Design of Home or Hetero Polynuclear Metal Dendritic Molecule for PDD or PDT

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ABSTRACT

The syntheses and properties of polynuclear metal complexes have been reported to develop the easy syntheses and noble photo-characteristics of those complexes for photodynamic diagnosis (PDD) or photodynamic therapy (PDT). We have been focused on the design and synthesis of polynuclear lanthanide dendritic molecule due to long life time of fluorescence. Therefore, we will be presented on the design of home (Eu or Gd) or hetero (Tb or Lu) polynuclear lanthanide dendritic molecule.

Keywords

polynuclear metal complex, lanthanide dendritic molecule, photodynamic diagonosis or therapy

I. Introduction

The photobiological active molecular model for photodynamic therapy has been attracted as a research for the development of cancer treatment, and more functionalized molecular models have been developed for the research of smart and stable photobiological active molecule systematically [1]. In addition, these systematical researches have been competed on the clinical and molecular level all over the world. Until now, every developed photosensitizer for photodynamic diagonosis(PDD) or photodynamic therapy (PDT) showed photosensitivity and side effect of the skin part for human, and the development of photosensitizer having more smart and less photosensitivity for human has been demanded. Furthermore, the research of the stable photosensitizing molecule showing the longer wavelength and longer life time has been also tried for the development of PDD or PDT. I have been researched the model molecule for PDD or PDT having metal complexes and prepared several types of those complexes having Ru(II) complexes [2]. Herein, I will introduce the design of new dendritic molecule composed of homo or hetero lanthanide complex unit for PDD or PDT.

II. Design of porphyrin having core metal

As shown in Fig. 1, Porphyrin-tetrabenzoic acid having lanthanide core metal(Eu or Gd) has been designed for the preparation of new metal dendritic molecule because of the longer fluorescence and life time of lanthanide ionic molecule. In particular, this porphrin molecule can be prepared easily by the synthetic process of amide connection.

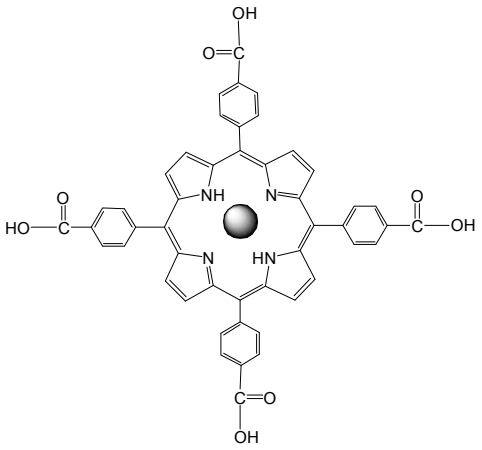

Fig. 1. Porphyrin-tetrabenzoic acid having lanthanide core metal (Eu or Gd) complex

In addition, the lanthanide ion such as europium or gadorium has been used as the application of PDD or PDT. Therefore, this core lanthanide porphyrin plays an important role in the preparation of home or hetero metal dendritic molecule.

III. Lanthanide porphyrin with terminal phenanthroline by amide bond

As shown in Fig. 2, the first target molecule is suggested as lanthanide porphyrin molecule with terminal phenanthroline by amide bond. As reported previously[2], various amide connection molecules have been prepared by easy synthesis and high yield. So, the preparation by amide connection is applicated to the first target molecule, and 5-aminophenanthroline molecule is used for the home or hetero dendritic molecule. Particularly, this first target molecule is also applicated to the second target molecule having the larger and well-organized multilayer dendritic molecule. In addition, this dendritic molecule will be interested in the research of energy conversion such as energy or electron transfer.

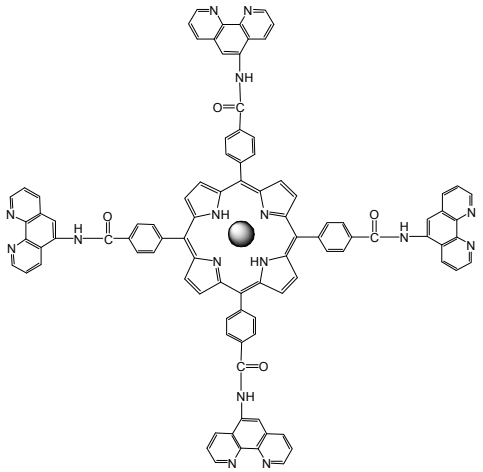

Fig. 2. Lanthanide (Eu or Gd) porphyrin with terminal phenanthroline by amide bond

IV. Home or hetero lanthanide porphyrin with second layer as dendritic molecule

As shown in Fig. 3, home(Eu or Gd) or hetero lanthanide(Tb or Lu) terminal phenanthroline complexes are introduced to core lanthanide(Eu or Gd) porphyrin. These dendritic molecules having second layer as lanthanide complex will be easily prepared and appeared new photophysical property such as the fluorescence behavior and long life time phenomenon. In addition, as the synthetic strategy for the preparation of dendritic molecule, the terminal phenanthroline unit will be utilized for the preparation of more macro-dendritic molecule as the multilayer.

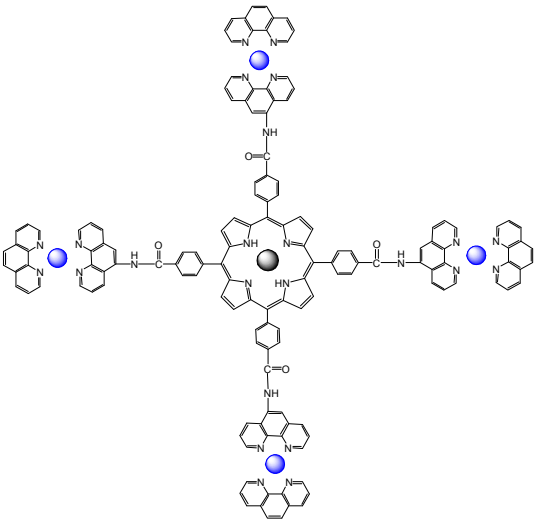

Fig. 3. The core lanthanide (Eu or Gd) porphyrin with hetero lanthanide (Tb or Lu) terminal phenanthroline complex as second layer

Herein, various home or hetero lanthanide dendritic molecules can be prepared for the development of the molecular design in the research of PDD or PDT as well as the spectroscopic research of new dendritic molecule such as energy harvesting system.

V. Conclusion

The core lanthanide (Eu or Gd) porphyrin can be well utilized for the preparation of the homo(Eu or Gd) or hetero (Tb or Lu) lanthanide dendritic molecule. In particular, the core porphyrin derivative has the four benzoic acidic group as functional group, which is connected to molecule having amino group by amide bond. In addition, the terminal phenanthroline unit can be applicated to the preparation of macro-dendritic molecule as well as the research of new photophysical behavior.

References

[1] (a) M. Saleem, A. Ali, C.-S. Choi, B. J. Park, E. H. Choi and K. H. Lee, “The smart 2-(2-fluorobenzoyl)-N-(2-methoxyphenyl)hydrazine carbothioamide functionalized as Ni(II) sensor in micromolar concentration level and its application in live cell imaging,” *Journal of Fluorescence,* Vol. 24, pp 995-1001, 2014. (b)

J.-J. Chen, L.-J. Gao and T.-J. Liu, "Photodynamic therapy with a novel porphyrin-based photosensitizer against human gastric cancer," *Oncology Letters*, Vol. 11. No. 1, pp 775-781, 2016.

[2] (a) C.-S. Choi, "Photophysical and redox properties of dinuclear Ru(II) complexes prepared from the photosensitizing unit"$[Ru(bpy)_2(dppz\text{-}NH_2)]^{2+}$complex (dppz-$NH_2$: 7-amino-dipyrido [3,2-*a*:2',3'-*c*]phenazine)," *Bulletin of the Korean Chemical Society*, Vol. 35, No. 2, pp 663-665, 2014. (b) C.-S. Choi, L. Mishra, T. Mutai, and K. Araki, "$[Ru(bpy)_2(dppz\text{-}NH_2)]^{2+}$complex (dppz-$NH_2$:7-amino-dipyrido [3,2-*a*:2',3'-*c*] phenazine) as a useful photosensitizing unit for the construction of photoinduced energy transfer systems," *Bulletin of the Chemical Society of Japan*, Vol. 73, No. 9, pp 2051-2058, 2000. (c) C.-S. Choi, "The recent current of fluorescent polypyridine compounds having photo-functionality," *Rapid Communication in Photoscience*, Vo. 5, No. 2, pp 21-26, 2016.