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Lin Hai-Bin, Chen Feng, Guo Hong-Xu

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Digital logic circuit based on two component molecular systems of BSA and salen

LIN Hai-Bin*, CHEN Feng, Guo Hong-Xu

(College of Chemistry and Environment, Fujian Province University Key Laboratory of Analytical Science, Minnan Normal University, Zhangzhou, 363000, China)

Abstract: A new fluorescent molecular probe 1 was designed and constructed by combining bovine serum albumin (BSA) and *N*,*N*′-bis(salicylidene)ethylenediamine (salen). Stimulated by Zn^{2+}, tris, or $EDTAH_2Na_2$, the distance between BSA and salen was regulated, which was accompanied by an obvious change in the fluorescence intensity at 350 or 445 nm based on Förster resonance energy transfer. Moreover, based on the encoding binary digits in these inputs and outputs applying positive logic conventions, a monomolecular circuit integrating one OR, three NOT, and three YES gates, was successfully achieved.

Keywords: logic circuit, BSA, FRET, component molecular systems, fluorescence

Development of molecular systems mimicking the operation of electronic logic gates and circuits has attracted significant attention in recent years because of their possible implications in the fabrication of molecular-scale electronic and photonic devices. Since the first influential exploration by de Silva[1] demonstrating that fluorescent probes can serve as molecular logic gates, the development of such molecular systems capable of performing binary arithmetic and logical operations has attracted continuous attention of academic researchers in the fields of chemistry and biology. In the past two decades, extensive research efforts have been devoted to excellent studies related to this field, such as digital logic circuit[2,3], half-adder and half-subtractor[4,5], full-adder and full-subtractor[6,7], molecular keypad lock [8,9], crossword puzzles, and logic memory[10]. These molecular devices mainly involve the construction of molecules with multiple fluorescent output logic functions that can be modulated by multi-input combinations.

In these excellent molecular devices reported in literature, most of the logic systems rely on deoxyribonucleic acid (DNA)[11-14] or organic molecules[15-19], and only a few logic systems have been designed and constructed using protein[20-22] or