PHOTOACTIVATABLE MOLECULAR SYSTEMS

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ABSTRACT

The present invention protects a photoactivatable molecular system that functions as a coupled molecular pair (biphotonic antenna-effector chromophore) which allows to control with great time and space precision, the release of molecules due to the nonlinear excitation of the biphotonic antenna.

BACKGROUND

Almost every area of research focuses on monophotonic processes, (single photon absorption with the exact energy for the desired effect to be observed).

However, multiphotonic technology offer four main advantages:

- Single-Point Sample Excitation
- Possibility to excite fluorophores
- Protons with high penetration capability
- Lower sample's damage in vivo microscopy

Photons have high penetration capabilities. This property allows the study of thick samples such as whole, alive embryos. While, in conventional microscopic analysis samples must be sliced. Lower damage to samples while conducting in vivo microscopy studies (damage due to phototoxicity is reduces). This characteristic is especially important when dealing with embryos that need to be replanted.

DESCRIPTION

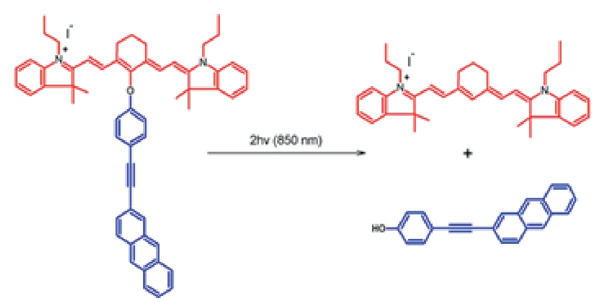
This invention involves the design and synthesis of new molecular systems that exhibit biphotonic absorption effects, with the following structural formula:

This molecular system is composed by two main moieties:
(I) a biphotonic molecular antenna and (II) a chromophore which will be released upon stimulation of the molecular system.

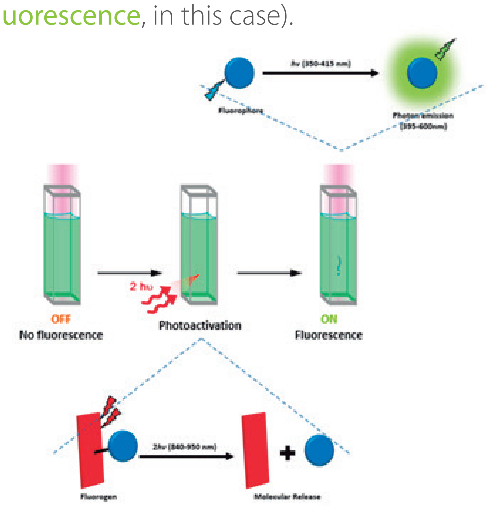
ether linkage

Cy-O-Ar

biphotonic molecular antenna   chromophore



The released molecule will be responsible of generating a physical, chemical, or biological response (fluorescence, in this case).



Stage of Research

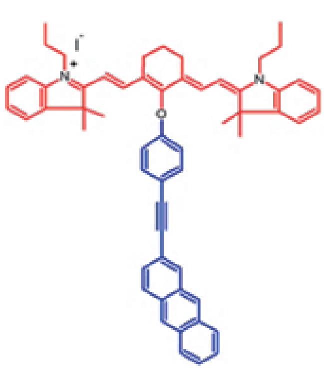
The research group has carried out the design, synthesis and characterization (through NMR spectrum) of the photoactivatable molecular system, as well as the verification of the spatial and temporal control of the chemical effector molecule's release (fluorophore's release). This process has been monitored through fluorescence spectra and high resolution mass spectrometry.

Applications Fields

Molecules that may be fluorescently modulated between the IR and visible electromagnetic radiation intervals are hugely studied and commercially demanded due to their usefulness in important and current areas such as super-resolution fluorescence microscopy:

They are also useful in areas such as:

- Photovoltaic Cells
- Photonic molecular machines
- Optoelectronics
- Photonics
- Photo pharmacology
- Selective, localized, and controlled release of molecules
- Optical information storage
- Photosynthetic artificial systems
- Biomarkers



Advantages

This invention has the following advantages:

- Separately improvement: The maintenance of the two moieties' properties allows the separately optimization.
  a) Improve the efficiency of the **biphotonic molecular antenna**
  b) Change the **released molecule** (the effector) to achieve a different effect.

- Ether linkage: the ether linkage bounds the two chromophores together, but doesn't maintain in conjugation their π electrons. This allows the individual moieties to keep their electronic and structural characteristics, even when linked.

The use of biphotonic absorption has also several advantages:

- Lower energy radiation: The inclusion of a **biphotonic molecular antenna** provides clear advantages in comparison to other molecular systems that are directly excited by monophotonic processes which use a greater amount of energy. Some of the gained advantages is the possibility to use Infrared radiation to activate the molecule, and the activation of small molecular system (Femtoliter sized systems =10^{-15} L).

- Less photodecomposition: The use of these wavelengths of irradiation has the advantage of avoiding the photodecomposition of the biphotonic antenna, the molecular system or the studied system with respect to the UV wavelengths.

- Higher selectivity in the excitation of the biphotonic antenna: Since the biphotonic absorption processes use lower energy radiation and the concerted spatial and temporal interaction of two photons is indispensable, there is a much greater control than in the monophotonic processes.

- Activation of the system only with the appropriate wavelength: Activation of the molecular system can produce a fluorescent species without the use of external reagents and by simultaneous absorption processes of two photons.

- Higher sample penetration

- Solubility: The molecule used as a biphotonic antenna is a cyanine, which is soluble in a wide range of organic solvents and even more in aqueous media, which provides an added value, since it can be solubilized in *biological media*.