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Abstract:

We describe the design of new fluorescent binary probe sensors for DNA detection based on spin-forbidden resonance energy transfer (SF-RET). Binary probes consist of a donor and acceptor fluorophores that are attached to two different oligonucleotides and serve as a resonance energy transfer (RET) donor-acceptor pair when hybridized to adjacent sites of a target sequence. In the absence of target, excitation of the donor results in fluorescence only from the donor, but when the probes hybridize to the target, the fluorophores are brought into close proximity favoring RET, yielding fluorescence mainly from the acceptor fluorophore. These new binary probes use the metal complex $Ru(bpy')(DIP)_2^{2+}$ as the energy donor and an organic fluorophore (Cy5) as the energy acceptor. Energy transfer from the MLCT state of the Ru complex to singlet Cy5 is spin forbidden and produces a delayed fluorescence of Cy5. This paper demonstrates that fluorescence delay of Cy5 can be used to time resolve the emission of the probe from the intense fluorescence background of a model system for cellular background; this provides the reported system to overcome intense autofluorescence, an important and general advantage over "classical" spin-allowed steady-state probes.