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A water-soluble 1,8-naphthyridine-based imidazolium molecular gripper for fluorescence sensing and discriminating of GMP

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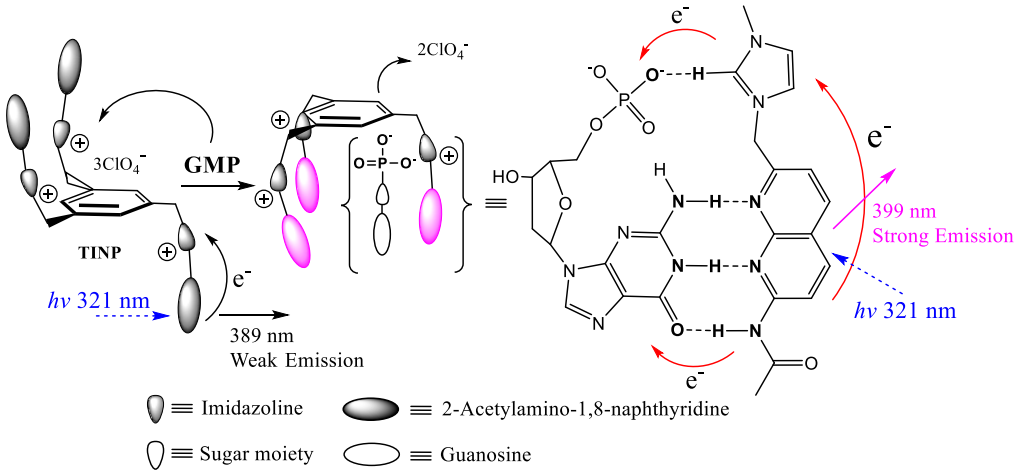
Abstract:

A selective chemosensor for sensing and discriminating of GMP is useful not only in the energy metabolism but also in the processes of DNA replication and transcription-related to GMP; such a sensor is presently rare especially in a pure water environment. Herein, a novel 1,8-naphthyridine-based tripodal imidazolium gripper-like receptor served as a "turn-on" fluorescent chemosensor (TINP) was designed and synthesized for selective sensing and discriminating GMP from structurally similar GNPs (N = D and T) and XMPs (X = U, T, A, and C) in 100% aqueous solution. TINP consists of 1,8-naphthyridines and imidazolium cations. 2-acetylamino-1,8-naphthyridine was chosen as fluorophore and tri-hydrogen bonds interactions sites for the nucleobase guanine. Imidazolium cations were identified as the phosphate part receiving moieties and communicators, while the three imidazolium cations also served as indispensable water-soluble parts. GMP caused a remarkable fluorescence enhancement (ca. 6.5-fold) with a quantum yield (Φ_f) of 0.26 at 399 nm, displaying an efficient "turn on" behavior. The sensing mechanisms and fluorescence response were explained by Job's plot, NMR spectroscopic analysis, and theoretical calculations. Finally, the preliminary results of cell experiments show that the receptor can be applied for the imaging of GMP in living mammalian cells.



References and Notes:

(1) Zhou Y, Xu Z, Yoon J. Fluorescent and colorimetric chemosensors for detection of nucleotides, FAD and NADH: highlighted research during 2004-2010. Chem Soc Rev 2011;40:2222-2235.

Bio-Sketch of the Speaker

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My research, in the general areas of synthetic and Host-Guest chemistry, is directed toward developing new paradigms of Organic-Host molecules and creating enormous variety of discrete, isolable structural Metal-N-heterocyclic carbene (NHC) cavities. We are particularly interested in the Host-Guest chemistry of homogeneous catalysis and molecular recognition. Their unique structural features, interesting properties, and potentially significant applications constitute the multifold impetus for my efforts.

CURRENT RESEARCH INTERESTS:
(1) Ultralarge Porous Organic Cages (POCs).
(2) NHC-metal cages or capsules.
(3) NHC macrocycles.
(4) Chemosensors.
(5) Theoretical calculations and molecular simulation.