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Medical Applications of Zinc(II) Complexes as Fluorescent Probes

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ABSTRACT

We are studying on researches of various composite systems of chiral Schiff base metal complexes and proteins. Recently we synthesized several zinc(II) complexes to measure fluorescence spectra or quenching its intensity due to intermolecular interaction (just like many examples of zinc(II) fluorescent probes) and probing concentration of metal ions in solutions. The major merits of chiral complexes are (1) Potential possibility of stereochemically specific interaction against chiral protein molecules. (2) Additional information from chiroptical (CD) spectroscopy and resulting quantum chemical data. In this short commentary, we introduce our research concept, especially usefulness of the zinc(II) complexes as fluorescent probes for medical study.

Chiral metal complexes are expected good molecular recognition for docking proteins and, in addition, advantage of CD measurement as well as UV-vis or fluorescence spectra to investigate excitation electronic states conventionally. Especially, even for application to medical researches, in order for elucidating how docking these metal complexes to protein molecules, effective consideration about electronic and structural features may be expected to be important factors with the aid of a variety of docking simulation software [1,2].

Recent investigations have demonstrated that zinc behave as the second messenger in signal transduction, zinc have a wide range of different roles in immunity [3-6]. Zinc is an inhibited phosphatase PTEN, enhances the phosphorylation of AKT by interleukin 2 (IL2). Therefore, went and put a stimulus to the cells in a state in which a certain amount fluorescence by the addition of zinc(II) complex was out fluorescence disappears, or when taken out of the cell after adding stimulate the zinc(II) complex in the solution and the cells become so shiny, external field stimulation sex fluorescent probe has been sought as a medical research tool. This is either zinc(II) complex that has been made is to work in the same way as zinc, range of applications will change depending on whether there is an inhibitory effect as of pyrithione [7].

Indeed, there are many reports on use of metal complexes involving various metal ions for medical purposes. The first example of an interesting type is a synthesis report of new iridium complex to fulfill two functions of the visible light-induced light reaction trigger in apoptosis of molecular recognition and the cancer cells of a protein kinase that has anti-angiogenic properties [8]. This Ir complex has the anti-light-dependent anti-angiogenic function based on potent inhibition of protein kinase. This complex having such two complementary anti-cancer activities in a single compound, may be possible to used as a drug with a novel anti-tumor properties. The second example is a report of examining the anti-cancer properties of inert half sandwich metal complexes [9]. The third example is a report on therapeutic effect against prostate cell line PC-3 of Zn(II) (tumor) and PNT1A (non-tumor) [10]. Fluorescence using microscopy or electrochemical technique were employed to evaluate the state of the Zn(II) ion after ion exposure in cells. Zn(II) ion detection and importance of *in vivo* substance were mentioned.

By the way, we have proposed some hybrid systems composed of chiral Zn(II) complexes for sensing metal ions in solutions. Three (hybrid) systems were constructed for quantitative fluorescence sensing of metal ions by using chiral Schiff base Zn(II) complexes [11]. The organic-inorganic composite material made from chiral Schiff base Zn(II) complex and spiropyran (Sp), this is the molecular logic circuit using change in fluorescence intensity of the complex due to the photoisomerization of the ring opening type merocyanine closed ring type Sp (namely Mc) It has been fabricated. This hybrid system composed of a trans-type chiral

Schiff base Zn(II) complex and Mc, which is open-form Sp after photoisomerization. Depending on intermolecular interactions and quenching, increase (Zn(II)) or decrease (Cu(II) and Gd(III) of fluorescence intensity of Zn(II) complex could be observed as functions of concentration of metal ions.

Moreover, we suppose that dual use as a probe for fluorescence and chroptical (CD) spectra of chiral Schiff base Zn(II) complexes may be useful strategy for study on docking of the complexes to protein molecules or other medical application. In the composite systems of complex and lysozyme, a typical and basic protein easy to treat, we subjected to UV-vis, fluorescence and CD spectroscopy. Stepwise increasing of the concentration of lysozyme resulted in increase of fluorescence intensity and shift absorption band. In the presence of molecular interactions between the complex and lysozyme, energy transfer from the complex of excited state has been suggested generally [12].

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