Phosphorescence

Unlike florescence, phosphorescence does not re-emit the light immediately. Instead, phosphorescence releases light very slowly in the dark due to its energy transition state. When light such as ultraviolet light is shined upon a glow in dark object, the object emits light, creating phosphorescence.

Introduction

There is a similarity between the phosphorescent and the fluorescent materials. They both contain substances with identical atoms. It is very important to understand the impurity state energy band, which is located between the conduction and valence energy bands. In a phosphorescence event, the absorbed energy usually goes through a high energy state which happens to be triplet state. The energy gets trapped in the triplet state because its physical situation forbids the transition to return to lower energy state, also as known from impurity to valence band. In order to change the energy of valence band, electrons must regain the energy they had lost during the impurity band transitional process. If the quantum yield of the phosphorescence is high enough, a great amount of light will be released and thus making the object glow in the dark.

Most compounds have the ground state of singlet $S_0$. When it absorbs light, the electrons in the molecule may move to excited state of $S_1$, $S_2$, $S_n$ and so on. There are also triplet states $T_1$ and $T_2$. The energy of the $T_1$ state is typically below the $S_1$ state, while $T_2$ is between $S_2$ and $S_1$ state. The wavelength of the radiation can determine which state the electron will move to. It is possible for the electron to return from excited state back to the ground state. An example is phosphorescence, where the emitting of radiation demotes the electrons from the excited state of $T_1$ to ground state $S_0$. The molecule of phosphorescence has long life time, it loses energy easily, so it is hard to observe phosphorescence.

Applications

Materials that can produce phosphorescence often contain zinc sulfide, sodium fluorescein, rhodamine, or strontium. The majority of phosphorescence is often used in drugs in pharmaceutical field. Some common drugs that have phosphorescence property include Aspirin, benzoic acid, morphine, and dopamine. Phosphorescence is also used to analyze water, air and chemical pollutions.
Reference

Outside Links
- J. of Chemical Education: Measuring phosphorescence lifetimes
- J. of Chemical Education: Phosphorescence and Delayed Fluorescence

Contributors
- Chern-Yi Tsai (UCD)