Luminescence Phenomena and Their Applications in Phosphor Materials

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Abstract

Luminescence, a process where materials emit light without significant heat, plays a vital role in various scientific fields. This paper explores different types of luminescence, including photoluminescence, thermoluminescence, and mechanoluminescence, and their applications in areas such as radiation dosimetry, geochronology, and electroluminescent devices. Advances in phosphor materials have enabled significant innovations in technology and research, from healthcare to display technologies.

Keywords:

Luminescence, Phosphor, Photoluminescence, Thermoluminescence, Dosimetry, Electroluminescence

Introduction

Luminescence is the emission of light by a material when it absorbs energy. Unlike incandescence, this process occurs at low temperatures. It can be triggered by different forms of energy, such as ultraviolet light or electrical energy. Phosphors, materials that exhibit luminescence, are pivotal in a wide range of applications, from glow-in-the-dark items to medical dosimetry. The phenomenon was first described by Wiedemann in 1888 as "cold light" produced by non-thermal processes. The study of luminescent materials has seen substantial advancements, contributing to fields like healthcare, radiation safety, and electronics.

Experimental

To explore the properties of luminescence, various phosphor materials were tested under different energy excitations, including UV light, heat, and mechanical stress. Photoluminescence (PL) was analyzed by exposing samples to UV radiation, observing the wavelength of emitted light. For thermoluminescence (TL), samples were heated post-radiation exposure, and the emitted light was measured. Mechanoluminescence (ML) was observed by applying mechanical stress on phosphor crystals.

Results and Discussion

1. ***Photoluminescence***: Phosphors exhibited strong emission when exposed to UV light, confirming their potential use in LEDs and display technologies.
2. ***Thermoluminescence***: TL proved effective in dosimetry for measuring radiation doses in medical and industrial applications.
3. ***Mechanoluminescence***: Materials showed potential in pressure sensors and mechanical impact detectors.

Conclusion

Luminescent materials, particularly phosphors, offer wide-ranging applications from radiation dosimetry to advanced display systems. Ongoing research is focused on improving the efficiency and durability of these materials to expand their use in cutting-edge technologies. Further exploration of mechanoluminescence could unlock new possibilities in sensor technology.

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References

1. Mesaros, A. Luminescent Materials*:* Synthesis*,* Characterization and Application, MDPI, 2023.
2. Virk, H.S. & Murthy, K.V.R., Luminescence Phenomena and Their Applications, Trans Tech Publications, 2014.