Method of Preparing Mechanoluminescent Material And Composite Material Containing It

Health & Wellness

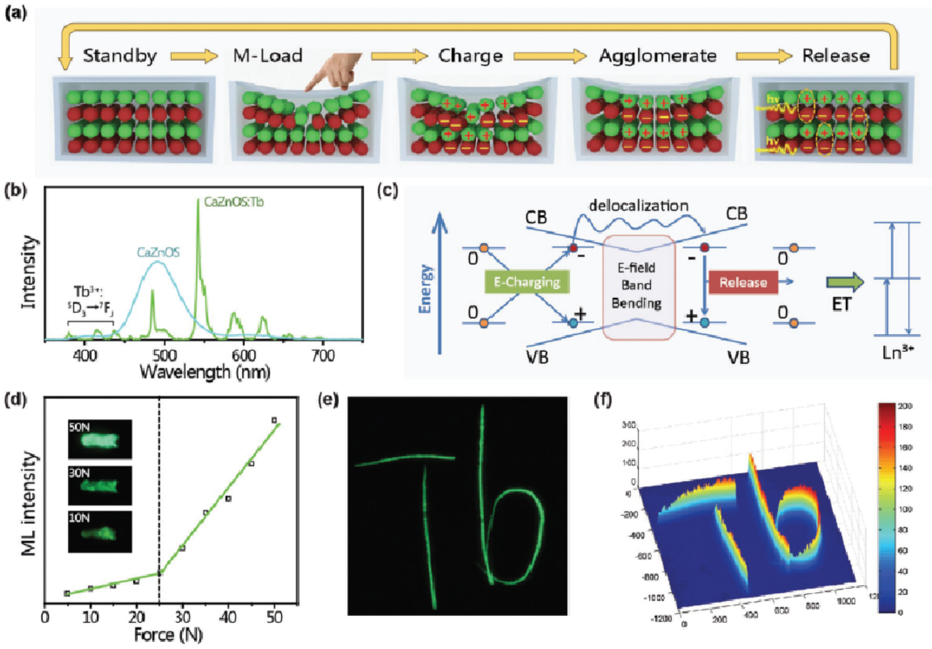
Manufacturing

Biomedical and Genetic Engineering

Nanotechnology and New Materials

Sensors

Testing Instruments



IP Status

Patent filed

Technology Readiness Level (TRL) 2

Inventor(s)

Prof. Feng Wang
Mr. DU Yangyang
Dr. SUN Tianying
Mr. ZHAO Jianxiong
Enquiry: kto@cityu.edu.hk

Opportunity

Mechanoluminescent materials which emit visible light under mechanical stimuli are important for the technological application. These materials are composed of organic complexes or inorganic crystals and they are potentially useful for constructing optoelectrical devices without requiring optical or electrical sources of energy for their operation. For example, mechanoluminescent materials may be used in modern technology such as wind-driven display, optical sensor, and artificial skin. However, it has been challenging to develop a mechanoluminescence (ML) system with multi ML emission colors which is vital for practical application of these systems, particularly in the development of mechanoluminescent materials displaying high and equal brightness across the whole spectral range.

Thus far, materials that are capable of producing sufficiently bright and self-recoverable ML for the aforementioned applications are rarely reported. In general, efficient mechanoluminescent materials may be composed of piezoelectric materials such as ZnS, CaZnOS, and LiNbO3, which promote the formation of lattice-defect complexes by strain-induced piezoelectric potential due to strong electron-lattice coupling. Dopant ions such as Mn2+ are often introduced in substitution for Zn^{2+} to provide additional energy levels to tune the emission profiles. Due to the close chemical properties between Mn^{2+} and Zn^{2+}, high concentration of Mn^{2+} ions can be conveniently incorporated into the host lattice without deleterious effects.

Nonetheless, in view of the development of multi ML emission colors, lanthanide ions may be used as the dopant ions as lanthanide ions are capable of giving highly designable emission profiles spanning almost the whole visible spectral range. However, owing to the low compatibility between lanthanide dopants and semiconducting ML host materials, attempts that made to obtain active ML materials with lanthanide dopants have been resulting in very low doping possibility of lanthanide activator, such as Sm^{3+} (1 mol %), Er^{3+} (0.5 mol %), and Nd^{3+} (2 mol %) activators, rendering very limited emission colors and weak ML emission intensities.

Accordingly, there is a strong need for developing an improved method for preparing ML materials with effective lanthanide doping for bright multicolor ML emission.

Technology

The present invention relates to a method of preparing a mechanoluminescent material. The present invention also pertains to a composite material containing the mechanoluminescent material. A method of preparing a mechanoluminescent material includes the steps of: a) providing a mixture including precursors of a base material, a fluxing agent, and at least one lanthanide ion; b) heat-treating the mixture to obtain the mechanoluminescent material; and c) optionally grinding the mechanoluminescent material into powder form; wherein the fluxing agent facilitates incorporation of the at least one lanthanide ion into the base material. A composite material includes a first mechanoluminescent material, wherein the first mechanoluminescent material includes at least 2-3 mol % of a lanthanide ion.

Advantages

- The developed method increases the effective doping concentration of lanthanide ion into the host lattice.
- The composite material is suitable for stress sensitive applications.
- The emission color of the first mechanoluminescent material is not be easily overwhelmed by the second material.
- It only requires a mechanical force for excitation and does not need extra excitation source such as ultraviolet lamps and near-infrared lasers.

Applications

- Electronic devices such as displays and sensors
- Medical or cosmetic applications such as manufacturing of artificial skin
- Anti-counterfeiting applications such as safety labeling, biometric authentication, clothing and accessories.