materialstoday.com

News

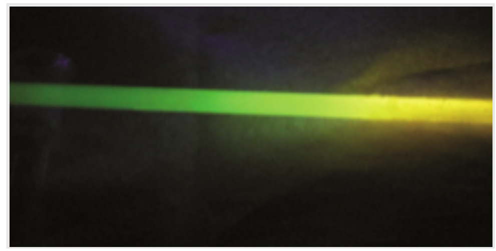
Excited inorganic nanocrystals give a peak performance

08 October 2010

Colloidal manganese-doped semiconductor nanocrystals capable of pronounced intrinsic high-temperature dual emission have been developed by researchers at the University of Washington in the US [Vlaskin et al., Nano Lett (2010) doi: 10.1021/nl102135k].

There are some molecules that can show luminescence at two different excited states, a process known as dual emission which has led to the use of these molecules in thermometric applications. In most cases organic molecules have been used but researchers are also keen to try out inorganic colloidal semiconductor crystals as they show a good resistance to photodegradation. However, the inorganic nanocrystals investigated so far have suffered from low thermometric sensitivity and poor ratiometric detection.

Daniel Gamelin's team has been studying dual emission in Mn2+ doped nanocrystals for some time and has finally overcome these problems. "Prior results from our group had identified the possibility of accessing this basic phenomenon in Mn-doped CdSe nanocrystals, but encountered big difficulties because of the need to work with very small nanocrystals in order to have the correct energy alignment of the two emissive states. Unfortunately, in those very small nanocrystals, we could never get all of the nanocrystals to be doped, so our signals were always contaminated with undoped nanocrystals and the results were very unreliable. To get around this problem, we separated the tasks of doping and energy gap tuning. We started with doping of wide-gap ZnSe nanocrystals so that we could grow them large enough that every nanocrystal contained Mn. We could then tune the semiconductor energy gap down to the correct range for this dual emission effect by growing a narrower-gap shell of ZnCdSe around the Mn-doped ZnSe cores. This turned out to provide precisely the right control over both doping and energy gap tuning to open up these materials for very clean, high-temperature dual emission," he explains to Materials Today.



Temperature Dependence in Mn2+-Doped Nanocrystals showing changes from cold (yellow) to warm (green). Image courtesy of Daniel Gamelin, University of Washington.

Related Stories

Nano-thermometry
Temperature sensing using fluorescent nanoclusters.

Paper with a memory
Medicine bottles that alert you when a prescription needs updating and computer screens which can be rolled up to fit in a briefcase are a step closer thanks to researchers at the De Montfort University Leicester.

Tiniest superconductor
Scientists have discovered the world's smallest superconductor, a sheet of four pairs of molecules less than one nanometer wide.

The tiniest superconductor
Scientists have discovered the world's smallest superconductor.

The scientific symposium "Materials Challenges for Clean Energy in the New Millennium"
The global energy problem is rapidly intensifying due to escalating competition for resources from emerging, populous countries such as China, India, and Brazil and compelling evidence pointing towards the imperative need for controlling greenhouse gas and carbon emissions.

The nanocrystals that the team produced have two distinct emissive excited states with a 10 000-fold difference in luminescence rates. This means that very small changes in temperature result in a very large change in relative peak intensities with dual emission being the dominant component of the overall luminescence.

Temperature ranges from cryogenic to well above room temperature can be achieved, where the dual-emission window is tuned by changing the energy gap during nanocrystal fabrication.

This article is featured in:
Nanotechnology

Comment on this article

You must be registered and logged in to leave a comment about this article.