Fluorescence/principle

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SOME REPETITION

Introduction

Fluorescence describes a phenomenon where light is emitted by an atom or molecule that has absorbed light or electromagnetic radiation from another source. In absorption, high energy light excites the system, promoting electrons within the molecule to transition from the ground state, to an excited state. Here, the electrons quickly relax to the lowest available energy state. Once this state is achieved and after a fluorescence lifetime, the electrons will relax back to ground state, releasing their stored energy as an emitted photon. Usually, the emitted light has lower energy than the absorbed radiation. Devices called fluorometers are used to measure fluorescence. Methods regarding this subject are mostly used in the biochemical and biophysical field.

Discussion

Fluorescence plays an important role in clinical medicine, especially as a diagnostic and research tool. The useful properties of fluorescence are applied in techniques such as fluorescence microscopy and fluorescence spectrometry. Here fluorescence has many aims, such as to detect viruses and to identify hormones. Another area where it is used, is in immunochemistry, to identify the distribution of a specific protein within a tissue, for example, a fluorochrome can be used to mark the protein via an antibody. FRET and FLIM are also two techniques related to fluorescence.

Furthermore, fluorescence also used in surgery as a medical imaging technique that is used to detect structures during surgery.

How does it work?

Fluorescence requires a fluorophore (molecule with a rigid conjugated structure) In absorption, high energy light excites the system, promoting the electron within the molecule to transition from the ground state, to the excited state. Here, the electrons quickly relax to the lowest available energy state. Once this state is achieved and after the fluorescence lifetime, the electrons will relax back to ground state, releasing their stored energy into an emitted photon. Usually, the emitted light has lower energy than the absorbed radiation. The entire fluorescence process is cyclical. Unless the fluorophore is irreversibly destroyed in the excited state, the same fluorophore can be repeatedly excited and detected. So, a single fluorophore can create thousands of photons, due to the high sensitivity of detection techniques.

Advantages and disadvantages

As we can see, there are many advantages of using fluorescence in medicine. The techniques associated with it, are very simple and specific. It is fairly sensitive and thus can detect low quantitates of a compound. Unfortunately, not all substances are able to emit light, and therefore techniques using fluorescence cannot always be applied.

Conclusion

In the future fluorescence is going to play a key role in oncology. Through flourescending-protein-markers that attach only to cancer cells, it will be possible to differentiate precisely between healthy and mutated cells. Thus, these cancer cells can be specifically targeted and attacked, whilst, the healthy cells remain unharmed. This will result in a very effective new form of chemotherapy for the benefit of the patients.

References

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