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Eu²⁺/Eu³⁺-activated nitride based red phosphors with narrow emission band for white light emitting diodes

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The rare earth Eu²⁺/Eu³⁺ ions have been widely used to act as activator for phosphors, especially red phosphors. Compared with oxide, Eu²⁺ activated nitride based phosphors commonly present broad excitation band and red emission light due to the larger crystal field splitting and higher nephelauxetic resulting from N³⁻ ions. The compact host lattices produced by the edge or face shared (Al, Si) N₄ tetrahedrons present excellent thermal stability and high bright red emission light. However, its broad emission band resulted from 4f-5d transitions of Eu²⁺ ions leads to low color purity. Different from Eu²⁺ ions, Eu³⁺ activated phosphors can emit a sharp red emission light due to its f-f transitions, but sharp excitation band limits their application. For solving this problem, the charge transfer band of Eu³⁺-N³⁻ in α-M₃B₂N₄ (M=Ca, Sr) and Li₂SiN₂ has been investigated in our work. Meanwhile, Eu²⁺ activated Ca₅Si₂Al₂N₈ has also been displayed for comparison. The results show that Eu²⁺ or Eu³⁺ activated phosphors have its own advantages and disadvantages, which also indicates their different application in WLEDs and FEWs.

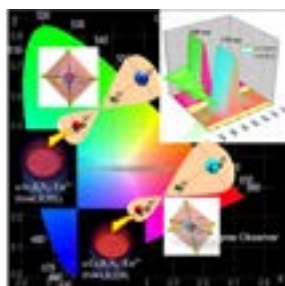


Figure: Eu³⁺ activated nitride red phosphors of α-M₃B₂N₄ (M = Ca, Sr) with broad excitation band of Eu³⁺-N³⁻.

Recent Publications

1. Ding J, Li Y, Wu Q et al. (2015) Novel red and green emitting Li₂SiN₂: Eu³⁺/Tb³⁺ phosphors with a broad charge transfer band. *Journal of Materials Chemistry C* 3(33):8542-8549.
2. Ding J, Wu Q, Li Y, et al. (2016) Eu²⁺-activated Ca₅Si₂Al₂N₈ – A novel nitridoalumosilicate red phosphor containing the special polyhedron of separated corner-shared [Al₂N₆] and [Si₂N₆]. *Chemical Engineering Journal* 302: 466-474.
3. Ding J, You H, Wang Y, et al. (2018) Site occupation and energy transfer of Ce³⁺-activated lithium nitridosilicate Li₂SrSi₂N₄ with broad-yellow-light-emitting property and excellent thermal stability. *Journal of Materials Chemistry C* 6(13):3435-3444.
4. Ding J, Wu Q, Li Y, et al. (2017) α-M₃B₂N₄ (M= Ca, Sr): Eu³⁺: a nitride-based red phosphor with a sharp emission line and broad excitation band used for WLED. *The Journal of Physical Chemistry C* 121(18): 10102-10111.
5. Ding J, Wu Q, Li Y, et al. (2016) Self-Activated Yellow Light Emitting Phosphors of α, β-Ca₃B₂N₄ with Long Afterglow Properties. *Inorganic Chemistry* 55(21):10990-10998.

Biography

Jianyan Ding has expertise in Physics and Materials Science. At present, his main research interest is focused on nitride based red phosphors used for white light emitting diodes (WLEDs). In order to realize the red phosphors, several nitride based phosphors activated by Eu³⁺/Eu²⁺ have been reported by him. The red phosphors with narrow emission band and broad excitation band have been realized. However, there are still some problems need to be resolved, such as: thermal stability, quantum efficiency and preparation condition. In the future work, Eu³⁺/Eu²⁺ activated nitride based red phosphors would be improved through investigating the relationship between luminescence properties and crystal or electron structure.

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